WSU Project No. 040-348980



Division of Finance and Business Operations

Wayne State University

Art Building Elevator Replacement

WSU Project Number 040-348980

FOR:

Board of Governors Wayne State University Detroit, Michigan

Purchasing Agent: Valerie Kreher, Senior Buyer

WSU – Procurement & Strategic Sourcing 5700 Cass, Suite 4200 Detroit, Michigan 48202 313-577-3720 rfpteam2@wayne.edu Owner's Representative: Lana Vrubel, Project Manager Facilities Planning & Management Design & Construction Services 5454 Cass Wayne State University

Consultant: Stantec Architecture Inc. 2338 Coolidge Highway Berkley, 48072-1500

Detroit, Michigan 48202

January 9, 2023



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Project Specific WSU Wage Schedule (posted separately) https://procurement.wayne.edu/vendors/wage-rates



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OWNER:	Board of Governors Wayne State University
PROJECT:	Art Building Elevator Replacement Project No. 040-348980
LOCATION:	Wayne State University 5400 Gullen Mall, Detroit, MI 48202 Detroit, Michigan 48202
PURCHASING AGENT:	Valerie Kreher, Senior Buyer WSU – Procurement & Strategic Sourcing 5700 Cass, Suite 4200 Detroit, Michigan 48202 313-577-3720 rfpteam2@wayne.edu
OWNER'S REPRESENTATIVE:	Lana Vrubel, Project Manager Facilities Planning & Management Design & Construction Services Wayne State University 5454 Cass Avenue Detroit, Michigan 48202
Architect:	Stantec Architecture Inc. 2338 Coolidge Highway Berkley, 48072-1500

INFORMATION FOR BIDDERS

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: January 9, 2023

<u>BIDDING</u>: Bidding documents may be obtained by vendors from the University Purchasing Web Site at <u>http://go.wayne.edu/bids</u> beginning **January 9, 2023**. 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 <u>Pre-Bid Conference</u>: To participate, it is Mandatory that you and/or responsible representatives of your organization attend our pre-bid conference, to be held on January 18, 2023, 10:00 am (Eastern - Detroit Time).

Vendors who would like to participate in the pre-bid meeting via a TEAMS Video Conference or Conference Call, may do so via the information below:

Microsoft Teams Meeting On-line or via Conference Call

Click here to join the meeting

Optionally - Dial in at +1 313-261-5339 Conference ID: 151 907 375#

OPTIONAL Site Visit (if needed): A Site visit may be scheduled at the conclusion of the pre-bid meeting, at the discretion of the project manager. The tentative date for Site Visit is **January 19, 2023: 10:00 to 11:00 am**. The University requires all guests to complete a Guest Campus Screener before coming to campus or upon arrival. This tool is available at https://forms.wayne.edu/guest-screening. Additional information on the University's protocols for COVID-19 can be found at https://wayne.edu/coronavirus?utm_source=wayne-header.

DUE DATE FOR QUESTIONS: Due Date for questions shall be **January 24, 2023 at 12:00 Noon.** All questions must be reduced to writing and emailed to the attention of **Valerie Kreher**, **Senior Buyer** at **rfpteam2@wayne.edu**.



Bids Due: Proposals for lump-sum General Contract will be received by electronic submission on **January 30, 2023**, until 2:00 p.m. (local time). The link for bid submission will be posted with the bid details at http://go.wayne.edu/bids beginning **January 9, 2023**. Vendors are required to combine documents into one PDF to ensure no portion of your response is inadvertently omitted. This includes your bid, bid bond, and any other documents.

No public bid opening will be held.

<u>Bid Qualification Meeting:</u> Bidders must be available for a bid prequalification meeting, as soon as 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 this meeting, the Vendor must provide a Project Schedule and a Schedule of Values, including a list of Contractor's suppliers, subcontractors, and other qualifications.

If all aspects of the bid are in order, an unsigned contract will be given to the successful Contractor as soon as it's available. 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 lowest qualified bidder.

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

http://go.wayne.edu/bids. Information that is not posted to the website is not available/not known



INSTRUCTIONS TO BIDDERS

OWNER:	Board of Governors Wayne State University
PROJECT:	Art Building Elevator Replacement Project No. 040-348980
LOCATION:	Wayne State University 5400 Gullen Mall, Detroit, MI 48202 , Detroit, Michigan 48202
PURCHASING AGENT:	Valerie Kreher, Senior Buyer WSU – Procurement & Strategic Sourcing 5700 Cass, Suite 4200 Detroit, Michigan 48202 313-577-3720 rfpteam2@wayne.edu

1. <u>PROPOSALS</u>

- A. Procurement will receive Proposals for the work as herein set forth on **January 30, 2023**, until 2:00 p.m. (local time). The link for bid submission will be posted with the bid details at http://go.wayne.edu/bids. 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 by electronic submission on forms furnished with the Bidding documents. The link for bid submission will be posted with the bid details at <u>http://go.wayne.edu/bids</u> beginning January 9, 2023. The forms must be completed in its entirety and must be signed, and the completed forms shall be without alterations, interlineations, or erasures. Forms shall contain no recapitulations of the work to be done.
- D. 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 University is not obligated to accept the lowest or any other bids. The University reserves the right to reject any and all bids and to waive any informalities in the Proposals.

2. PROPOSAL GUARANTEE

- A. A 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 or A- rating as denoted in the AM Best Key Rating Guide.
- C. 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.



D. Withdrawal of Proposals is prohibited for a period of ninety (90) days after the actual date of opening thereof.

3. CONTRACT SECURITY

- 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 University policy and the laws of the State of Michigan.
- 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 University policy and 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 or 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 and Material & Labor Payment bonds will not be required.

5. INSPECTION

A. Before submitting its Proposal, each Bidder shall be held to have visited the site of the proposed work and to have familiarized themselves 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 its 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 submitted in writing to the Purchasing Agent, and if explanation is necessary, a reply will be made in the form of an Addendum, a copy of which will be distributed via the appropriate Listserv maintained by Procurement & Strategic Sourcing, and will be posted to the website.
- B. All addenda issued 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 posted to the website and distributed via the listserv. Each proposal submitted shall list all addenda, by numbers, which have been published prior to the time scheduled for receipt of proposal.

8. <u>SUBSTITUTION OF MATERIALS AND EQUIPMENT</u>

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. Information regarding the State of Michigan sales and use tax laws can be found in <u>SOM Revenue Administrative Bulletin 2016-18</u>.

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 5 business days to produce this document. If the required document is not received within this time, the bidder will be disgualified.

13. NOTICE OF AWARD/ACCEPTANCE OF BID PROPOSAL

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 fullyexecuted 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. <u>CONTRACTOR'S PERFORMANCE EVALUATION</u>

In an effort to provide continuous process improvement regarding the construction of various university projects, Wayne State University is embarking upon a process of evaluating the contractor's overall performance following the completion of work. At the conclusion of the construction project a subjective evaluation of the Contractor's performance will be prepared by the Project Manager and the supervising Director of Construction. The evaluation instrument that will be used in this process is shown in Section **00440-01 - Contractor's Performance Evaluation**.

16. BIDDING DOCUMENTS

A. Bid specifications are available online beginning January 9, 2023 through Wayne State University Procurement & Strategic Sourcing's Website for Advertised Bids: <u>http://go.wayne.edu/bids</u>. 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



- Wayne State University Procurement & Strategic Sourcing's Website.
 All available information pertaining to this project will be posted to the Purchasing web site at http://go.wayne.edu/bids.
 Information that is not posted to the website is not available/not known.
- (2) Notification of this Bid Opportunity has been sent to those entities registered with our ListServ. Available ListServs can be found at http://www.forms.procurement.wayne.edu/Adv_bid/Adv_Bid_Listserve.html
- (3) Please note: Bid notices will be sent only to those Vendors registered to receive them via our Bid Opportunities list serve. To register, to http://go.wayne.edu/bids, and click on the "Join our Listserve" link at the top of the page.

15. <u>Smoke and Tobacco-Free Policies</u>

On August 19, 2015, Wayne State joined hundreds of colleges and universities across the country that have adopted smoke- and tobacco-free policies for indoor and outdoor spaces. Contractors are responsible to ensure that all employees and all subcontractors' employees are in compliance anytime they are on WSU's main, medical, or extension center campuses. The complete policy can be found at http://wayne.edu/smoke-free/policy/.



Notice of Mandatory Pre-Bid Conference

PROJECT: Art Building Elevator Replacement,

PROJECT NOS .: WSU PROJECT NO. 040-348980

It is **Mandatory** that each Contractor proposing to bid on this work must attend a pre-bid conference as a condition for submitting a proposal.

Pre-registration for the meeting is to be made on or before Noon on, **January 17**, **2023**. Please use our online registration form to confirm your attendance. The link for the registration form will be posted with the proposal details at <u>http://go.wayne.edu/bids</u>. The pre-bid meeting will be held on **January 18**, **2023**, **10:00 am** (*Eastern - Detroit Time*).

Vendors who would like to participate in the pre-bid meeting via a TEAMS Video Conference or Conference Call, may do so via the information below:

Microsoft Teams Meeting On-line or via Conference Call

Click here to join the meeting

Optionally - Dial in at +1 313-261-5339 Conference ID: 151 907 375#

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.

In the event that less than 3 individual contractor firms attend the pre-bid conference, the University reserves the right, at its sole discretion, to either reschedule the pre-bid conference or proceed and offer a second pre-bid conference date. (Attendance at only one pre-bid conference will be required).

Minutes of the conference shall be posted to the Website at http://go.wayne.edu/bids.

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

All available information pertaining to this project will be posted to the Purchasing web site at http://go.wayne.edu/bids.

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 company name and representative in attendance 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 the appropriate ListServ.
 - D. Questions and concerns that come up after this meeting are to be addressed to **Valerie Kreher**, 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 January 24, 2023, 12:00 noon.
- IV. Minimum Participation
 - A. Pre-registration for the Pre-Bid meeting is required. In the event that we do not have 3 or more eligible bidders preregistered, the University reserves the right to postpone the Pre-bid meeting with up to 4 business hour notice.
 - B. If less than 3 individual contractor firms attend the **Mandatory** pre-bid meeting, the University reserves the right, at its sole discretion, to either reschedule the pre-bid conference or proceed and offer a second pre-bid conference date. (Attendance at only one pre-bid conference will be required).
 - C. On the day of the bid opening, if less than 3 sealed bids are received, the University reserves the right, at its sole discretion, to rebid the project in an effort to obtain greater competition. If the specifications are unchanged during the rebid effort, any contractor who submitted a bid will be given the option of keeping its bid on file for opening after the second bid effort, or of having the bids returned to them unopened.
- V. Proposal Due Date: January 30, 2023, 2:00 p.m.
- VI. Final Comments
- VII. Adjourn



VENDOR NAME

GENERAL CONTRACT - PROPOSAL FORM

Sealed proposals for lump-sum General Contract will be received at the office of the Procurement & Strategic Sourcing by electronic submission on January 30, 2023, until 2:00 p.m. (local time). The link for bid submission will be posted with the bid details at http://go.wayne.edu/bids beginning January 9, 2023.

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:		Art Building Elevator Replacement		
PROJECT NO.:		WSU PROJECT NO. 040-348980		
PROJECT TYPE:		General Work		
PURCHASING AGENT:		Valerie Kreher, Senior Buyer WSU – Procurement & Strategic Sourcing 5700 Cass, Suite 4200 Detroit, Michigan 48202 313-577-3720 rfpteam2@wayne.edu)	
OWNER'S REPRESENT	ATIVE:	Lana Vrubel , Project Manager Design & Construction Services Facilities Planning & Management 5454 Cass Avenue Detroit, Michigan 48202		
TO:		Board of Governors Wayne State University Detroit, Michigan		
BASE PROPOSAL:	The undersigne Building Eleva Bidding Docume	ed agrees to enter into an Agreement to tor Replacement project (WSU Project N ents for the following amounts:	o complete the entire w lo. 040-348980) in accor	ork of the Art dance with the
			\$	Dollars
<u>WSU WAGES:</u>	Did your compa Yes	ny quote based upon Union or WSU Wag No	e Rates as required?	
CONFICT OF INTEREST:	Are you or any or have you bee Yes	Officer, Owner or Partner in this company n an employee within the past 24 months? No	an employee of Wayne S If Yes, explain below.	state University,



Are any immediate family members of any Officer, Owner or Partner in this company employees of Wayne State University? If Yes, explain below. Yes _____ No _____

LAWN REPLACEMENT:	The undersigned agrees that, in Contractor's work, that has not I University, the University may rep be at a unit cost of \$15.00 per the cost of said repairs , the full	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 \$15.00 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:	The undersigned agrees to the fo contract work:	The undersigned agrees to the following pricing formula and rates for changes in the contract work:							
	Where changed Work is performe such Work no more than ten (10% (7.5%) for self-performed trade we bonds, and any other costs not al	d, the Contractor may add to b) for subcontractor mark-up a ork for profit, overhead, insura owed by section 4.02.01	the total estimated actual cost for and seven and one-half percent nce, taxes, indirect supervision,						
	Within 14 days of the project's Subcontractor's hourly labor ra lowest level of subcontractor p	contract execution Contract te breakdown details. This articipation.	or shall provide to the Owner; requirement shall extend to the						
	 * Job and general overhead incl tools, scaffolding, blocking, shore 	udes supervision and executi s, appliances, etc., and other i	ve expenses; use charges on small miscellaneous job expenses.						
	** Net labor cost is the sum of organizations, applicable payroll (Workman's Compensation, P.L. a	the base wages, fringe bene taxes, and increased expens and P.D.).	efits established by governing trade se for contractor's liability insurance						
TIME OF COMPLETION:	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 co	npleted no later than Decemt	per 22, 2023.						
LIQUIDATED DAMAGES:	It is understood and agreed that, plus any extension of time allowed because of any such delay, will reasonable foreseeable value of per day , and therefore the contre \$None.00 per day for each day specified in the Contract and any	if project is not completed wit ad pursuant thereto, the actua be uncertain and difficult to the use of said project by Ow actor shall pay as liquidated s delay in substantially comp extensions of time allowed the	hin the time specified in the contract al damages sustained by the Owner ascertain, and it is agreed that the ner would be the sum of \$None.00 damages to the Owner the sum of oleting said project beyond the time ereunder.						
TAXES:	The undersigned acknowledges character or description. Michiga that the Owner reserves the right therein.	hat prices stated above inclun n State Sales Tax is applicat to reject any or all bids and t	ude all applicable taxes of whatever ole to the work. Bidder understands o waive informalities or irregularities						
ADDENDA:	The undersigned affirms that the the lump sum price of this propos	cost of all work covered by th al.	e following Addenda are included in						
	Addendum NoDate	Addendum No.	Date						
	Addendum NoDate	Addendum No.	_Date						
	Addendum NoDate	Addendum No.	_Date						
	Addendum NoDate	Addendum No	Date						



Addendum No.____Date_____ Addendum No.____Date_____

CONTRACTOR'S PREQUALIFICATION STATEMENT & QUESTIONNAIRE:

Our Minimum Requirements for Construction Bids are:

WSU considers this project: General Work.

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

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

<u>Contractors must complete the following information to determine their eligibility to participate in this bid.</u> 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

Partnership

Individual

Other (Evalein hele)

Joint Venture

Other (Explain below):



Diversity Classification: Please indicate the appropriate diversity classification for your company. The University recognizes the following groups as diverse or disadvantaged:

	 Majority Owned Minority Business Enterprises (MBE) Women Business Enterprises (WBE) Disabled Veteran Enterprises (DVBE) Disabled Person Enterprises (DBE) Veteran Owned Businesses (VBE) Small Businesses per the US Small Business Administration (SBE) Other (Please 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 that their bid may be disqualified, at the sole discretion of the University.	I.0 understand
6.	What percentage of work performed on projects are by company employees; excluding any hired subcontrac outsourced relationships, for the bid submitted? $\%$	ting and
7.	What percentage of work performed on your company's behalf are by subcontracted business relationships; contracting work forces, for the bid submitted? $_$ %	disallowing 1099
8.	Have you ever failed to complete any work awarded to you? If so, attach a separate sheet of explanation. In the Project, the customer, the dates of the work, and the amount of the contract?	clude the name of
9.	Have you withdrawn a bid after a University bid opening and/or refused to enter into a contract with the Univernotification of award within the last 3 years? If so, state the Project Name and Number, and the date of bid s below.	ersity upon ubmission
10.	Has any officer or partner of your organization ever been an officer or partner of another organization that fail complete a construction contract? If so, attach a separate sheet of explanation.	ed to
11.	List the construction experience of the principals and superintendents of your company.	
	Name: Title:	
	Name: Title:	



	Name: ٦	Fitle:
12.	List the construction Projects, and approximate date	es, 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 date	es, when you performed work similar in Dollar Amount to this project.
		_ Owner:
	Contract Amount:	Date Completed:
		Owner:
	Breiset:	
		Date Completed:
11	ls vour Company "bondable"? Ves	No
14.	What is your present bonding capacity?	
16	Who is your bonding agent?	
.0.	NAME:	
	ADDRESS:	
	PHONE: ()	
	CONTACT:	
17.	Does your company agree to provide financial repo disqualification of your bid? (select one): Yes _	rts to the University upon request? Failure to agree may result in No
18.	Does your company agree that all of the Terms and any ensuing agreement? (select one): Yes	I Conditions of this RFP and Vendor's Response Proposal become part of No
19.	Does your company agree to execute a contract co Contractor and Owner for Construction"? (select on	ntaining the clauses shown in Section 00500 "Agreement between e): Yes No

FORM OF PROPOSAL FOR THE GENERAL CONTRACT



If "No", clearly note any exceptions to any information contained in the contract documents and include with your proposal. Otherwise, a "No" response without documentation will be considered a non-responsive proposal. In addition, any proposed exceptions may or may not be accepted by the University.

20. Does your company agree to comply with the University Smoke and Tobacco Free Policies? 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	The undersigned has read and understands the minimum qualifications
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:	DATE
SIGNED BY:	
	Signature
_	
	(Please print or type name here)
TITLE	
EMAIL ADDRESS:	@



WAYNE STATE UNIVERSITY RATE SCHEDULE (revised 11-01-2018)

POLICY

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

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 on any of Wayne State's properties. Rates for all counties are available at https://wdolhome.sam.gov/, and Procurement will post the schedules quarterly that pertain to Wayne County on its website at http://procurement.wayne.edu/vendors/wage-rates.php.

Certified Payroll must be provided for each of the contractor's or subcontractor's payroll periods for work performed on any University project. Certified Payroll must accompany Pay Applications, and be fully reconciled with the final Pay Application. Failure to provide certified payroll will constitute a material breach of contract, and pay applications will be returned unpaid, and remain unpaid until satisfactory supporting documents are provided.

Additional information can be found on the University Procurement & Strategic Sourcing's web site at the following URL address: http://procurement.wayne.edu/vendors/wage-rates.php

PROCEDURE

Construction Bids and other Bids or Proposals for work that includes construction shall contain a WSU Wage Rate clause outlining a contractor's responsibilities under University policy. Each bid solicitation shall include reference to the most current wage determination schedule that contractors can use when preparing their bids.

When compensation will be paid under WSU Wage Rate requirements, the University shall require the following:

- 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.
- The contractor shall submit a completed certified payroll document [U.S. Department of Labor Form WH 347] verifying and confirming the WSU Wage and benefits rates for all employees and subcontractors for each payroll period for work performed on this project. The certified payroll form can be downloaded from the Department of Labor website at http://www.dol.gov/whd/forms/wh347.pdf.
- A properly executed sworn statement is required from all tiers of contractors, sub-contractors and suppliers which
 provide services or product of \$10,000.00 or greater. Sworn statements must accompany applications for payment.
 All listed parties on a sworn statement 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.

If the VENDOR or subcontractor fails to pay the WSU 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:

- Withhold a 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.
- Terminate the 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.



Propose to the Associate Vice President for Business Services / Procurement that the Vendor be considered for Debarment in accordance with the University's Debarment Policy, found on our website at https://policies.wayne.edu/appm/2-8-debarment-policy-on-non-responsible-vendor-in-procurement-transactions

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

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.



Art Building Elevator Replacement WSU Project No. 040-348980

APPENDIX A FOR THE WSU WAGE SCHEDULE FOR THIS PROJECT

See web site:

http://go.wayne.edu/bids



Key Performance Indicator Tracking Sworn Statement Requirements

The University tracks it's level of spend along a number of socio-economic categories. This includes it's spend with Diverse organizations, it's spend with Detroit based organizations, and it's spend with Michigan based organizations. To assist with this, The University has the following requirements for submission of your bid and for Pay Applications submitted by the successful contractor.

Submission of Bid

- 1. **Diverse or disadvantaged prime contractor:** Please specify in your bid whether ownership of your company is a certified diverse or disadvantaged business, according to the categories listed previously in section 00300. In accordance with guidelines from the MMSDC and GL-WBC, the University considers a business to be diverse when it is at least 51% owned, operated, and controlled by one or more members of a diverse classification. Section 00300 has a place for this information on page 00300-3.
- 2. **Detroit based and Michigan Based contractor:** It is presumed that the contractor is headquartered at the location we submit our Purchase Orders to, and that it should be the same address as listed in Section 00300 at the signature line. If a supplier is headquartered elsewhere, please make note of this information, so we do not inaccurately include or exclude spend.

Pay Applications and Sworn Statements

- 1. Applicability: The University requires Sworn Statements with Pay Applications for all construction projects that use
 - Subcontractors greater than \$10,000.00
 - Significant suppliers (those with a purchase value of \$10,000 or more).
- 2. Sworn Statements: The Supplier must submit applicable monthly sworn statements to the Project Manager and the Buyer of Record, in the format shown on page 2 of Section 00420. Sworn Statements are "always required" for this project, and are to be submitted to (*Project_Manager*), the project manager, and to Valerie Kreher, Senior Buyer
- 3. **Inclusion**: Sworn Statements are to detail the inclusion of recognized diverse and disadvantaged groups in the following 2 categories; Subcontracts or Suppliers. The University recognizes the following groups as diverse or disadvantaged:
 - Minority Business Enterprises (MBE)
 - Women Business Enterprises (WBE)
 - Disabled Veteran Enterprises (DVBE)
 - Disabled Person Enterprises (DBE)
 - Veteran Owned Businesses (VBE)
 - Small Businesses per the US Small Business Administration (SBE)

1.

4. A complete set of the University's Supplier Diversity Program, which includes complete definitions of each of the above, can be downloaded from our web site at http://policies.wayne.edu/administrative/04-02-supplier-diversity.php.



Art Building Elevator Replacement WSU Project No. 040-348980

STAT	E OF MICHIGAN							Sworn Sta	atement		
COUN	TYOF } §										
	, being duly sworn, deposes and says that (s)he makes the Sworn Statement on behalf of, who is the Contractor for										
	provement to the ionowing described real property situated inC	Jounty	, wiichiga	n, and described as follows:							
That t perfor are on	That the following is a statement of each subcontractor and supplier and laborer, for which laborer the payment of wages or fringe benefits and withholdings is due but unpaid, with whom										
NO.	SUBCONTRACTOR (Name, Address, Telephone Number) SUPPLIER OR LABORER	S=Supplier C=Contractor	Type of Entity *see below	TYPE OF IMPROVEMENT FURNISHED	TOTAL CONTRACT PRICE	CONTRACT CHANGE +/-	ADJUSTED CONTRACT AMOUNT	AMOUNT PAID TO DATE	AMOUNT CURRENTLY OWING	BALANCE TO COMPLETE	
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2											
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	* Type of Entity: MBE=Minority Business Enterprises; WBE=Women Business Enterprises; DVBE=I SBE=Small Businesses per the US Small Business Administration	Disable	l Veteran I	Interprises; DBE=Disabled Perso	on Enterprises;	VBE=Veteran (Owned Busines	sses;			
	Please attach additional sheets if the number of items exceeds the page limit.										



Art Building Elevator Replacement WSU Project No. 040-348980

That	has not procured material from or subc	ontract	ed with any	person other than those set for	th above and o	wes no money	for the improve	ment			
			,,	,							
	1										
Depoi	nent further savs that makes the foregoing statement as a r	epreser	ntative of				, for	the purpose o	f representing to	the owner or	
lessee	of the above-described premises and his or her agents that the above-described property is free from	laims c	of construct	ion liens, or the possibility of co	nstruction liens	excent as sne	cifically set for	th above and e	except for claims	of	
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ON R	ECEIPT OF THIS SWORN STATEMENT. THE OWNER OF LESSEE, OR THE OWNER'S OR LESS	EE'S D	ESIGNEE, I	AUST GIVE NOTICE OF ITS RE	ECEIPT, EITHF	R IN WRITING	. BY TELEPH	ONE. OR PER	SONALLY, TO	FACH	
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									(NOTARY ST.	AMP BELOW)	
Subsc	cribed and sworn to before me this day of										
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WAYNE STATE UNIVERSITY PAYMENT PACKAGE DOCUMENT REQUIREMENTS (*Revised 7-23-2015*):

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

PAYMENT APPLICATION - AIA document G702 & G703 (or equivalent) –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.
- Correct Period Reporting Dates Applications support docs must be sequential and within application range.
- Approved & Executed Change Orders Listed. (Cannot invoice for unapproved Change Orders)
- 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... \geq \$10,000.00
- A sworn statement is required from every Sub Contractor on the job with a material purchase or subcontract of \$10,000 or more. (All tiers.)
- Purchase Order Number
- Dates Back dating not accepted.
- Signed and Notarized.

CERTIFIED PAYROLL - Dept. of Labor Form WH-347 – Checklist: (Union and Non-Union)

- For every contractor & sub-contractors work, for each week within the application reporting period.
- Correct Project Number
- List ALL workers on-site.
- Make sure their addresses are listed.
- o Social Security Numbers MUST be blackened out or listed in XXX-XX-1234 format.
- Work classifications based on the job specific WSU Wage Schedule descriptions.
- For any workers paid at the Apprenticeship rates proof of enrolled program and current completion required.
- o Rate of Pay verified against the WSU Wage Schedule with an hourly cost breakdown of fringes paid.
- Authorized signatures on affidavit.
- Dates must represent the weeks within the application period.

APPLICATION PACKAGE SUPPORTING DOCUMENTATION -

- Proof of Ownership for any 'Owner Operator' contractors not wishing to claim their time on WSU Wage.
 (Must list their hours and dates worked on the WH-347 Form and enter EXEMPT on the income brackets.) The Owner must provide copies of "DBA" registration form confirming status as exempt from WSU Wage requirements.
- Proof of Stored Materials Bill of Lading, Delivery Receipts, Pictures, Certificate of Insurance or endorsement pate specifically insuring stored material at location, and pictures with materials clearly



separated and labeled for WSU. The University reserves the right to on site verification of stored materials.

- **Partial Conditional Waivers** The contractor shall provide covering the entire amount of the application. For non-bonded projects all sub-contractors must provide for all applications which they have a draw.
- Partial Unconditional Waivers Must release amount paid for work and be delivered starting with application #2 and in no case after payment application #3, through all sequential applications for contractors, sub-contractors, and suppliers listed on the Sworn Statements.
- Full Unconditional Waivers Must be delivered with final payment application, releasing all contractors, sub-contractors, suppliers listed on the sworn statements and any legitimate notice of furnishings reconciled.

FINAL PAYMENT APPLICATION – Checklist:

- Clear and concise As-Built drawings.
- Operation and Maintenance Manuals
- Process and training directions (if applicable).
- Warranty of work in accordance with project documents.
- Submittals log and samples installed on the job.
- Certificate of Substantial Completion
- Full Unconditional Waiver

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

Revised 11-01-2018

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Contractor Performance Evaluation

In an effort to provide continuous process improvement regarding the construction of various university projects, Wayne State University is embarking upon a process of evaluating the contractor's overall performance following the completion of work. At the conclusion of the construction project a subjective evaluation of the Contractor's performance will be prepared by the Project Manager and the supervising Director of Construction. The evaluation instrument that will be used in this process is presented below:



		Contracto	or Eval	uat	ion S	Shee	et					
Cont	Contractor Name :			Droid	oct No.	mo:						
Contractor Name :				Project Name: PM Name:								
Supe	Superintendent:			Project Number:					PO#:			
Desi	Designer:											
FVΔ	ΙΠΟΙ	FION SCORING: 1 = Inaccentable 2 = ess than S	atisfactor	v 3:	= Satisf	actor	v or N	eutral 4	= Good 5 = Exc	ellei	nt	
Note	e: Co	omments are REQUIRED if any score is less than 3.	Write co	omme	ents or	the t	ack of	the eval	uation.			
Fie	Id IV	lanagement	1	2	Score	4	E		Weight °		Total	
	1)		1	2	5	4	5		0			
	2)	Compliance with Construction Documents:	1	2	3	4	5		8		. <u></u>	
	3)	Safety Plan & Compliance:	1	2	3	4	5		5			
	4)	Compliance with WSU procedures:	1	2	3	4	5		7			
	5)	Effectiveness of Project Supervision:	1	2	3	4	5		8			
	6)	Project Cleanliness:	1	2	3	4	5		3			
	7)	Punch List Performance:	1	2	3	4	5		5			
	8)	Contractor Coordination with WSU Vendors:	1	2	3	4	5		3			
	9)	Construction Quality:	1	2	3	4	5		8			
الم ۵												
Aui	10)	Responsiveness:	1	2	3	4	5		4			
	, 11)	Contractor communication:	1	2	3	4	5		4			
	12)	Contractor Drofossionalism	1	2	2	4						
	12)		1	2	3	4			3			
	13)	Subcontractor Professionalism:	1	2	3	4	5		3			
	14)	Compliance with Contract Requirements:	1	2	3	4	5		3			
	15)	Submittal\RFI Process:	1	2	3	4	5		4			
	16)	Close-out - Accuracy of Documents	1	2	3	4	5		7			
Image	-:	and Change Menagement										
Inv	17)	Change Management	1	2	3	4	5		7			
	18)	Applications for Payment	1	2	3		5		6			
•	10)		1	2	3	4	5		0			
	19)	Timely payment of Subs/Suppliers:	1	2	3	4	5		4 Total		Total	
									100		Total	
	20)	Level of Self-Performance:	Low		Med		High					
	21)	Would you work with this Contractor again?			Yes		No					
	22)	Would you work with this team again?			Yes		No			-		
One	vear	follow up								F		
2.10	23)	Warranty Support:	1	2	3	4	5					
Eval	uato	r										
		Signature				Date						
		Title:										
		Please Print					Rev. 2	2-17-2015	5 RGP			



We are providing the evaluation instrument at this time to allow the bidder's to review and understand the criterion that the University's project management team will use to evaluate the successful bidder's performance at the conclusion of the project. It is the intent of the university to utilize the results of this evaluation to determine if it will continue to conduct business with the Contractor in future bidding opportunities.

The scoring range is between 100 to 500 points, with 100 being low and 500 being high. Each question has an associated 'weight' factor, and the higher the weight; the greater the importance of satisfactory performance on the final score. At the conclusion of the project, and after the Project Manager and the supervising Director has prepared their independent evaluation, the University's project representative will meet with the Contractor to review the results. Acceptable contractor performance is essential to avoid having the University decline future work with the Contractor. An appeals process is available for Contractor disagreement with evaluation scores.

Contractors engaged in work are encouraged to maintain an open and regular dialog with the Design and Construction Department over the course of the construction project to ensure that the final evaluation is an accurate representation of the Contractor's performance.





1.00 CONTRACT DOCUMENTS

The Contract Documents shall consist of this Agreement, the Contractor's Bid or Proposal attached to this Agreement as Exhibit A only insofar as consistent with the other Contract Documents, the General Conditions of Construction, the Supplementary General Conditions, the approved plans and specifications, and other documents listed in Article 11, Inclusion by Reference. In the case of conflicts between the Contractor's Bid and this Agreement or other Contract Documents, the language of this Agreement and the other Contract Documents shall prevail over the Contractor's Bid or Proposal.

2.00 DESIGN PROFESSIONAL

The Design Professional for this Project is:

[<mark>NAME</mark>] [ADDRESS] |

The University intends that the relationship between the Contractor, Design Professional and University will be one of mutual cooperation and respect in order to promote efficiency and quality in the Project work.

3.00 CONTRACTOR'S RESPONSIBILITIES

3.01 Scope of Work

The Contractor shall furnish all labor, materials, equipment, project management and construction superintendent services necessary to construct the Work in accordance with the approved Contract Documents and executed Change Orders, including requirements reasonably inferable therefrom.

3.02 Skill and Judgment

The Contractor covenants with the University to furnish its best skill and judgment in furthering the interests of the University as defined in the Contract Documents. The Contractor shall perform all obligations under the Contract Documents using efficient business administration, superintendence and best efforts to facilitate the expeditious and timely completion of the Project consistent with the interests of the University as expressed in the Contract Documents. The Contractor acknowledges that significant effort will be invested in complying with the Contractor's Construction Schedule, and in maintaining construction quality. Accordingly, the Contractor further acknowledges that the greatest degree of professionalism is expected from the Contractor and the Design Professional in accomplishing their respective contractual obligations and that when potential conflicts exists, each shall demonstrate appropriate respect, professionalism and cooperation with each other in resolving such conflicts.

3.03 Scheduling

The Contractor shall develop a Contractor's Construction Schedule that clearly indicates the interrelationship of activities and defines the critical path of the entire Project. The Contractor shall submit a preliminary Contractor's Construction Schedule, by the earlier of fifteen (15) days from either the Notice to Proceed or the execution of this Agreement. The Contractor shall provide iterative updates to the Contractor's Construction Schedule with each Application for Payment, but no less than monthly. Upon request by the University, the Contractor shall prepare and submit a resource-loaded Contractor's Construction Schedule to the University and Design Professional for approval.



3.04 Construction

3.04.1 Subcontracts and Purchase Agreements

The Subcontracts shall be solely between the Contractor and the Subcontractors. Nothing in any Subcontract shall establish any contractual relationship between the University and any Subcontractor. However, the University is an intended third-party beneficiary of all Subcontracts, purchase orders and other agreements; the Contractor shall incorporate the obligations of the Contract Documents into its respective Subcontracts, supply agreements and purchase orders.

The Contractor will screen and pre-qualify, utilizing appropriate industry standards, potential Subcontractors for the Work keeping in mind the requirement to recruit and encourage Minority/Women Business Enterprise participation. The University shall have the right to review and approve all Subcontractors qualified or rejected for qualification by the Contractor. The Contractor shall notify the University of all Subcontractors to be used, and the Contractor shall remove any Subcontractor to which the University has an objection.

The Contractor shall obtain appropriate guarantees and warranties acceptable to the University from the Subcontractors, which shall be for the direct benefit of the University.

3.04.2 Construction Supervision

- a) The Contractor shall establish sufficient on-site organization, staffing and support as well as clear lines of authority in order to expeditiously complete the Project in accordance with the Contract Documents, in every aspect, on a totally coordinated basis.
- b) The Contractor shall maintain a competent full-time staff available at the site while Work is being performed to supervise, schedule and coordinate the performance of the Work of all Subcontractors in accordance with the University's objectives including cost, time for completion and quality of the Work. Contractor's Staffing Plan is attached as Exhibit D to this Agreement. The Staffing Plan shall not be changed, except with the written consent of the University's Representative unless members of the Project Staff cease to be in the employ of the Contractor.
- c) The Contractor shall notify the University of the dates, times and locations of conferences with Subcontractors and schedule and conduct regular progress meetings to be attended by all parties in interest including the University to discuss such matters as procedures, progress, job problems, scheduling, coordination, changes, and related matters.
- d) The Contractor shall take, transcribe and promptly distribute to all parties, including the University, minutes of such progress meetings with the Subcontractors, weekly job meetings and monthly management meetings.
- e) The Contractor shall maintain an on-site daily log of construction progress, problems and items of special interest. The Contractor shall provide digital photographic files and digital recording showing Project status or progress. Such logs, records, photographs and videos shall be immediately available to the University upon request.
- f) The Contractor shall furnish monthly written progress reports on the Subcontractors' work in a form acceptable to the University and assist the Design Professional and the University with periodic and final inspections of the Work. At all inspections preceding the final inspection, the Contractor shall furnish a detailed report to the University of observed discrepancies, deficiencies, and omissions in the Work performed by any Subcontractor.



- g) The Contractor shall provide and maintain a correct layout of the structures and monitor the Work to verify that all lines and levels are adhered to by the Subcontractors. The Contractor shall immediately report in writing all discrepancies with respect to design details for prompt resolution by the Design Professional.
- h) The Contractor shall submit any Request for Information (RFI) to the Design Professional and University only after attempting to determine if the requested clarification is contained in the Contract Documents; any RFI shall contain sufficient detail to allow a response within seven (7) calendar days of when the RFI is submitted. In no event shall the response to an RFI be considered delayed unless more than fourteen days have passed since the RFI was submitted.
- i) The Contractor shall supervise and direct the Work using the Contractor's best skill and attention. The Contractor shall be solely responsible for and have control over construction means, methods, techniques, sequences and procedures and for coordinating all portions of the Work under the Contract Documents or that which is reasonably inferable for the completion of the Project.
- j) The Contractor shall be responsible to the University for acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and other persons performing any portion of the Work related to a contract with the Contractor.
- k) The Contractor shall not be relieved of obligations to perform the Work in accordance with the Contract Documents either by activities of the University, Design Professional, or by tests, inspections or approvals required or performed by persons other than the Contractor, except where such relief is authorized by the University in writing in accordance with this Agreement.
- I) The Contractor shall inspect portions of Work performed or portions of existing facilities being renovated in this Project to determine that such portions are in proper condition to receive subsequent Work. Further, the Contractor shall plan for and call for the review of the Work by the University's commissioning agents as required. The Contractor's Construction Schedule shall include activities that recognize this coordination responsibility.

3.04.2.1 Safety

The Contractor shall protect adjoining property and nearby buildings, roads, and other facilities and improvements from dust, dirt, debris and other nuisances arising out of Contractor's operations or storing practices. Dust shall be controlled by sprinkling, negative pressure exhausting or other effective methods acceptable to University. Fugitive dust from interior demolition shall be controlled by negative pressure exhausting. An erosion and sedimentation control program shall be initiated, which includes measures addressing erosion caused by wind and water and sediment in runoff from site. A regular watering program shall be initiated to adequately control the amount of fugitive dust.

The Contractor is knowledgeable of and understands that the University may intend to maintain occupancy of certain portions of the existing facility. The Contractor shall exercise precaution at all times for the protection of persons and their property. The Contractor shall take reasonable precautions for safety of, and shall provide reasonable protection to prevent damage, injury or loss to: (1) employees on the Work and other persons who may be affected thereby; (2) the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody or control of the Contractor or the Contractor's subcontractors or sub-subcontractors; and (3) other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction. The Contractor shall install adequate safety guards and protective devices for all equipment and machinery, whether used in the Work or permanently installed as part of the Project.



The Contractor shall also provide and adequately maintain all required means of egress, including but not limited to, proper temporary walks, roads, guards, railings, lights, and warning signs. The Contractor shall comply with all applicable laws relating to safety precautions. The Contractor shall establish, maintain and update a Project Specific Safety Program.

The Contractor shall designate a responsible member of the Contractor's organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the University and Design Professional.

The Contractor shall require each and every one of its subcontractors and Trade subcontractors to comply with all of the provisions of this section.

The Contractor shall not load or permit any part of the construction or site to be loaded so as to endanger its safety.

In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury or loss. Additional compensation or extension of time claimed by the Contractor on account of an emergency shall be determined as provided in the Contract.

3.04.2.2 Hazardous Condition

The University and/or the Design Professional may bring to the attention of the Contractor a possible hazardous situation in the field regarding the safety of personnel on the site. The Contractor shall be responsible for verifying that all local, state, and federal workplace safety guidelines are being observed. In no case shall this right to notify the Contractor absolve the Contractor of its responsibility for monitoring safety conditions. Such notification shall not imply that anyone other than the Contractor has assumed any responsibility for field safety operations.

Explosives shall not be used without first obtaining written permission from the University and then shall be used only with the utmost care and within the limitations set in the written permission and in accordance with prudence and safety standards required by law. Storage of explosives on the Project site or University is prohibited. Powder activated tools are not explosive for purposes of this Article; however, such tools shall only be used in conformance with State safety regulations.

The Contractor shall immediately make a report to the University's Police Department and report in writing to the University's Representative, within eight (8) hours, all accidents whatsoever arising out of, or in connection with, the performance of the Work, whether on or off the Site but on University property, which caused death, personal injury or property damage, giving full details and statements of witnesses. In addition, if death or serious injuries or serious damages are caused, the accident shall be reported immediately by telephone or messenger. If any claim is made by anyone against the Contractor or any subcontractor on account of any accident, the Contractor shall report promptly the facts in writing to the University's Representative, giving full details of the claim.

3.04.2.3 University's Right to Stop the Work

If the Contractor fails to correct work which is not in accordance with the requirements of the Contract Documents as required, or persistently fails to carry out work in accordance with the Contract Documents, the University Representative, by written order may order the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of the University to stop the Work shall not give rise to a duty on the part of the University to exercise this right for the benefit of the Contractor or any other person or entity.



It is understood that while the Contractor is fully responsible for the safety of the Work, and for the methods of its execution, if the University deems that the Contractor is failing to provide safe conditions, the University may stop the Work under such conditions. However, this ability shall not create such duty on the University. Under no circumstance shall the Contractor be granted a time extension or Contract Sum increase for conditions resulting by a stop work order.

3.04.2.4 University's Right to Carry Out the Work

If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a three (3) day period after receipt of written notice from the University to commence and continue correction of such default or neglect with diligence and promptness, the University may after such three (3) day period, without prejudice to other remedies the University may have, correct such deficiencies. In such case an appropriate Change Order shall be issued deducting from payments then or thereafter due the Contractor the cost of correcting such deficiencies, including compensation for the Design Professional's additional services and expenses made necessary by such default, neglect or failure. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to the University.

3.04.3 Document Management

The Contractor shall maintain at the job site, on a current basis, all Project documents including plans, specifications, shop drawings, samples, submittal, purchase orders, Subcontracts, material specifications, and any other related documents, and revisions thereto, which arise out of or relate to the Project, this Agreement or the Work. Prior to final payment, copies of all such records shall be provided to the University.

The Contractor shall be responsible for reviewing, processing and paying applications by Subcontractors for progress and final payment. The University will compensate the Contractor monthly based on the requirements of Article 4.04, Application For Payment.

The Contractor shall prepare and submit to the University every three months a report of the total M/WBE participation in the Project to demonstrate compliance with Paragraph 3.04.6 together with a projection of M/WBE participation through Final Completion.

3.04.3.1 Review of Contract Documents and Field Conditions by Contractor

Execution of the Contract by the Contractor is a representation that the Contractor shall have thoroughly and carefully examined the site of the of Work, investigated any and all conditions which can affect the Work or its cost, including but not limited to availability of labor, materials, supplies, water, electrical power, roads, access to the site, University episodic and scheduled closures, uncertainties of weather, water tables, the character of equipment and facilities needed to perform the Work, and local conditions under which the Work is to be performed; and turther, that the Contractor shall insure that the documents issued for bidding by Trade Contractors reflect the results of this investigation and are adequate to complete the Work. It is the responsibility of the Contractor to be familiar with the materials, equipment, or procedures to be used in the Work, or which in any other way could affect the completion of the Work. Any failure to properly familiarize themselves with the proposed Work shall not relieve the Contractor from the responsibility for completing the Work in accordance with the Contract Documents.

The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Project. Contract Documents are complementary, and what is required by one shall be as binding as if required by all. Performance by the Contractor shall be required to be consistent with the Contract Documents and the highest standard of care. In the case of an inconsistency between, or perceived omission or error in the Drawings, Specifications, or other Contract Documents which is not clarified by addendum or RFI, or should the Contractor be in doubt as to their exact meaning, the Contractor shall notify



the Design Professional and the University prior to performing any related Work. The University shall not be responsible for the Contractor's misinterpretations of Drawings and Specifications and/or other Contract Documents.

The Contractor shall have a continuing duty to read, carefully study and compare the Contract Documents and product data with each other and with information furnished by the University, and shall at once report to the Design Professional and the University errors, inconsistencies, ambiguities and omissions before proceeding with the affected Work. The Contractor shall be liable to the University for damage resulting from errors, inconsistencies or omissions in the Contract Documents, relating to constructability if the Contractor recognized or should have recognized such error, inconsistency, ambiguity or omission and failed to report it to the Design Professional and the University. If the Contractor performs any construction activity which involves such error, inconsistency, ambiguity or omission in the Contract Documents relating to constructability, without such notice to the Design Professional and the University, the Contractor shall assume responsibility for such performance and shall bear all costs attributable for correction. If the Contractor submits authorized substitutes that cost in excess of the Contract Sum which cause coordination conflicts, the Contractor shall bear all costs attributable to correction.

The Contractor shall take field measurements and verify field conditions and shall carefully compare such field measurements and conditions and other information known to the Contractor with the Contract Documents before commencing activities. Errors, inconsistencies or omissions discovered shall be reported to the Design Professional prior to performing any affected Work.

The Contractor shall perform the Work in accordance with the Contract Documents.

3.04.4 Cash Flow Estimates and Cost Control

At the University's request, the Contractor shall prepare a Cash Flow Estimate indicating the anticipated schedule of payment application amounts within tifteen (15) days after the Contractor's Bid has been accepted. The Cash Flow Estimate shall be revised periodically, at least every three months, unless significant deviations are expected or otherwise more frequently as requested by the University.

The Contractor shall review requests for changes with the University, and with the University's approval, obtain quotations from affected Subcontractors. Bulletins to Subcontractors shall define the scope of the change and require pricing using either lump sum, time and materials or cost of Work for all items of Work, including overhead and profit as may be defined in the Bid and this Agreement and shall include costs related to schedule delays, if applicable. Where both additions and deductions are involved, each should be calculated separately. Contractor shall be responsible for reviewing the pricing submitted by Subcontractors for accuracy, completeness, and reasonableness.

3.04.5 Minority/Women Business Enterprise Participation

The University makes a continuous effort to strongly encourage Minority Business Enterprise (MBE) and Women Business Enterprise (WBE) contractors and supplier to bid on and participate in University contracts. To the fullest extent permitted under federal and Michigan law, you are strongly encouraged to retain the services of WBE and MBE Subcontractors and suppliers of goods and services in connection with performance of this Contract. For purposes of this Contract, MBE is defined as a business entity in which 51% or minority individuals hold more of the voting shares and interest in the enterprise. The minority ownership of the enterprise shall have management and investment control of the voting shares and interest in the enterprise shall have management and investment control of the voting shares and interest in the enterprise shall have management and investment control of the voting shares and interest in the enterprise shall have management and investment control of the voting shares and interest in the enterprise shall have management and investment control of the voting shares and interest in the enterprise shall have management and investment control of the voting shares and interest in the enterprise. The female ownership of the enterprise shall have management and investment control of the company.



3.04.7 Time of Completion

The Contractor acknowledges that time is of the essence in performing and completing the Work on the Project. Accordingly, the Contractor shall comply with the activity and milestone completion dates as defined in the Contractor's Construction Schedule as mutually agreed by the Contractor, the University and the Design Professional. The Contractor shall provide, prepare and/or participate in developing schedules, submittals, shop drawings, construction schedules, close out documents, or other activities consistent with the conditions of the Contract Documents and as set forth below:

- A. Substantial Completion: [ENTER COMPLETION DATE]
- B. Punchlist Completion: [ENTER COMPLETION DATE]
- C. Final Completion: [ENTER COMPLETION DATE]

3.04.8 Timely Completion

Contractor acknowledges that the University has scheduled use of the Project immediately following the Dates of Substantial Completion. In scheduling that use, the University may have signed contracts and otherwise made financial commitments relating to the use of the Project no later than the date of Substantial Completion. In the event that the Contractor fails to complete on or before the date for Substantial Completion, the Contractor shall be responsible to reimburse the University for all direct, indirect and administrative costs and expenses incurred in locating, coordinating and securing alternate sites, refunding deposits, and taking any other reasonable action as a consequence of the Contractor's failure to achieve Substantial Completion by the date stated in this Agreement.

The University shall be entitled to retain from the Contractor those damages incurred upon the Contractor's default of Substantial Completion, as provided above

The Contractor further agrees to complete 100% of all punchlist items, documented on the Substantial Completion certificate, within forty-five (45) days of the date of Substantial Completion. Nothing in this Article 3.04.08 shall be construed as a limitation or waiver on such other rights as the University may have.

3.04.8.1 Substantial Completion

"Substantial Completion" shall mean the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so the University can occupy or utilize the Work for its intended use. Substantial Completion shall only be determined as described in the Contract Documents.

3.04.8.2 Final Completion

"Final Completion" means the completion of all the Work in accordance with the Contract Documents and the acceptance thereof by the University. Completion of the Work includes (1) full performance of all Contract terms; (2) acceptance of the Work by University; (3) resolution of all outstanding Changes of Contract; (4) completion of all "punch-list" items; and (5) delivery of all Close-out Documents.

3.05 Contractor's Insurance

The Contractor shall not commence Work under this Contract until it has obtained all the insurance required by the Contract Documents and such insurance has been approved by the University; likewise, no subcontractor or subconsultant shall be allowed to commence Work until the insurance required has been


obtained. The Contractor shall, at its expense, purchase and maintain in full force and effect such insurance as will protect itself and the University from claims, such as for bodily injury, death, and property damage, which may arise out of or result from the Work required by the Contract Documents, whether such Work is done by the Contractor, by any subcontractor, by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable. The types of such insurance and any additional insurance requirements are specified herein with the amounts and limits set forth in the Supplementary General Conditions.

3.05.1 Policies and Coverage

The following policies and coverages shall be furnished by the Contractor promptly upon request by the University:

(1) Comprehensive or Commercial Form General Liability Insurance covering all Work done by or on behalf of the Contractor and providing insurance for bodily injury, personal injury, property damage, and Contractual liability. Except with respect to bodily injury and property damage included within the products and completed operations hazards, the aggregate limit shall apply separately to work required of the Contractor by these Contract Documents. This insurance shall include the contractual obligations assumed under the Contract Documents and specifically section 4.06.

(2) Business Automobile Liability Insurance on an "Occurrence' form covering owned, hired, leased, and non-owned automobiles used by or on behalf of the Contractor and providing insurance for bodily injury, property damage, and Contractual liability.

(3) 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.

(4) The Umbrella Excess Liability insurance must be consistent with and follow the form of the primary policies, except that Umbrella Excess Liability insurance shall not be required for the Medical Expense Limit.

- (5) Builder's Risk Insurance.
- (6) Professional Liability Insurance (Errors and Omissions).

3.05.2 Proof of Coverage

Certificates of Insurance, or other evidence of the insurance required by these Contract Documents or requested by the University, shall be submitted by the Contractor to the University. The Certificates of Insurance shall state the scope of coverage and deductible, identify any endorsements to the policies and list the University as an additional named insured. Any deductible shall be the Contractor's liability. The Certificates of Insurance shall provide for no cancellation or modification of coverage without thirty (30) days prior written notice to the University. Acceptance of Certificates of Insurance by the University shall not in any way limit the Contractor's liabilities under the Contract Documents. In the event the Contractor does not comply with these insurance requirements, the University may, at its option, provide insurance coverage to protect the University; the cost of such insurance shall be deducted from the Contract Sum or otherwise paid by the Contractor. Renewal certifications shall be filed in a timely manner for all coverage until the Project is accepted as complete. Upon the University's request, the Contractor shall provide copies of the policies obtained from the insurers.

3.05.3 Subcontractor's Insurance

The Contractor shall either require subcontractors to carry the insurance or the Contractor shall insure the activities of the subcontractors in the amount, types and form of insurance required by the Contract



Documents. If the Contractor elects to have its subcontractors purchase individual insurance policies, the Contractor's subcontracts shall include a clause requiring that copies of any insurance policies which provide coverage to the Work shall be furnished to the University. The Contractor shall supply the University with a list of all subcontractors showing whether or not they have individual insurance policies and certifying that those subcontractors without individual insurance policies are insured by the Contractor.

3.05.4 Scope of Insurance Coverage

The Contractor's insurance as required by the Contract Documents (including subcontractors' insurance), by endorsement to the policies and the Certificates of Insurance, shall include the following and may be presented in the form of a rider attached to the Certificates of Insurance:

(1) The Board of Governors of Wayne State University, the University, their officers, employees, representatives and agents including the Design Professional, shall be included as additional named insureds for and relating to the Work to be performed by the Contractor and subcontractors. This shall apply to all claims, costs, injuries, or damages.

(2) A Severability of Interest Clause stating that, "The term 'insured' is hereby used severally and not collectively, but the inclusion herein of more than one insured shall not operate to increase the limits of the insurer's or insurers' liability."

(3) A Cross Liability Clause stating that, "In the event of claims being made under any of the coverages of the policy or policies referred to herein by one or more insured hereunder for which another or other insured hereunder may be liable, then the policy or policies shall cover such insured or insured against whom a claim is made or may be made in the same manner as it separate policies had been issued to each insured hereunder. Nothing contained herein, however, shall operate to increase the insurer's limits of liability as set forth in the insuring agreements."

(4) The Board of Governors of Wayne State University, the University, their officers, employees, representatives and agents, shall not by reason of their inclusion as insured incur liability to the insurance carriers for payment of premiums for such insurance. However, the Board of Governors of Wayne State University may, in their sole discretion after receiving a notice of cancellation for nonpayment, elect to pay the premium due and deduct such payment from any sums due to the Contractor or recover the amount paid from the Contractor if the sums remaining are insufficient.

(5) Coverage provided is primary and is not in excess of or contributing with any insurance or selfinsurance maintained by the Board of Governors of Wayne State University, the University, their officers, employees, representatives and agents.

3.05.5 Miscellaneous Insurance Provisions

The form and substance of all insurance policies required to be obtained by the Contractor shall be subject to approval by the University. All such policies shall be issued by companies lawfully authorized to do business in Michigan and be acceptable to the University. All property insurance policies to be obtained by the Contractor shall name the University as loss payee as its interest, from time to time, may appear.

The Contractor shall, by mutual agreement with the University and at the University's cost, furnish any additional insurance as may be required by the University. The Contractor shall provide appropriate endorsements evidencing such additional insurance.

In the event that the scope of Work includes asbestos abatement, the Contractor or subcontractor, as appropriate, shall provide \$1,000,000 asbestos liability insurance.



The University is not required to provide or purchase any additional insurance with respect to this Project or the Work required of the Contractor for the Project.

3.05.6 Loss Adjustment

Any insured loss is to be adjusted with the University and made payable jointly to the University and the Contractor. The Contractor shall cooperate with the University in a determination of the actual cash value or replacement value of any insured loss. Any deductible amount shall be the responsibility of the Contractor to resolve.

3.05.7 Compensation Distribution

The University upon the occurrence of an insured loss shall account for any money so received and shall distribute it in accordance with such agreement as the interested parties may reach. Claim payments received shall be distributed proportionately according to the actual percentages of losses to both. If after such loss no other special agreement is made, replacement of damaged work shall be covered by an appropriate contract change order. Any dispute shall be resolved by the University

3.05.8 No Waiver of Subrogation

The University does not waive any rights of Subrogation that it may possess on this Project.

3.06 Indemnification

3.06.1

To the fullest extent permitted by law, the Contractor shall hold harmless, defend, and indemnify the Board of Governors of Wayne State University, the University, and officers, employees, representatives and agents of each of them, from and against any and all claims or losses arising out of or are alleged to be resulting from, or relating to (1) the failure of the Contractor to perform its obligations under the Contract or the performance of its obligation in a willful or negligent manner; (2) the inaccuracy of any representation or warranty by the Contractor given in accordance with or contained in the Contract Documents; and (3) any claim of damage or loss by any subcontractor, or supplier, or laborer against the University arising out of any alleged act or omission of the Contractor or any other subcontractor, or anyone directly or indirectly employed by the Contractor or any subcontractor.

3.06.2

To the fullest extent permitted by law, the Contractor shall be liable for and hereby agrees to defend, discharge, fully indemity and hold the University harmless from and against any and all claims, demands, damages, liability, actions, causes of action, losses, judgments, costs and expenses of every nature (including investigation costs and/or expenses, settlement costs, and attorney fees and expenses incident thereto) sustained by or asserted against the University arising out of, resulting from, or attributable to the performance or nonperformance of any Work and/or obligation covered by the Contract or to be undertaken in connection with the construction of the Project contemplated by the Contract (collectively, "Claim"), including, but not limited to, any Claim for: (a) any personal or bodily injury, illness or disease, including death at any time resulting therefrom of any person, (including, but not limited to, employees of the University, the Contractor, any subcontractor, and any materialman and the general public); (b) any loss, damage or destruction of any property; (c) any loss or damage to the University's operations, arising out of, resulting from, or attributable in whole or in part to (i) any negligence or other act or omission of the Contractor, and any subcontractor, any other person or any of the directors, officers, employees or agents of any of them or (ii) any defects in material or equipment furnished hereunder; (d) any payments allegedly owed to subcontractors, sub-subcontractors or materialmen; (e) any acts or omissions relative to



conditions of safety and protection of persons on the Project site; and/or (f) any act or omission relative to the Contractor's breach of obligations and regarding non-discrimination as set forth in these General Conditions. The Contractor shall not be liable hereunder to indemnify the University against liability for damages arising out of bodily injury to persons or damage to property caused by or resulting from the sole negligence or willful misconduct of the University, its agents or employees. The Contractor, at its own cost and expense, shall take out and maintain at all times during the effective period of the Contract, contractual liability insurance insuring the performance by the Contractor of its contractual duties and obligations under this Article, which insurance shall name the University as additional insured and shall be in form and amount and from an insurance company satisfactory to the University. The Contractor's duty to fully indemnify the University shall not be limited in any way by the existence of this insurance coverage.

3.06.3

The Contractor shall also be liable for and hereby agrees to pay, reimburse, fully indemnify and hold the University harmless from and against all costs and expenses of every nature (including attorney fees and expenses incident thereto) incurred by the University in collecting the amounts due from the Contractor, or otherwise enforcing its rights, under the indemnifications described in this Article.

3.06.4

In claims against any person or entity indemnified under this Article made by an employee of the Contractor or a Subcontractor, supplier or indirectly employed by any of them, or anyone for whose acts is made liable, the indemnification obligation under this Article shall not be limited by a limitation on amount or type of damages, compensation, or benefits payable by or for the Contractor, Subcontractor or supplier under workers compensation laws, disability benefit laws, or other laws providing employee benefits.

3.06.5

The indemnification obligations under this Article shall not be limited by any assertion or finding that the person or entity indemnified is liable by reason of a non-delegable duty.

3.06.6

The Contractor shall hold harmless, defend, and indemnify the University from and against losses resulting from any claim of damage made by any separate contractor of the University against the University arising out of any alleged acts or omissions of the Contractor, a subcontractor, anyone directly or indirectly employed by either the Contractor or subcontractor, or anyone for whose acts either the Contractor or subcontractor may be liable.

3.06.7

The Contractor shall hold harmless, defend, and indemnify the separate Contractors of the University from and against losses arising out of the negligent acts or omissions or willful misconduct of the Contractor, a subcontractor, anyone directly or indirectly employed by the Contractor or subcontractor, or anyone for whose acts the Contractor or subcontractor may be liable.

3.07 Guarantee

The Contractor unconditionally guarantees the Work under this Contract to be in conformance with the Contract Documents and to be and remain free of defects in workmanship and materials not inherent in the quality required or permitted. Contractor shall repair or replace any Work, together with any adjacent Work which may be displaced in so doing, which is not in accordance with the requirements of the Contract or which is defective in its workmanship or material, all without any expense whatsoever to the University for a



period of one (1) year / two (2) years from the date of Substantial Completion, unless a longer guarantee period is stipulated in the Contract Documents or otherwise available from the manufacturer ("Repair Period").to.

Special guarantees that are required by the Contract Documents shall be signed by the Contractor who is responsible for the entire work and countersigned by the subcontractor who performs the work.

The Contractor further agrees that within five calendar days after being notified in writing by the University of any Work not in accordance with the requirements of the Contract Documents or of any defects in the Work, it shall commence and prosecute with due diligence all Work necessary to fulfill the terms of this guarantee and to complete the Work in accordance with the requirements of the Contract with sufficient manpower and material to complete the repairs as expeditiously as possible. The Contractor, in the event of failure to so comply, does hereby authorize the University to proceed to have the Work done at the Contractor's expense, and it agrees to pay the cost thereof upon demand. The University shall be entitled to all costs necessarily incurred upon the Contractor's refusal to pay the above cost.

Notwithstanding the foregoing paragraph, in the event of an emergency constituting an immediate hazard to health, safety or damage of the University's employees, property, or licenses, the University may undertake at the Contractor's expense, without prior notice, all Work necessary to correct such hazardous conditions caused by the Work of the Contractor not being in accordance with the requirements of this Contract.

The Contractor shall require a similar guarantee in all subcontracts, including the requirement that the University be reimbursed for any damage or loss to the Work or to other Work resulting from such defects.

If required by the Contract Documents, the Maintenance and Guarantee Bond shall be in full force and effect during the entire Repair Period, unless a longer bond period is stipulated in the Contract Documents. **4.00 CONTRACTOR'S COMPENSATION**

4.01 Basis of Compensation

In consideration of the full performance of this Agreement by the Contractor, the University shall compensate the Contractor as stated in Exhibit B

4.02 Change Orders and Construction Change Directives

4.02.1 Generally

The University reserves the right to issue written orders whether through a formal Change Order or Construction Change Directive, directing changes in the Contract at any time prior to the acceptance of the Project without voiding the Contract, and Contractor shall promptly comply with such order. A Construction Change Directive may be issued in writing by the University directing the Contractor to perform changed Work in the absence of a final agreement on a Change Order and the costs will be calculated as provided in 6.01.4. The Contractor may request changes in the Work, but shall not act on the changes until approved in writing by the University. Any change made without authority in writing from the University shall be the responsibility of the Contractor.

Any such changes in the Work that have a cost impact shall only be authorized by Change Orders approved by the University. No action, conduct, omission, prior failure or course of dealing by the University shall act to waive, modify, change or alter the requirement that Change Orders must be in writing and signed by the University and Contractor and that such written Change Orders are the exclusive method for changing or altering the Contract Sum or Contract Time. The University and Contractor understand and agree that the Contract Sum and Contract Time cannot be changed by implication, oral agreements, actions, inaction, course of conduct or Construction Change Directive.



On the basis set forth herein, the Contract Sum may be adjusted for any Change Order requiring a different quantity or quality of labor, materials or equipment from that originally required, and the partial payments to the Contractor, set forth in section 8.01, may be adjusted to reflect the change. Whenever the necessity for a change arises, the Contractor shall take all necessary steps to mitigate the effect of the ultimate change on the other Work in the area of the change. Changed Work shall be performed in accordance with the original Contract requirements except as modified by the Change Order. Except as herein provided, the Contractor shall have no claim for any other compensation including lost productivity or increased overhead expenses due to changes in the Work. The amounts set forth in the Change Order constitute full compensation for both direct and indirect costs of the Work described in the Change Order. Payment by the University pursuant to the Change Order shall constitute full satisfaction of any and all claims for compensation and extension of time by the Contractor shot by the Work by the Contractor and all subcontractors.

4.02.2 Proposed Change Orders

The Design Professional, with approval of the University, shall issue to the Contractor a cost request Bulletin for a proposed change order describing the intended change and shall require the Contractor to indicate thereon a proposed amount to be added to or subtracted from the Contract Sum due to the change supported by a detailed estimate of cost. Upon request by the University, the Contractor shall permit inspection of the original Contract estimate, subcontract agreements, or purchase orders relating to the change. Any request for adjustment in Contract Time which is directly attributable to the changed Work shall be included with substantiating detailed explanation by the contractor in its response to the cost request bulletin. Failure by Contractor to request adjustment of Contract Time in the response to the cost request Bulletin shall waive any right to subsequently claim an adjustment of the Contract Time based on the changed Work. The Contractor shall submit the response to the cost request Bulletin with detailed estimates and any time extension request thereon to the Design Protestional and the University's Representative within ten (10) calendar days after issuance of the cost request bulletin. Upon its submission the Design Professional will review it and advise the University who will make the decision. If the Contractor fails to submit the response within the required ten (10) calendar days, and the Contractor has not obtained the Design Professional's and the University's permission for a delay in submission, the University may order the Contractor in writing to begin the Work immediately, and the Contract Sum shall be adjusted in accordance with the University's estimate of cost. In that event, the Contractor, within fifteen days following completion of the changed Work, may present information to the University that the University's estimate was in error; the University, in its sole discretion, may adjust the Contract Sum. The Contractor must keep and submit to the University time and materials records verified by the University to substantiate its costs. The University may require the Contractor to proceed impediately with the changed Work in accordance with section 4.02.4. "Failure to Agree as to Cost" or section 4.02.6 "Emergency Changes."

When the University and the Contractor agree on the amount to be added to or deducted from the Contract Sum and the time to be added to or deducted from the Contract Time and an Impact Report or a Contract Change Order is signed by the University and the Contractor, the Contractor shall proceed with the changed Work. If agreement is reached as to the adjustment in compensation for the performance of changed Work but agreement is not reached as to the time adjustment for such Work, the Contractor shall proceed with the Work at the agreed price, reserving the right to further pursue its Claim for a time adjustment. Any costs incurred to acquire information relative to a proposed Change Order shall not be borne by the University.

4.02.3 Allowable Costs Upon Change Orders

The only estimated or actual costs that will be allowed because of changed Work and the manner in which those costs shall be computed is described by this section.

4.02.3.1 Labor



Costs are allowed for the actual payroll cost to the Contractor for direct labor, engineering or technical services directly required for the performance of the changed Work, (but not site management such as field office estimating, clerical, project engineering, management or supervision) including payments, assessments, or benefits required by lawful labor union collective bargaining agreements, compensation insurance payments, contributions made to the State pursuant to the Unemployment Insurance Code, and for taxes paid to the federal government required by the Social Security Act of August 14, 1935, as amended, unless the time of completion adjustments affect the general condition inclusion of the Contract Sum.

No labor cost will be recognized at a rate in excess of the appropriate wage rates established for that portion of the Work, nor will the use of a classification which would increase the labor cost be permitted unless the Contractor established to the satisfaction of the University the necessity for payment at a higher rate.

4.02.3.2 Materials

Costs are allowed for the actual cost to the Contractor for the materials directly required for the performance of the changed Work. Such cost of materials may include the costs of transportation, sales tax, and delivery if necessarily incurred. However, overhead costs shall not be included. If a trade discount by the actual supplier is available to the Contractor, it shall be credited to the University. If the materials are obtained from a supply or source owned wholly or in part by the Contractor, payment therefor will not exceed the current wholesale price for such materials.

If, in the opinion of the University, the cost of materials is excessive, or if the Contractor fails to furnish satisfactory evidence of the cost from the actual suppliers thereof, then in either case the cost of the materials shall be deemed to be the lowest wholesale price at which similar materials are available in the quantities required at the time they were needed.

4.02.3.3 Equipment

Costs are allowed for the actual cost to the Contractor for the use of equipment directly required in the performance of the changed Work except that no payment will be made for time while equipment is inoperative due to breakdowns or for non-working days. The rental time shall include the time required to move the equipment to the Project site from the nearest available source for rental of such equipment, and to return it to the source. If such equipment is not moved by its own power, then loading and transportation costs will be paid. However, neither moving time nor loading and transportation costs will be paid if the equipment is used on the Project in any other way than upon the changed Work. Individual pieces of equipment having a replacement value of \$500.00 or less shall be considered to be tools or small equipment, and no payment therefor will be made.

For equipment owned or furnished by the Contractor, no cost therefor shall be recognized in excess of the rental rates established by distributors or equipment rental agencies in the locality where the Work is performed. Blue Book rates shall not be used for any purpose.

The amount to be paid to the Contractor for the use of equipment as set forth above shall constitute full compensation to the Contractor for the cost of fuel, power, oil, lubrication, supplies, small tools, small equipment, necessary attachments, repairs and maintenance of any kind, depreciation, storage, insurance, labor (except for equipment operators who shall be paid for as provided in Article 4.02.3.1) and any and all costs to the Contractor incidental to the use of such equipment.

4.02.3.4 Work by Subcontractors and Vendors

For any portion of the changed Work which is to be performed by a subcontractor, the Contractor shall furnish to the University a detailed estimate prepared and signed by subcontractor of the cost to subcontractor for performing the changed Work. At the sole discretion of the University, a lump sum estimate of such cost to



subcontractor may be accepted in lieu of the detailed estimate. The combined costs for subcontractor's overhead, profit, taxes, indirect supervision, insurance, bonds shall not exceed ten percent (10%). Estimates of the amount to be deleted from subcontractor's portion of the Work shall be gross cost of the deducted Work plus eight percent (8%). For changed Work to be furnished by a supplier, the Contractor shall furnish upon demand of the University, a lump sum estimate of the cost of the items including taxes and cartage to the Contractor prepared by the supplier. No supplier mark-up for overhead, profit, layout, supervision or bonds will be allowed for changed Work furnished by a supplier.

4.02.3.5 Contractor Mark-up for Added Work

Where changed Work is performed, the Contractor may add to the total estimated actual cost for such Work no more than ten (10%) for subcontractor mark-up and seven and one-half percent (7.5%) for self-performed trade work for profit, overhead, insurance, taxes, indirect supervision, bends, and any other costs not allowed by section 4.02.01.

4.02.3.6 Credit for Deleted Work

The amount to be deducted from the Contract Sum shall be the total estimated actual cost of the deducted Work plus eight percent (8%).

Where an entire item or section of Work is deleted from the Contract, the entire subcontract cost or bid cost shall be considered the appropriate deduction less the value of Work performed. If the subcontract cost or bid cost is not identifiable, then estimates of the amount to be deducted from the Contract Sum shall be the gross cost of the deducted work plus six percent (6%) for saved overhead, bonds, insurance, and taxes.

For proposed change orders which involve both added and deleted Work, the Contractor shall separately estimate the cost of the added Work before mark-ups, and separately estimate the cost of the deleted Work before allowance of a credit. If the difference between the costs results in an increase to the Contract Sum, the mark-up for added Work shall be applied to the difference, and if the difference in the costs results in a decrease, then the mark-up for deleted Work shall be applied to the difference.

4.02.3.7 Market Values

Cost for added Work shall be no more than market values prevailing at the time of the change, unless the Contractor can establish to the satisfaction of the University that it investigated all possible means of obtaining Work at prevailing market values and that the excess cost could not be avoided.

When a change order deletes Work from the Contract, the computation of the cost thereof shall be the values which prevailed at the time bids for the Work were opened or the Contract Sum established.

4.02.4 Failure to Agree as to Cost

4.02.4.1 For Added Work

Notwithstanding the failure of the University and the Contractor to agree as to the cost of the proposed Change Order, the Contractor, upon written order from the University, shall proceed immediately with the changed Work. A Construction Change Directive or letter signed by the University shall be used for this written order. At the start of each day's Work on the change, the Contractor shall notify the University in writing as to the size of the labor force to be used for the changed Work and its location. Failure to so notify may result in the non-acceptance of the costs for that day. At the completion of each day's Work, the Contractor shall furnish to the University a detailed summary of all labor, materials, and equipment employed in the changed Work. The University will compare his/her records with Contractor's daily summary and may make any necessary adjustments to the summary. After the University and the Contractor agree upon and



sign the daily summary, the summary shall become the basis for determining costs for the additional Work. The sum of these costs when added to an appropriate mark-up will constitute the payment for the changed Work. Subsequent adjustments, however, may be made based on later audits by the University. When changed Work is performed at locations away from the job site, the Contractor shall furnish in lieu of the daily summary, a summary submitted at the completion of the Work containing a detailed statement of labor, material, and equipment used in the Work. This latter summary shall be signed by the Contractor who shall certify thereon that the information is true.

The Contractor shall maintain and furnish on demand of the University itemized statements of cost from all vendors and subcontractors who perform changed Work or furnish materials and equipment for such Work. All statements must be signed by the vendors and the subcontractors.

4.02.4.2 For Deleted Work

When a proposed Change Order contains a deletion of any Work, and the University and the Contractor are unable to agree upon the cost thereof, the University's estimate shall be deducted from the Contract Sum and may be withheld from any payment due the Contractor until the Contractor presents adequate substantial information to the University that the University's estimate was in error. The amount to be deducted shall be the actual costs to the Contractor for labor, materials, and equipment which would have been used on the deleted Work together with an amount for mark-up as defined in the Contract Documents.

4.02.5 Allowable Time Extensions

For any change in the Work, the Contractor shall only be entitled to such adjustments in Contract Time due solely to performance of the changed Work. The procedure for obtaining an extension of time is set forth in Section 4.08 of these General Conditions. No extension of time shall be granted for a change in the Work unless the Contractor demonstrates to the satisfaction of the University that the Work is on the critical path and submits an updated CPM schedule showing that an extension of time is required and that the Contractor is making, or has made, every reasonable effort to guarantee completion of the additional Work called for by the change within the time originally allotted for the Contract. Failure by the Contractor to make the required submission or showing constitutes a waiver of any possible adjustment in Contract Time.

Any adjustment in Contract time shall specify the exact calendar day.

4.02.6 Emergency Changes

Changes in the Work made necessary due to unforeseen site conditions, discovery of errors in plans or specifications requiring immediate clarification in order to avoid a serious Work stoppage, changes of a kind where the extent cannot be determined until completed, or under any circumstances whatsoever when deemed necessary by the University are kinds of emergency changes which may be authorized by the University in writing to the Contractor. The Contractor shall commence performance of the emergency change immediately upon receipt of written direction from the University.

If agreement is reached as to compensation adjustment for the purpose of any emergency change, then compensation will be as provided in this section relating to ordinary changes. If agreement is not reached as to compensation at the time of commencing the emergency change, then compensation will be as provided in section 4.02.4, that is, time and materials records and summaries shall be witnessed and maintained until either a lump sum payment is agreed upon, or the changed Work is completed.

4.03 Records and Audit

4.03.1



Contractor's records, which shall include but not be limited to accounting records (hard copy, as well as computer readable data if it can be made available), written policies and procedures; subcontract files (including proposals of successful and unsuccessful bidders, bid recaps, etc.); original estimates; estimating work sheets, correspondence; change order files (including documentation covering negotiated settlements); backcharge logs and supporting documentation; general ledger entries detailing cash and trade discounts earned, insurance rebates and dividends; and any other supporting evidence deemed necessary by the University to substantiate changes related to the Agreement (collectively referred to as "Records") shall be maintained in accordance with Generally Accepted Accounting Principles and open to inspection and subject to audit and/or reproduction by University's agent or its authorized representative to the extent necessary to adequately permit evaluation and verification of Cost of the Work, and any invoices, change order, payments or claims submitted by the Contractor or any of his payees pursuant to the execution of the contract.

4.03.2

Such audits may require inspection and copying from time to time and at reasonable times and places of any and all information, materials and data of every kind and character, including without limitation, records, books, papers, documents, subscriptions, recordings, agreements, purchase order, leases, contracts, commitments, arrangements, notes, daily diaries, superintendent reports, drawings, receipts, vouchers and memoranda, and any and all other agreements, sources of information and matters that may in University's judgment have any bearing on or pertain to any matters, rights, duties or obligations under or covered by any Contract Documents. Such records subject to audit shall also include, but not be limited to, those records necessary to evaluate and verify direct and indirect costs, (including overhead allocations) as they may apply to costs associated with this Agreement.

4.03.3

The University or its designee shall be afforded access to all of the Contractor's Records, and shall be allowed to interview any of the Contractor's employees, pursuant to the provisions of this article throughout the term of this contract and for a period of six (6) years after Final Payment or longer if required by law. To the extent University deems is allowed by law, the Contractor's records shall remain confidential. Contractor recognizes and agrees that University will disclose documents it deems is required or apprepriate pursuant to law, defense against lawsuits or other claims, or other reason deemed necessary by University.

4.03.4

Contractor shall require all Subcontractors, insurance agents, and material suppliers (payees) to comply with the provisions of this article by insertion of the requirements hereof in a written contract agreement between Contractor and payee. Such requirements will also apply to Subcontractors and all lower tier Subcontractors. Contractor will cooperate fully and will cause all of Contractor's Subcontractors (including those entering into lump sum contracts, payees or lower tier Subcontractors) to cooperate fully by furnishing or making available to University from time to time whenever requested in an expeditious manner any and all such information, materials and data.

4.03.5

University's agent or its authorized representative shall have access to the Contractor's facilities, shall have access to all records deemed necessary by University; and shall be provided adequate and appropriate work space, in order to conduct review or audits in compliance with this article.

4.03.6



Contractor agrees that University's designee shall have the right to examine the Contractor's records (during the contract period and up to six(6) years after Final Payment is made on the contract) to verify the accuracy and appropriateness of the pricing data used to price change proposals or claims. Contractor agrees that if the University determines the cost and pricing data submitted (whether approved or not) was inaccurate, incomplete, not current or not in compliance with the terms of the contract regarding pricing of change orders, an appropriate contract price reduction shall be made. Such post-approval contract price adjustments will apply to all levels of Contractors and/or Subcontractors and to all types of change order proposals specifically including lump sum change orders, unit price change orders and cost-plus change orders.

4.03.7

If an audit, inspection or examination in accordance with this article, discloses overcharges (of any nature) by the Contractor to the University in excess of one percent (1%) of the total contract billings, the actual cost of the University's audit shall be reimbursed to the University by the Contractor. Any adjustments and/or payments which must be made as a result of any such audit or inspection of the Contractor's invoices and/or records shall be made within a reasonable amount of time (not to exceed 90 days) from presentation of University's findings to Contractor.

4.03.8

If this Agreement is determined to be subject to Section 1861(v)(1)(1) of the Social Security Act, as amended from time to time, the Contractor agrees that for a period of four (4) years following the expiration or earlier termination of this Agreement, the Contractor shall retain and make available to the Secretary of Health and Human Services, the Comptroller General of the United States, or any of their duly authorized representatives, this Agreement, and any books, documents, and records of the Contractor which are necessary to certify the nature and extent of amounts paid by the University pursuant to this Agreement. In the event access to books, documents, and records is requested by the Secretary, the Comptroller General, or any of their duly authorized representatives, the Contractor shall immediately notify the University and make such books, documents and records available to the University unless prohibited by law.

4.04 Applications for Payment

The Contractor shall prepare and deliver to the University monthly an itemized Application for Payment. The University shall pay the Contractor within thirty (30) days of receipt of a properly submitted, complete and correct Application for Payment. The Applications for Payment shall include a Schedule of Values describing the services included and Work completed in the Application for Payment. No interest shall accrue on any unpaid portion of the Applications for Payment or any other sums that the Contractor or any Subcontractor or supplier claim are or may be due under this Agreement.

The Application for Payment shall constitute a representation by the Contractor to the University that the Work has progressed to the point indicated, the quality of the Work is in accordance with the Contract Documents, and the Contractor is entitled to payment. No progress payment, partial use or entire use of the Project by the University shall constitute acceptance of work not in strict conformity with the Contract Documents.

The Contractor shall keep records of cost and expense to support the Contractor's Applications for Payment, including without limitation records of staff time, material costs, and reimbursable expense items in connection with the Work. Financial records shall be kept on a generally recognized accounting basis, as approved by the University. Contractor shall make them readily available to the University or its representatives for inspection and audit for a period of six (6) years after the Project Close-out and Final Payment to the Contractor.



The Application for Payment shall be accompanied by a Sworn Statement completed by the Contractor, together with Certified Payrolls prepared in accordance with Section 5.02, as well as other documentation that may be required by the University, stating that all Subcontractors and suppliers have been paid in full for Work performed through the last or most recent progress payment.

4.05 Retainage

Payments to the Contractor shall be subject to retainage of ten percent (10%) of the Cost of Work for each Application for Payment until the Work is fifty percent (50%) complete; at that time, no further retainage will be deducted from the Applications for Payment. Draws on retainage may only be submitted after Substantial Completion and in the following quantities: (1) at the completion of all Punchlist items, the retainage may be reduced to two percent (2%); and (2) at delivery of all Closeout Documents and warranties, the remainder of the retainage may be paid to the Contractor. Any release of retainage shall be at the sole discretion of the University.

4.06 Final Payment

Issuance of Final Payment shall be expressly conditioned on certification of Substantial Completion, certification of Punchlist completion and written acceptance of closeout documents by the Design Professional and University.

5.00 WSU WAGES

5.01 Applicable Wage Rates

The Contractor acknowledges and shall able by the University's prohibition on use of 1099 independent contractors and owner / operator business entities wherein such individuals or entities are not able to secure and maintain workers compensation insurance. 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 subcontractor for any tier thereof, and that each worker is covered by workers compensation insurance.

For this project, it is a University requirement that the Contractor and all Subcontractors and subsubcontractors who provide labor on this project shall compensate each worker, regardless of their employment status, not less than the wage and fringe benefit rates prevailing in the locality in which the work is to be performed. At the time of advertising for bids on the project, the University shall provide the prevailing rates of wages and fringe benefits for all classes of construction mechanics called for in the Contract. A schedule of these rates shall be made a part of the specifications for the work to be performed and shall be printed on the bidding forms where the work is to be done by contract. Contractor shall also 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 posted.

5.02 Certified Payroll Records and Supporting Documents

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 working in connection with this contract and shall be submitted with each pay application in accordance with Section 4.04. Contractor shall be required to 1) collect all certified payroll records from Contractor and Subcontractors and sub-subcontractors; 2) provide and require Subcontractors and sub-subcontractors to provide the University access to supporting documentation, and 3) shall provide this information, records, and/or access to documentation to the University or its agent(s) or auditors for review or audit promptly on request. Contractor shall, and shall also require all subcontractors and sub-subcontractors to, promptly provide



information relating to payroll and job classification and work duties to University upon request. The University reserves the right to audit Contractor, Subcontractors, and sub-subcontractors for compliance with wage and hour requirements, WSU Wage, employee classifications and other applicable requirements.

5.02.1 Audit

In connection with the WSU Wage rate audit conducted by the University, the Contractor is required to maintain and/or promptly obtain the following information, records and documentation from Contractor, all Subcontractors, and all sub-subcontractors and to promptly provide them to the University upon request:

- 1. Canceled payroll checks
- 2. Pay stubs
- 3. Weekly time cards on time sheets
- 4. Payroll registers
- 5. Employee handbook
- 6. Fringe benefit plan documents
- 7. Minutes of Board of Directors meetings
- 8. Worksheets for calculation of non-cash fringe benefit amounts included in compensation

9. Apprentice certificates and other documents to verify registration of all apprentices in recognized apprentice program certified by the Bureau of Apprentices in and Training (B.A.T.) of the U.S. Dept. of Labor or an acceptable equivalent

10. Other related documents as requested by the University.

5.02.2 Failure to Comply with Audit

If the requested information and/or records are not promptly provided pursuant to University's request, in addition to all other rights and remedies it has pursuant to law, equity and contract, the University, by written notice to Contractor and the sureties of the contractor known to the University may, but has no obligation or duty to, 1) terminate the contract with Contractor and University owe Contractor and be liable only for that prorated portion of satisfactorily completed work up to the date of termination; 2) withhold further payments owed until Contractor supplies the requested information and records and/or otherwise complies with the request for records and/or access to documentation; and 3) inform the Vice-President for Finance and Business Operations of what has been requested and what has not been provided by Contractor and/or subcontractor or sub-subcontractor. Contractor is hereby given express notice that failure to comply with University's requests for information and records may disqualify Contractor and/or non-complying Subcontractors/sub-subcontractors from bidding and/or receiving work on future University projects. The University may proceed to complete this contract by separate agreement with another contractor or otherwise and the original Contractor and its sureties shall be liable to the University for any excess cost occasioned thereby.

5.03 Classification of Workers

All apprentices utilized on this University project must be registered in a recognized apprentice program, i.e., one that is certified by the Bureau of Apprenticeship (B.A.T.), U.S. Department of Labor. The workers used on a University project by either Contractor or a Subcontractor must be employees of the Contractor or Subcontractor and not individuals claimed as subcontractors or independent contractors, such as individuals whose compensation is reflected on IRS form 1099. The use of individuals as independent contractors is prohibited without express written permission of the University.

5.04 Failure to Pay



If a Contractor or subcontractor fails to pay the prevailing rates of wages and fringe benefits and does not cure such failure within fourteen (14) 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:

5.04.1

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.

5.04.2

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

5.04.3 University's Rights Cumulative

It is expressly understood by both parties that the above are in addition to University's other rights and remedies, and University retains all other rights and remedies it has pursuant to this Agreement, or otherwise, to enforce its rights to require that WSU Wages and fringe benefits be paid for the construction work on this Project, but the University shall have no duty or contractual obligation to enforce these provisions. Contractor agrees that it shall be solely responsible for ensuring that these requirements are met and shall handle and defend all complaints or claims regarding wage payments to construction mechanics without assistance or involvement of the University. Contractor shall permit its employees and workers, and its Subcontractors and sub-subcontractors and their employees and workers, to discuss payment and work duty information with University staff, but otherwise Contractor shall continually prohibit its employees and workers, and all subcontractors and sub-subcontractors and their employees and workers, from directing or making any claims or complaints regarding the payment of wages to any employee or official of the University, and shall indemnify and reimburse University for all expenses and fees, including attorney fees, which it incurs for defending or representing itself against such claims or complaints. The University shall not be asked to nor be responsible to address or resolve any disputes with or between Subcontractors on the Project.

5.05 Application to Subcontractors

The Contractor shall include terms identical or substantially similar to this section in all Subcontracts, Purchase Orders and other agreements pertaining to the Project.

6.00 OWNERSHIP OF ELECTRONIC OR HARD-COPY DOCUMENTS

All drawings and specifications and other data and materials prepared and furnished whether in electronic or hard-copy format by the University, the Design Professional and/or the Contractor shall become the property of the University. The Contractor shall have no claim for further employment or additional compensation as a result of exercise by the University of its full rights to ownership of such documents, information, data and materials. The Contractor shall not use or copy such documents, information, data or materials in any format for any purpose other than for the Project.

7.00 SUCCESSORS AND ASSIGNS

This Agreement shall be binding upon and inure to the benefit of the parties to this Agreement and their respective successors and assigns; provided, however, that none of the parties hereto shall assign this Agreement without the prior written consent of the other.

8.00 CLAIMS, DISPUTES AND GOVERNING LAW



8.00 CLAIMS AND DISPUTES

8.01 Claims Definition

A Claim is a demand or assertion by one of the parties seeking adjustment or interpretation of Contract terms, payment of money, extension of time or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes and matters in question between the parties arising out of or relating to the Contract. Claims must be made by written notice within a specified time period. The responsibility to substantiate Claims shall rest with the party making the Claim.

8.01.1 Policy of Cooperation

The parties shall endeavor to resolve all of their claims and disputes amicably and informally through open communication and discussion of all issues relating to the Project. To the greatest extent possible, the parties shall avoid invoking the formal dispute resolution procedures contained in the Contract Documents.

8.02 Recommendation of Design Professional

Claims must be referred initially to the Design Professional for action as provided in paragraph 8.10 as an express condition precedent to proceeding further in resolving any claim.

8.03 Time Limits on Claims

Claims must be made within 5 business days after occurrence of the event giving rise to such Claim or within 5 days after the claimant first recognizes the condition giving rise to the Claim, whichever is later. Claims must be made by written notice. An additional Claim made after the initial Claim has been resolved by Change Order will not be valid.

8.04 Continuing Contact Performance

Pending final resolution of a Claim, unless otherwise agreed in writing, the Contractor shall proceed diligently with performance of the Contract and the University shall continue to make payments in accordance with the Contract Documents subject to the University's rights relative to payments, withholding of payments, termination, or all other rights afforded it in the Contract Documents.

8.05 Claims for Concealed or Unknown Conditions

If conditions are encountered at the site which are (1) subsurface or otherwise concealed physical conditions which differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature, which differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, then written notice by the observing party shall be given to the other party promptly before conditions are disturbed and in no event later than 24 hours after first observance of the conditions. The Design Professional will promptly investigate such conditions and, if the conditions differ materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any part of the Work, the Design Professional will recommend an equitable adjustment in the Contract Sum or Contract Time, or both. If the Design Professional determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Design Professional shall so notify the University and Contractor in writing, stating the reasons. Claims by either party in opposition to such determination must be made within 5 days after the Design Professional has issued such determination. If the University and Contractor cannot agree on an adjustment in the Contract Sum or Contract Time, the



adjustment shall be referred to the Design Professional for initial determination, subject to further proceedings pursuant to Paragraph 8.09.

8.06 Claims for Additional Cost

Any Claim by the Contractor for an increase in the Contract Sum shall be submitted in writing as required by the Contract Documents before proceeding to execute the Work. If the Contractor believes additional cost is involved for reasons including but not limited to (1) a written interpretation from the Design Professional, (2) an order by the University to stop the Work where the Contractor was not at fault, (3) a written order for a minor change in the Work issued by the Design Professional, (4) failure of payment by the University, (5) termination of the Contract by the University, (6) University's suspension or (7) changes in the scope of Work, the Contractor's claim shall be filed in strict accordance with the procedure established herein.

8.07 Claims for Additional Time

Any Claim by Contractor for an increase in the Contract Time shall be submitted in writing as required by this provision and the Contract Documents. The Contractor's Claim shall include an estimate of the probable effect of delay on progress of the Work. In the case of a continuing delay only one Claim is necessary.

As a precondition for the Claim to be considered by the University, Contractor must identify the precise activities affected as located on the approved network Project Schedule. Contractor must also describe the efforts that it has made to mitigate the effects of any negative schedule impact.

If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data substantiating that weather conditions were abnormal for the period of time and location and could not have been reasonably anticipated, and that the abnormal weather conditions had an adverse effect on the scheduled construction.

8.08 Injury or Damage to Person or Property

If either party to the Contract suffers injury or damage to person or property because of an act or omission of the other party of any of the other party's employees or agents, or of others for whose acts such party is legally liable, written notice of such injury or damage, whether or not insured, shall be given to the other party within a reasonable time not exceeding 5 days after first observance. The notice shall provide sufficient detail to enable the other party to investigate the matter. If a Claim for additional cost or time related to this Claim is to be asserted, it shall be filed as provided in the Contract Documents.

8.09 Verification of Claims Submitted

With respect to any Claim asserted by Contractor for itself or on behalf of a Subcontractor for additional time or cost, the Contractor shall evaluate the claim and verify that any amounts claimed are valid, compiled in accordance with generally accepted accounting principles and are consistent with the terms of the existing contractual agreements regarding entitlement before presentation of the Claim to the Owner. Any Claim not verified in accordance with this requirement shall be denied without further recourse by the Contractor or Subcontractor.

8.10 Resolution of Claims and Disputes

8.10.1 Review by Design Professional

Design Professional will review all Claims and take one or more of the following preliminary actions within 10 days of receipt of a Claim: (1) request additional supporting data from the claimant, (2) submit a schedule to the parties indicating when the Design Professional expects to take action, (3) reject the Claim in whole or in



part, stating reasons for rejection, (4) recommend approval of the Claim by the other party or (5) suggest a compromise. The Design Professional may also, but is not obligated to, notify the surety, if any, of the nature and amount of the Claim.

If a Claim has been resolved, the Design Professional will prepare or obtain appropriate documentation. If a Claim has not been resolved, the party making the Claim shall, within 10 days after the Design Professional's preliminary response, take one or more of the following actions: (1) submit additional supporting data requested by the Design Professional, (2) modify the initial Claim or (3) notify the Design Professional that the initial Claim stands.

If a Claim has not been resolved after consideration of the foregoing and of further evidence presented by the parties or requested by the Design Professional, the Design Professional will notify the parties in writing that the Design Professional's opinion will be rendered within 5 days. Upon expiration of such time period, the Design Professional will render to the parties the Design Professional's written opinion relative to the Claim, including any change in the Contract Sum or Contract Time or both. If there is a surety and there appears to be a possibility of a Contractor's default, the Design Professional may, but is not obligated to, notify the surety and request the surety's assistance in resolving the controversy. The opinion of the Design Professional shall be subject to the review of the Vice-President for Finance and Business Operations Wayne State University (VPFBO).

8.10.2 Review by Vice-President for Finance and Business Operations

The Vice-President for Finance and Business Operations (VRFBO) shall review the Design Professional's opinion and the supporting information submitted by the parties for the purpose of upholding the Design Professional's opinion, or rejecting the Design Professional's opinion. The VPFBO shall render a decision within forty-five days of the completion of any submissions by the parties. The decision of the VPFBO is final unless it is challenged by either party by filing a lawsuit in the Court of Claims of the State of Michigan within one year of the issuance of the decision.

8.10.3 Jurisdiction

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 the 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.

8.10.4 Condition Precedent

The process and procedures described in Section 8.10 are an express condition precedent to filing or pursuing any legal remedy including litigation. Pursuing litigation prior to exhaustion of the Dispute Resolution process set forth herein shall be premature and a material breach of this Agreement.

8.10.5 Governing Law

This Agreement shall be governed by and construed in accordance with the laws of the State of Michigan.

9.00 NON-DISCRIMINATION

9.01 General

The Contractor shall not discriminate against any job applicant, contractor, or employee because of race, color, religion, national origin, age, sex (including gender identity) height, weight, or familial, disability, or



veteran status, and shall include terms identical or substantially similar to this section in all Subcontracts, Purchase Orders and other agreements pertaining to the Project.

9.02 Solicitation/Advertisements

The Contractor shall in all solicitation 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 race, color, religion, national origin, age, sex (including gender identity), height, weight, or familial, disability or veteran status.

9.03 Rules/Laws

The Contractor shall comply with all applicable federal and state laws, and current published rules, regulations, directives, and orders of the Michigan Civil Rights Commission and other governmental agencies/departments.

9.04 Reports

The Contractor shall furnish and file compliance reports within such time and upon such forms as provided by the Michigan Civil Rights Commission; these forms may also elicit information as to the practices, policies, program, and employment statistics of the Contractor and of each Subcontractor. The Contractor shall permit access to all books, records, and accounts by the Michigan Civil Rights Commission and/or its agents, for purposes of investigation to ascertain compliance with this contract and with rules, regulations, and orders of the Michigan Civil Rights commission.

9.05 Persons with Disabilities

The Contractor shall comply with the provisions of the Michigan Persons with Disabilities Civil Rights Act (M.C.L. 37.1101, et seq.).

9.06 Contract Provisions

The Contractor shall include, or incorporate by reference, the provisions of this Article in every Subcontract, Subcontract and purchase order unless exempted by the rules, regulations or orders of the Michigan Civil Rights Commission, and shall provide in every Subcontract, subcontract or purchase order that said provisions shall be binding upon each Subcontractor, subcontractor or seller.

10.00 ADDITIONAL PROVISIONS

10.01 Prohibited Contracts or Subcontracts due to Unfair Labor Practices

Public Act No. 278 of 1980 prohibits State of Michigan from awarding Contract or Subcontract to employer who has been found in contempt of court by a Federal court of appeals, on not less than three (3) occasions involving different violations during preceding seven (7) years, for failure to correct unfair labor practice as prohibited by Section 8 of Chapter 372 of National Labor Relations Act, 29 U.S.C. 158. Contractor may not in relation to that Contract subcontract with such employer. The University may rescind, or require Contractor to rescind a contract if the employer or Subcontractor, manufacturer, or supplier of employer subsequently appears in register of such employers which will be compiled by Michigan's Department of Licensing and Regulatory Affairs, pursuant to Section 2 of Public Act No. 278 of 1980.

10.02 Buy-American



University endeavors to buy products made in the United States of America whenever an American-made product is available that meets or exceeds the specifications requested and the price is equal to or lower than foreign-made product. Vendors and Contractors are instructed to bid American-made products and/or services whenever available. Vendors and Contractors may bid foreign-made products or services when:

1. those products or services are specified, or

2. as an alternate as long as the products or services are technically acceptable to the University and American-made goods or services that are competitively price and of comparable quality are not available.

A product or service shall be considered "American-made" if more than 50% of the product is manufactured or assembled in the United States or more than 50% of the services are performed in the United States.

10.03 Michigan Products

Contractor and its Subcontractors and suppliers shall utilize Michigan-made products whenever possible where price, quality and performance are equal to or better than non-Michigan products.

10.04 Drug and Alcohol Testing

The University is a "DRUG FREE WORKPLACE", and the University requires Contractors, Subcontractors and sub-subcontractors with access to the work site to ablde by the University's policies on drugs, alcohol and tobacco, which can be found at <u>http://bog.wayne.edu/code/2_20_04.php</u> and http://policies.wayne.edu/administrative/00-03-smoke-free-campus.php. All costs for initial and periodic testing shall be borne by the Contractor.

1. The Contractor and University shall reserve the right to administer drug and alcohol tests to any and/or all site personnel at random periods and without notice.

a. The Contractor shall be responsible for all costs including wages for those individuals testing drug or alcohol-free at the Contractor's direction.

b. Subcontractors shall be responsible for all costs including wages for those individuals not testing drug or alcohol-free at the direction of the Contractor, and the Subcontractor shall immediately remove those individuals from the site.

4. Any individual not testing drug or alcohol-free shall not be allowed to return to the site under any circumstances.

10.05 Other University Policies

The University's policies related to Duty to Report Criminal Acts and Weapons on Campus shall apply to this Project and Contractor shall include this requirement in all Subcontracts, purchase orders and supply agreements.

10.06 University Representative

The University's Representative shall be the Associate Vice President of Facilities Planning and Management, the Senior Director of Design and Construction Services, the Director of Design and Construction Services and the Project Manager. Any project decision on behalf of the University may only be in accordance with the Authorization Matrix that is attached as Exhibit C and incorporated by reference.



11.00 INCLUSION BY REFERENCE

This Contract and Contract Documents hereby include and incorporate by reference the General Conditions of Construction and Supplementary General Conditions, the Request for Proposal by University, the approved plans and specifications, Contractor's Bid or Proposal insofar as it is not inconsistent with the other Contract Documents and other Project documents attached as Exhibits.

Exhibit A – Contractor's Bid or Proposal Exhibit B – Basis of Compensation Exhibit C - Authorization Matrix Exhibit D – Staffing Plan

12.00 TERMINATION

12.01 Termination by the University for Cause



12.01.1

The University may terminate the Contract if the Contractor. (a) becomes insolvent (b) files or has filed against it any Petition in Bankruptcy or makes a general assignment for the benefit of its creditors; (c) fails to pay, when due, for materials, supplies, labor, or other items purchased or used in connection with the Work; (d) refuses or fails to prosecute the Work, or any separable part thereof, with such diligence as will ensure the completion of the Work in accordance with the Master Project Schedule; (e) in the University's opinion, persistently fails, refuses or neglects to supply sufficient labor, material or supervision in the prosecution of the Work; (f) interferes with or disrupts, or threatens to interfere with or disrupt the operations of the University, or any other Contractor, supplier, subcontractor, or other person working on the Project, whether by reason of any labor dispute, picketing, boycotting or by any other reason; or (g) commits any other breach of this Contract.

When any of the above reasons exist, the University may, without prejudice to any other rights or remedies of the University and after giving the Contractor and the Contractor's surety, if any, three days written notice, terminate employment of the Contractor and may, subject to any prior rights of the surety: (1) take possession of the site and of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor; (2) accept assignment of subcontracts; and (3) finish the Work by whatever reasonable method the University may deem expedient.

When the University terminates the Contract for one of the stated reasons, the Contractor shall not be entitled to receive further payment until the Work is finished.

12.01.2

If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Design Professional's services and expenses made necessary thereby, the remaining balance shall be paid to the Contractor. If such costs exceed the unpaid balance, the Contractor shall pay the difference to the University. The amount to be paid to the Contractor or University, as the case may be, shall be certified by the Design Professional, upon application, and this obligation for payment shall survive termination of the Contract.

12.02 Suspension by the University for Convenience

12.02.1



The University may, without cause, order the Contractor in writing to suspend, delay or interrupt the Work in whole or in part for such period of time as the University may determine.

12.02.2

An adjustment shall be made for increases in the cost and/or time of performance of the Contract, including profit on the increased cost of performance, caused by suspension, delay or interruption. No adjustment shall be made to the extent: (1) that performance is, was or would have been so suspended, delayed or interrupted by another cause for which the Contractor is responsible; or (2) that an equitable adjustment is made or denied under another provision of this Contract.

Adjustments made in the cost of performance may have a mutually agreed fixed or percentage fee.

12.03 Termination By The University For Convenience

12.03.1

The University, with or without cause, may terminate all or any portion of the services by the Contractor under this Agreement, upon giving the Contractor 30 days written netice of such termination. In the event of termination, the Contractor shall deliver to the University all reports, estimates, schedules, subcontracts, Contract assignments, purchase order assignments, and other documents and data prepared by it, or for it, pursuant to this Agreement.

12.03.2

Unless the termination is for cause, the Contractor shall be entitled to receive only the payments provided for in Article 4, pro-rated to the date of termination (including payment for the period of the 30-day notice) plus reimbursement for approved and actual costs and expenses incurred by the Contractor to the date of termination. Prior to payment, the Contractor shall furnish the University with a release of all claims against the University.

12.04 Termination By The Contractor

12.04.1

The Contractor may terminate the Contract if the Work is stopped for a period of 60 days through no act or fault of the Contractor or a subcontractor, sub-subcontractor or their agents or employees or any other persons performing portions of the Work under Contract with the Contractor, for any of the following reasons: (1) issuance of an order of a court or other public authority having jurisdiction; (2) an act of government, such as a declaration of national emergency, making material unavailable; (3) because the Design Professional has not approved a Certificate for Payment and has not notified the Contractor of the reason for withholding approval, or because the University has not made payment of undisputed amounts on an approved Certificate for Payment within the time stated in the Contract Documents; (4) if repeated suspensions, delays or interruptions by the University constitute in the aggregate more than 100 percent of the total number of days scheduled for completion, or 120 days in any 365-day period, whichever is less.

If one of the above reasons exists, the Contractor may, upon seven additional days' written notice to the University and Design Professional, terminate the Contract and recover from the University payment for Work executed and for proven loss with respect to materials, equipment, tools, and construction equipment and machinery, including reasonable overhead and profit.

12.04.2



If the Work is stopped for a period of 60 days through no act or fault of the Contractor or a subcontractor or their agents or employees or any other persons performing portions of the Work under Contract with the Contractor because the University has persistently failed to fulfill the University's obligations under the Contract Documents with respect to matters important to the progress of the Work, the Contractor may, upon seven additional days' written notice to the University and the Design Professional, terminate the Contract and recover from the University as provided in Subparagraph 12.03.2

13.00 COMPLETE AGREEMENT

The Contract Documents constitute the entire agreement between the parties and supersede any prior discussions or negotiations. Any modification of these Contract Documents must be in writing and signed by the duly authorized representatives of the parties.

IN WITNESS WHEREOF, each of the parties has caused this Agreement to be executed by its duly authorized representative on the dates shown beside their respective signatures, with the contract to be effective upon the date set forth above.

CONTRAC	TOF	Wayne State University
By: _		By:
Name: _		Name: William R. Decatur
Title: _		Title: VP Finance & Business Operations
Date: _		Date:
Exhibit A -	- Co	ntractor's Bid or Proposal
[GI		RAL CONTRACTOR'S NAME] bid/proposal dated
	7 pa	sis of compensation
	a.	The University shall pay the Contractor a not to exceed amount of \$\$\$\$\$ ("Amount in words 00" /100 dollars) based on unit pricing in the proposal which will be adjusted to reflect actual units used for the performance of all work associated with the Contractor's Base Bid "and Alternates (List)".
	b.	List of Alternates. The University may, at its sole discretion, during the life of the contract, award the following alternates at the amounts indicated: (If this section is not used, delete all text and enter_ Deleted)
		DescriptionAmountAlternate1Alternate2Alternate3
	C.	List of unit prices. 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"



Art Building Elevator Replacement WSU Project No. 040-348980

Work Item

Unit Price

- 1. 2.
- d. Liquidated Damages. 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 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 \$

(_______Hundred 00/100 dollars) per day. Therefore, the Contractor shall pay as liquidated damages to the University the sum of (________Hundred 00/100 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.

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GENERAL CONDITIONS OF CONSTRUCTION

1.00 DEFINITIONS

Bulletin - A bulletin is defined as a compilation of changes to the scope of the work issued by the Design Professional or University which requests the Contractor to submit a quote for the changes.

Change Order - A written agreement entered into after the award of the Contract which alters or amends the executed Contract.

Claim - **A** Claim is a demand or assertion by one of the parties seeking adjustment or interpretation of Contract terms, payment of money, extension of time or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes and matters in question between the parties arising out of or relating to the Contract. Claims must be made by written notice. The responsibility to substantiate Claims shall rest with the party making the Claim.

Close-out Documents - Close-out Documents shall include as-built record drawings and specifications, Operations and Maintenance Manuals, Requests for Information (RFIs), submittals, shop drawings, coordination drawings, warranties, unconditional lien waivers and governing approvals.

Cost of Work - The term Cost of Work, as used herein, is that portion of the Project Cost, that is the estimated or actual labor and material costs of that Work performed (or to be performed) on the Project by the Contractor and all subcontractors, and is inclusive of the cost of construction as described by divisions of the Construction Specifications Institute or other standard format, which constitutes the Direct Cost of Work. However, Cost of Work shall not include the Indirect Cost of Work as herein defined.

Contract - The Contract Documents form the Contract for Construction. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations or agreements, either written or oral. The Contract may be amended or modified only by a duly executed written Change Order.

Contract Documents - The Contract Documents consist of the bonds, insurance certificates, plans, specifications, drawings, bulletins, addenda, Agreement, General Conditions of Construction, Supplementary General Conditions, Change Orders, Contractor's Bid, and to the extent not otherwise inconsistent with any other Contract Document.

The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Project. Contract Documents are complementary, and what is required by one shall be as binding as if required by all. Performance by the Contractor shall be required to be consistent with the Contract Documents and the highest standard of care. In the case of an inconsistency between, or perceived omission or error in the Drawings, Specifications, or other Contract Documents which is not clarified by addendum or Requests for Information (RFI), or should the Contractor be in doubt as to their exact meaning, the Contractor shall notify the Design Professional and the University at once. The University shall not be responsible for the Contractors misinterpretations of Drawings and Specifications and/or other Contract Documents.

Nothing contained in the Contract Documents shall create a contractual relationship between University and any third party; however, the University is an intended third-party beneficiary of all contracts for design and engineering services, all subcontracts, purchase orders and other agreements between Contractor or Design

Professional and third parties. The Contractor and Design Professional shall incorporate the obligations of the Contract Documents into its respective subcontracts, agreements and purchase orders.

Contractor: The term "Contractor" as used in the General Conditions shall include the term "Construction Manager" as used in the Contract for Construction Management Services.

Contractor's Construction Schedule- The construction schedules required by the Contract Documents shall be a logic network prepared in the critical path method or other sequential network in use within the construction industry and shall depict: (1) a sequence of operations mutually agreeable to the University, Design Professional and Contractor; (2) the dates of commencement and completion of each task of the Work (including lead time activities, drawing and sample submissions, bidding, awarding Trade Contracts, manufacturing and shipping); (3) delivery dates for materials and equipment; and (4) at the University's request shall include all Finish Work to be performed by separate Contractors. The construction schedule includes a complete itemized breakdown of the Work.

Contract Sum- The Contract Sum shall be the total dollar value of the Agreement between the University and Contractor.

Delay – A delay shall be recognized as a time of completion impact on the performance of the Work by the Contractor that extends the overall duration of the Project beyond the substantial completion and final completion dates specified in the Agreement. A delay shall not be recognized if the time of completion impact on the performance of the Work occurs on a non-critical path activity, and does not extend the overall duration of the Project.

Day - "Days" means calendar days unless specifically provided to the contrary herein or in the Construction Agreement; provided, however, if any day falls on a weekend or a holiday, same shall refer to the next business day thereafter.

Design Professional - The Design Professional is the person lawfully licensed to practice architecture or engineering or an entity lawfully practicing architecture or engineering identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The term "Design Professional" means the Design Professional or the Design Professional's authorized representative.

Final Completion - "Final Completion" means the completion of all the Work in accordance with the Contract Documents and the acceptance thereof by the University. Completion of the Work includes (1) full performance of all Contract terms; (2) acceptance of the Work by University; (3) resolution of all outstanding Changes of Contract; (4) completion of all "punch-list" items; and (5) delivery of all Close-out Documents.

Incomplete Construction List – The Incomplete Construction List is prepared by the Contractor for review by Design Professional and University identifying Work remaining to be completed at the time of Substantial Completion and the date by which Contractor shall complete the Work on the Incomplete Construction List.

Knowledge - The terms "knowledge," "recognize" or "discover," their respective derivatives and similar terms in the Contract Documents, as used in reference to the Contractor, shall be interpreted to mean that which the Contractor knows or should know, recognizes or should reasonably recognize and discovers or should reasonably discover in exercising the care, skill and diligence required by the Contract Documents.

Master Project Schedule - The Master Project Schedule shall show the sequence, duration in calendar days, interdependence for the complete performance of all Work. The Master Project Schedule shall begin with the date of issuance of the Notice to Proceed and conclude with the date of final completion.

Notice to Proceed - A "Notice to Proceed" means written notice given by the University to the Contractor fixing the date on which the Contract Time will commence to run and/or on which Contractor shall start to

perform Contractor's obligations under the Contract Documents. A Notice to Proceed by the University shall authorize all or a portion of the Work for the Costs so defined.

Persistently fails - The phrase "persistently fails" and other similar expressions, as used in reference to the Contractor, shall be interpreted to mean any combination of acts and omissions, which cause the University to reasonably conclude that the Contractor will not complete the Work within the Contract Time, or for the Contract Sum or in substantial compliance with the requirements of the Contract Documents.

Plans - The drawings prepared by the Design Professional and accepted by the University which include elevations, sections, details, schedules, diagrams, information, notes, or reproductions or any of these, and which show the location, character, dimension, or details of the Work. These include the graphic and pictorial portions of the Contract Documents as listed in the Agreement.

Preliminary Project Cost and Schedule Impact Report – The direction from the University to perform changed Work in the absence of agreement between the University and Contractor, which may result in a Change Order upon agreement of the cost or schedule impact.

Project - The Project is the total construction of which the Work performed under the Contract Documents may be the whole or a part and which may include construction by the University or by separate Contractors.

Punchlist - Punchlist items shall include all Work remaining on the Contractor's Incomplete Construction List and additional items documented by the Design Professional, Contractor and University and issued to the Contractor and may be issued with a Certificate of Substantial Completion. It is understood and accepted that the Punchlist included with the Certificate of Substantial Completion may not represent all remaining Work for which the Contractor is obligated and that Punchlist may be expanded prior to Final Completion.

Reasonably inferable - The phrase "reasonably inferable" and similar terms in the Contract Documents shall be interpreted to mean reasonably inferable by a Contractor familiar with the Project and exercising the care, skill and diligence required by Contract Documents.

Site - The area specified in the Contract Documents and the area made available for the Contractor's operation.

Soft Costs - "Soft Costs" are those costs derived by the University and shall include, but not be limited to, items such as Environmental services, State administration fees, Design Professional fees, moving furniture, fixtures and equipment, and telecommunications, unless otherwise agreed to by the Parties.

Specifications - The term Specifications shall mean the written instructions and requirements prepared by the Design Professional which complement the plans and which describe the manner of executing the Work or the qualities and types of materials to be furnished.

Statement of Probable Cost - The Statement of Probable Cost, as developed by the Contractor, is essential to the budgetary and management processes of the University. The Statement of Probable Cost, once established and accepted by the University, is relied upon by the University for its subsequent budgetary planning and financial needs for the Project.

The Statement of Probable Cost, applicable to either an estimated or actual cost, is the sum of all costs for a completely constructed, functionally ready-for-use project, in accordance with the scope, scheme, concept, and statement, as developed, documented and accepted by the University, and as constructed by the accepted contracting method or methods. The Contractor shall provide Statements of Probable Cost as needed during the Project to aid the University and Design Professional in making scope of work selection decisions, especially during design phase and minimally at the end of each design phase of the Project and shall include all costs included in the Contract Sum. The University shall be responsible for the derivation and provision of all Soft Costs that comprise the Project scope and budget.

Subcontractor - The term "subcontractor" shall mean any business entity under contract to the Contractor for services on or regarding the Project. The term "Subcontractor" as used in the General Conditions shall be synonymous with the term "Trade Contractor" as used in the Contract for Construction Management Services. Nothing contained in this contract shall create any contractual relationship between the University and any subcontractor. However, the University is the intended third-party beneficiary of all contracts for design, engineering or consulting services, all Trade Contracts, subcontracts, purchase orders and other agreements between the Contractor and third parties. The Contractor shall incorporate the obligations of this Agreement into its respective Trade Contracts, subcontracts, supply agreements and purchase orders.

Substantial Completion - "Substantial Completion" shall mean the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so the University can occupy or utilize the Work for its intended use. Substantial Completion shall only be determined as described in the Contract Documents.

Unsafe Persons – Unsafe persons shall be those individuals that present a safety hazard to themselves or others.

University - The University is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The term "University" means the University or the University's authorized representative. Any reference to "Board of Governors" shall be considered to mean "University."

University's Representative - The University's Representative shall include the Associate Vice President for Facilities Planning and Management, the Senior Director of Design and Construction Services, the Director of Design and Construction Services and the Project Manager. Any project decision on behalf of the University may only be in accordance with the Authorization Matrix.

Vice President of Finance and Business Operations - The Vice President of Finance and Business Operations shall be the level of review over the Associate Vice President of Facilities Planning & Management.

Work - The term "Work" means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment, licenses, permits, insurance and services provided or to be provided by the Contractor to fulfill the Contractor's obligations. The Work may constitute the whole or a part of the Project.

2.00 BIDDING

2.01 Duty to Carefully Examine These Instructions

Prospective bidders for this project shall carefully examine the instructions contained herein and be cognizant of and satisfied with the conditions which must be satisfied prior to submitting a proposal and to the conditions which affect the award of the Contract.

2.02 Disclosure of Bidders

The Contractor shall only accept proposals from Subcontractors who are acceptable to the University.

2.03 Clarification During Bidding

The Contractor shall examine the plans and specifications in preparing the bid and shall immediately report to the Design Professional any omissions, discrepancies, or apparent errors found in the plans and specifications. Prior to the date of bid opening, bidders shall submit a written request for clarification in accordance with the instruction contained in the request for bids. If time permits, such clarification shall be issued in the form of addenda to all bidders.

2.04 Bidding Documents

2.04.1 Bid Proposal Package

Each bidder will receive a bid proposal package containing a standard proposal form which shall be used for bidder's proposal. Each proposal shall give the prices proposed in the manner required by the proposal and shall be signed by the bidder or the bidder's duly authorized representative, with its address and telephone number. If the proposal is made by an individual, the individual's name, postal address, and telephone number must be shown. If made by a partnership, the proposal shall have the signature of all partners or an affidavit signed by all partners empowering one partner as an agent to act in their behalf and the address and telephone number of the partnership. A proposal submitted by a corporation shall show the name of the state in which the corporation is chartered, the name of the corporation, its address and telephone number, and the title of the person who signs on behalf of the corporation.

2.04.2 Listing of Proposed Subcontractors Acceptable to the University

The Contractor will require every subcontractor to provide the name and location of the place of business of each Subcontractor and subordinate Subcontractor which will perform work or labor or render services for the Project.

2.04.3 Bidder's Security

All bids shall be presented under sealed cover and have enclosed an amount as directed in the instructions to bidders as bid security. The bid security may be a cashier's check made payable to Wayne State University or as otherwise directed in the instructions to bidders.

2.05 Bid Proposals

2.05.1 Submission of Proposals

Proposals shall be submitted to the office indicated on the bid proposal. It is the responsibility of the bidder to see that its bid is received in the proper time. Delays in timely receipt of the bid caused by the United States or the University mail system, independent carriers, acts of God, or any other cause shall not excuse late

receipt of a bid. Any bid received after the scheduled closing time for receipt of bids shall not be considered and will be rejected by the University, opened, retained by the University or returned to the bidder unopened.

2.05.2 Withdrawal of Proposals

Any bid may be withdrawn at any time prior to the time fixed for receiving bids but only by a written request from the bidder or its authorized representative filed with the University. An oral, faxed, or telephonic request to withdraw a bid proposal is not acceptable. The withdrawal of a bid shall not prejudice the right of a bidder to file a new bid. This paragraph does not authorize the withdrawal of any bid after the time fixed for receiving bids.

2.05.3 Public Opening of Proposals – SECTION DELETED

2.05.4 Rejection of Irregular Proposals

Proposals may be rejected if they show any alterations of forms, additions not called for, conditional bids, incomplete bids, erasures, or irregularities of any kind. If the bid amount is changed after the amount has been once inserted, the change shall be initialed.

2.05.5 Power of Attorney or Agent

When proposals are signed by an agent, a power of attorney shall either be on file with the University prior to the opening of bids or be submitted with the proposal. Failure to submit a power of attorney may result in the rejection of the proposal as irregular and unauthorized. A power of attorney is not necessary in the case of a general partner of a partnership.

2.05.6 Waiver of Irregularities/University's Right to Reject Bids

The University reserves the right to waive any or all irregularities in proposals submitted. The University reserves the right to reject any or all of the bids submitted.

2.05.7 Exclusion from Contract Documents

Nothing in any of the bidding documents, including but not limited to Request for Proposal form, Notice to Contractors, Proposal by Contractor and Design Professional and bids including any attachments or exhibits by Contractor, shall be considered part of the Contract Documents unless specifically incorporated.

2.06 Mistake in Bid

A bidder shall not be relieved of a bid nor shall any change be made in a bid because of mistakes without consent of the University. Failure by the Contractor to honor its proposal following the opening of bids for any reason shall result in the forfeiture of the Bid Security and possible suspension from future work consideration by and with the University.

2.07 Non-Discrimination

Wayne State University is an affirmative action/equal opportunity employer. The University has a strong commitment to the principle of diversity in all areas.

The Contractor and all Subcontractors shall not discriminate against any employee or applicant for employment because of race, color, religion, national origin, age, sex (including gender identity), height, weight or familial, disability or veteran status. The Contractor will ensure that applicants are employed and that employees are treated during employment, without regard to their race, color, religion, national origin, age, sex (including gender identity), height, weight or familial, disability, or veteran status. Such action shall

include, but not be limited to, the following: employment, upgrading, demotion or transfer; recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor shall, in all solicitation 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 race, color, religion, national origin, age, (including gender identity), height, weight or familial, disability or veteran status.

The Contractor shall comply with all requirements of the Elliott-Larsen Civil Rights Act being 1976 PA 453, as amended.

The Contractor shall also comply with the Persons with Disabilities Civil Rights Act being 1976 PA 220, as amended.

The Contractor shall include, or incorporate by reference, the provisions of this Article 2.07 in each and every subcontract or purchase order and shall provide in each and every subcontract or purchase order that said provisions will be binding upon each and every subcontractor and Supplier and Vendor.

Any breach of the requirements and covenants of this Article 2.07 shall constitute a material breach of the Contract Documents.

3.00 AWARD AND EXECUTION OF CONTRACT

3.01 Contract Bonds and Insurance

3.01.1 Payment and Performance

The Contractor shall forward to the University fully executed Payment & Performance Bonds in the amount of 100 percent of the Contract value on the AIA Form 312 or an equivalent form that is acceptable to the University and in compliance with MCL 129.201 et seq. within five (5) days after execution of the Agreement.

In the same five (5) day period the Contractor shall present to the University, in an acceptable form, evidence of the insurance as required by the Contract Documents. Actual Work shall not commence until the bond and insurance is received by the University. Failure to provide the bond and insurance in the time-frame allowed shall not be cause for an extension of Contract Time.

All alterations, extensions of time, extra and additional work, and other changes authorized by any part of the Contract, including determinations made under Article 7.00, Claims and Disputes, shall be made without securing the consent of the surety or sureties on the Contract bonds.

Whenever the University has cause to believe that the surety has become insufficient, the University may demand in writing that the Contractor provide such further bonds or additional surety, not exceeding that originally required, as in the University's opinion is necessary, considering the extent of the work remaining to be done. Thereafter no payment shall be made to the Contractor or any assignee of the Contractor until the further bonds or additional surety have been furnished.

Contract bonds shall remain in full force and effect during the repair and guarantee period required by the Contract Documents.

3.02 Execution of Contract

The Contract shall be signed by the Contractor in three (3) duplicate counterparts and returned to the University within five days of receipt from the University, not including Saturdays, Sundays, or legal holidays. No Contract shall be binding upon the University until it has been executed by the Contractor and a University official in accordance with the Authorization Matrix.

3.03 Failure or Refusal to Execute Contract

Failure or refusal by the Contractor to execute the Contract within the time set in Section 3.02 shall be just cause for the rescission of the award and the forfeiture of bidder's security. Failure or refusal to file acceptable bonds within the time set in Section 3.01 constitutes a failure or refusal to execute the Contract. If the Contractor fails or refuses to execute the Contract, the University may award the Contract to another contractor and the Contractor shall forfeit his Cashier's Check.

4.00 RESPONSIBILITIES OF THE PARTIES

4.01 University

4.01.1 Information and Services Required of the University

The University shall make available existing surveys describing physical characteristics, legal limitations and utility locations for the site of the Project. The University does not warrant or guarantee the accuracy of the information provided.

Unless otherwise agreed to, the University shall be responsible for the abatement of asbestos containing materials and/or site related environmental hazards. The University will provide documentation regarding the presence of asbestos containing materials or other possible environmental hazards to the Contractor. Second opinions on previously documented clean conditions shall be provided at the Contractor's expense. Positive results regarding environmental hazards shall become the University's obligation. If, during the execution of the Work, previously unknown environmental hazards are encountered, the University shall be allowed a reasonable amount of time to abate environmental hazards.

The University shall provide available information regarding requirements for the Project including plans and specifications for the buildings and a survey of the site where required. The Contractor shall review the plans and specifications and survey, if provided, for errors, inconsistencies, ambiguities or omissions as required by Article 4.02.2, Review of Contract Documents and Field Conditions by Contractor. In the event errors, inconsistencies, ambiguities or omissions were not reasonably identifiable in the Contractor's review as specified in Article 4.02.2, Review of Contract Documents and Field Conditions by Contractor, and such errors, inconsistencies, ambiguities or omissions result in changes in time and cost, the University may make reasonable adjustment in the Contract Sum in accordance with Article 6.00, CHANGES IN THE WORK of the General Conditions.

Except for permits and fees, which are the responsibility of the Contractor under the Contract Documents, the University shall secure and pay for necessary approvals, easements, assessments and charges required for construction, use or occupancy of permanent structures or for permanent changes in existing facilities.

Information or services under the University's control shall be furnished by the University with reasonable promptness to avoid delay in orderly progress of the Work.

All reproduction required for construction is the obligation of the Contractor.

4.01.2 University's Right to Stop the Work

If, in the University's determination, the Contractor fails to correct work which is not in accordance with the requirements of the Contract Documents as required, or persistently fails to carry out work in accordance with the Contract Documents, the University Representative, by written order may order the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of the University to stop the Work shall not give rise to a duty on the part of the University to exercise this right for the benefit of the Contractor or any other person or entity.

It is understood that while the Contractor is fully responsible for the safety of the jobsite, and for the methods of its execution, if the University deems that the Contractor is failing to provide safe conditions, the University may stop or restrict the Work under such conditions. However, this right shall not create such duty on the University. Under no circumstance shall the Contractor be granted a time extension or Contract Sum increase for conditions resulting by a stop work order occurring as a consequence of the Contractor's failure to maintain safe working conditions.
4.01.3 University's Right to Carry Out the Work

If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a three (3) day period after receipt of written notice from the University to commence and continue correction of such default or neglect with diligence and promptness, the University may after such three (3) day period, without prejudice to other remedies the University may have, correct such deficiencies. In such case an appropriate Change Order shall be issued deducting from payments then or thereafter due the Contractor the cost of correcting such deficiencies, including compensation for the Design Professional's additional services and expenses made necessary by such default, neglect or failure. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to the University.

4.01.4 University's Right to Audit

4.01.4.1

Contractor's records, which shall include but not be limited to accounting records (hard copy, as well as computer readable data if it can be made available), written policies and procedures; subcontract files (including proposals of successful and unsuccessful bidders, bid recaps, etc.); original estimates; estimating work sheets, correspondence; change order files (including documentation covering negotiated settlements); backcharge logs and supporting documentation; general ledger entries detailing cash and trade discounts earned, insurance rebates and dividends; and any other supporting evidence deemed necessary by the University to substantiate changes related to the Agreement (collectively referred to as "Records") shall be maintained in accordance with Generally Accepted Accounting Principles and open to inspection and subject to audit and/or reproduction by University's agent or its authorized representative to the extent necessary to adequately permit evaluation and verification of Cost of the Work, and any invoices, change order, payments or claims submitted by the Contractor or any of his payees pursuant to the execution of the contract that are or have been charged on a basis other than a lump sum approved in writing by the University.

4.01.4.2

Such audits may require inspection and copying from time to time and at reasonable times and places of any and all information, materials and data of every kind and character, including without limitation, records, books, papers, documents, subscriptions, recordings, agreements, purchase order, leases, contracts, commitments, arrangements, notes, daily diaries, superintendent reports, drawings, receipts, vouchers and memoranda, and any and all other agreements, sources of information and matters that may in University's judgment have any bearing on or pertain to any matters, rights, duties or obligations under or covered by any Contract Documents. Such records subject to audit shall also include, but not be limited to, those records necessary to evaluate and verify direct and indirect costs, (including overhead allocations) as they may apply to costs associated with this Agreement.

4.01.4.3

The University or its designee shall be afforded access to all of the Contractor's Records, and shall be allowed to interview any of the Contractor's employees, pursuant to the provisions of this article throughout the term of this contract and for a period of five (5) years after Final Payment or longer if required by law. To the extent feasible, the Construction Manager's records shall remain confidential, and the University's third party auditors will enter into a confidentiality agreement between and among the University, the third-party auditor and the Contractor prior to any audits being conducted.

4.01.4.4

Contractor shall require all Subcontractors and material suppliers (payees) to comply with the provisions of this article by insertion of the requirements hereof in a written agreement between Contractor and payee so as to allow the University to verify any amounts charged to the Project by a payee on a basis other than a lump sum approved in writing by the University. Such requirements will also apply to Subcontractors and all lower tier Subcontractors. Contractor shall cooperate fully and shall cause all of Contractor's Subcontractors to cooperate fully by furnishing or making available to University from time to time whenever requested in an expeditious manner any and all such information, materials and data.

4.01.4.5

University's agent or its authorized representative shall have access to the Contractor's facilities, shall have access to all necessary records; and shall be provided adequate and appropriate work space, in order to conduct audits in compliance with this article.

4.01.4.6

Contractor agrees that University's designee shall have the right to examine the Contractor's records (during the contract period and up to five (5) years after Final Payment is made on the contract) to verify the accuracy and appropriateness of the pricing data used to price change proposals or claims. Contractor agrees that if the University determines the cost and pricing data submitted (whether approved or not) was inaccurate, incomplete, not current or not in compliance with the terms of the contract regarding pricing of change orders, an appropriate contract price reduction will be made. Such post-approval contract price adjustments will apply to all levels of contractors and/or subcontractors and to all types of change order proposals specifically including lump sum change orders, unit price change orders and cost-plus change orders.

4.01.4.7

If an audit, inspection or examination in accordance with this article, discloses overcharges (of any nature) by the Contractor to the University in excess of five percent (5%) of the total contract billings, the actual cost of the University's audit shall be reimbursed to the University by the Contractor. Any adjustments and/or payments which must be made as a result of any such audit or inspection of the Contractor's invoices and/or records shall be made within a reasonable amount of time (not to exceed 90 days) from presentation of University's findings to Contractor.

4.02 Contractor

The Contractor recognizes the relationship of trust and confidence established between the University and the Contractor by this Contract. The Contractor shall furnish the University with its best skill and judgment and fully cooperate with the University in furthering its best interests. All the Work is to be done in the best manner by persons skilled in the type of Work to be performed.

4.02.1 Contractor's Responsibility for the Work

The Contractor shall be responsible to the University for all Work performed under this Contract. For purposes of assessing responsibility to the Contractor by the University, all persons engaged in the Work shall be considered employees of the Contractor. The Contractor shall give its personal attention to the fulfillment of the Contract and keep all phases of the Work under its control.

4.02.2 Review of Contract Documents and Field Conditions by Contractor

The Contractor shall have a continuing duty to read, carefully study and compare the Contract Documents as defined in Article 1.00, DEFINITIONS, and product data with each other and with information furnished by the University. The Contractor shall perform construction coordination and constructability review of the Contract Documents and shall at once report to the Design Professional and the University, any errors, inconsistencies, ambiguities and omissions before proceeding with the affected Work. The Contractor shall be liable to the University for damage resulting from the Contractor's failure to properly perform such reviews or failure to promptly report any errors, inconsistencies, ambiguities or omissions identified in the Contract Documents to the Design Professional and the University. If the Contractor performs any construction activity that involves such error, inconsistency, ambiguity or omission in the Contract Documents without such notice to the Design Professional and the University. If the Contractor shall assume responsibility for such performance and shall bear all costs attributable for correction. If the Contractor submits authorized substitutes that cost in excess of the Contract Sum or which cause coordination conflicts, the Contractor shall bear all costs attributable to correction.

The Contractor shall perform the Work in accordance with the Contract Documents.

The Contractor shall take field measurements and verify field conditions and shall carefully compare such field measurements and conditions and other information known to the Contractor with the Contract Documents before commencing activities. Errors, inconsistencies or omissions discovered shall be reported to the Design Professional and University at once.

4.02.3 Supervision and Construction Procedures

The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible to the University for and have control over construction means, methods, techniques, sequences and procedures and for coordinating all portions of the Work under the Contract, unless Contract Documents give other specific instructions concerning these matters.

The Contractor shall be responsible to the University for acts and omissions of the Contractor's employees, subcontractors and their agents and employees, and other persons performing portions of the Work under a Contract with the Contractor.

The Contractor agrees to furnish efficient business administration, coordination, supervision and superintendence of the Work and to furnish at all times a competent and adequate administrative and supervisory staff and an adequate supply of workmen and materials to perform the Work in the best and most sound way in the most expeditious and economical manner consistent with the interests of the University. The Contractor agrees from time to time at the University's request to furnish estimates and technical advice as to construction methods and equipment to the University and Design Professional.

The Contractor agrees to cooperate with the Design Professional, University's Representative, commissioning agents, and all persons or entities retained by the University to provide consultation and advice, and to coordinate the Work with the Work of such parties so that the Project shall be completed in the most efficient and expeditious manner. In the event that Contractor's failure to efficiently sequence or coordinate the Work results in additional costs to the University, the Contractor shall promptly reimburse the University for the actual costs incurred. Contractor shall remain responsible for any delays resulting from its failure to efficiently coordinate and schedule the Work; any delays or extensions shall be addressed as provided in Sections 4.08, 4.09 and 4.10 of these General Conditions.

4.02.4 Quality Control

The Contractor shall be fully responsible for the quality of materials and workers' skill in the Project. The Contractor shall not rely upon the inspection and testing provided by the University or Design Professional other than those special inspections and tests performed at the University's direction for which there are written reports. Reports issued by the University's commissioning agent are to be considered complementary in nature and in no way relieve the Contractor of its responsibility to deliver Work in compliance with the Contract Documents.

The Contractor shall inspect the Work of the subcontractors on the Project, while the Work is being performed through final completion and acceptance of the Project by the University to assure that the Work performed and the materials furnished are in strict accordance with the drawings and specifications; the Contractor shall also inspect the Work to verify that Work on the Project is progressing on schedule.

The Contractor shall be responsible for inspection of portions of Work performed under this Contract to determine that such portions are in proper condition to receive subsequent Work. In the event that it becomes necessary to interpret the meaning and intent of the plans and specifications during construction and the meaning is not reasonably inferable, the Contractor shall submit as a Request for Information (RFI) to the Design Professional to make the interpretation in writing and transmit same to appropriate Subcontractors and the University in accordance with the procedures established in section 5.02 of these General Conditions.

The Contractor shall not be relieved of obligations to performing the Work in accordance with the Contract Documents either by activities or duties of the Design Professional in the Design Professional's administration of the Contract, or by tests, inspections or approvals required or performed by persons other than the Contractor.

4.02.5 Labor and Materials

The Contractor shall provide an analysis of the types and quantity of labor required for the Project and review the availability of the appropriate categories of labor required for all Work, and the Contractor shall be responsible to provide the necessary and adequate labor needed to complete the Project by the Contract Time. During the course of the Project, the Contractor shall endeavor to maintain harmonious labor relations on the Project.

Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, materials, equipment, tools, construction equipment and machinery, , transportation, and other facilities and services necessary for proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.

Unless otherwise noted in the Information to Bidders, the Contractor shall provide and pay for water, heat, electric and other utilities.

The Contractor shall enforce strict discipline and good order among the Contractor's employees and Subcontractors and others carrying out the Work of the Contract. The Contractor shall not permit employment of unsafe persons or persons not skilled in tasks assigned to them.

4.02.6 Disputes with Subcontractors

Wherever any provision of any section of the Plans and Specifications conflicts with any agreement or regulation of any kind at any time in force among members of any Trade Associations, Unions or Councils which regulate or distinguish what Work shall or shall not be included in the Work of any particular trade, the Contractor shall make all necessary arrangements to reconcile any such conflict without delay, damage, increase to the Contract Sum or recourse to the University. The University will not arbitrate disputes among subcontractors nor between the Contractor and one or more subcontractors concerning responsibility for performing any part of the Project.

In case the progress of the Work is affected by any undue delay in furnishing or installing any items of material or equipment required under the Contract Documents because of conflict involving any agreement or regulation of the type described above, the University's Representative may require that other material or equipment of equal kind and quality be provided at no additional cost to the University.

4.02.7 Project Manager and Superintendent

The Contractor shall have at the Project site, during the full term of the Contract, an approved, competent project staff, which may include a Project Manager and Superintendent, and any necessary assistants, all satisfactory to the University's Representative and in accordance with the Contract Documents and the Contractor's Staffing Plan. The Project Manager or the Superintendent shall not be changed, except with the written consent of the University's Representative unless the Project Manager or the Superintendent ceases to be in the employ of the Contractor. The Project Manager or the Superintendent shall represent the Contractor and all directions given to either of them by the University or the University's Representative shall be as binding as if given to the Contractor. All directions and communications shall be confirmed in writing.

If a Project Manager or a Superintendent approved by the University's Representative ceases to be in the Contractor's employ, the Contractor shall immediately replace him with a person acceptable to the University's Representative. The University in its sole discretion shall have the right to require the removal of any agent or employee of the Contractor or any subcontractor without cause at any time.

4.02.8 Taxes

The Contractor shall pay sales, consumer, use and similar taxes for the Work or portions thereof provided by the Contractor which are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect and such taxes are included in the Contract Sum.

4.02.9 Permits and Notices

The Contractor shall comply with and give notices required by laws, ordinances, rules, regulations, policies and lawful orders of public authorities and the University bearing on performance of the Work.

4.02.10 Allowances

The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. Items covered by allowances shall be supplied for such stated amounts including identified unit cost, but the Contractor shall not be required to employ persons or entities against which the Contractor makes reasonable objection. Unless otherwise provided in the Contract Documents:

- 1. materials and equipment under an allowance shall be selected promptly by the University to avoid delay in the Work;
- 2. allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;
- 3. the Contractor's costs for unloading and handling at the site, labor, installation costs, overhead, profit and other expenses contemplated for stated allowance amounts shall be included in the allowances;
- 4. if allowance assumptions prove inappropriate, the Contract Sum may be adjusted accordingly by Change Order. The amount of the Change Order shall reflect the difference between actual costs and the allowances.

4.02.11 Use of Site

The Contractor shall confine operations at the site to areas permitted by law, ordinances, permits and the Contract Documents and shall not unreasonably encumber the site with materials or equipment. The site shall be safely maintained and kept clean, orderly and neat.

4.02.12 Safety

The Contractor shall protect adjoining property and nearby buildings, roads, and other facilities and improvements from dust, dirt, debris and other nuisances arising out of Contractor's operations or storing practices. Dust shall be controlled by sprinkling, misting or other effective methods acceptable to University and in accordance with legal requirements. An erosion and sedimentation control program shall be initiated, which includes measures addressing erosion caused by wind and water and sediment in runoff from site. A regular watering program shall be initiated to adequately control the amount of fugitive dust.

The Contractor is knowledgeable of and understands that the University may intend to maintain occupancy of certain portions of the existing facility. The Contractor shall exercise caution at all times for the protection of persons and their property. The Contractor shall take reasonable precautions for safety of, and shall provide reasonable protection to prevent damage, injury or loss to: (1) employees on the Work site together with Subcontractors and other persons who may be affected thereby; (2) the Work and materials and equipment to be incorporated therein, whether in storage on or offsite, under care, custody or control of the Contractor or the Contractor's Subcontractors or sub-subcontractors; and (3) other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction. The Contractor shall install adequate safety guards and protective devices for all equipment and machinery, whether used in the Work or permanently installed as part of the Project.

The Contractor shall also provide and adequately maintain all proper temporary walks, roads, guards, railings, lights, and warning signs. The Contractor shall comply with all applicable laws relating to safety precautions. The Contractor shall establish and maintain and update as required a Project Specific Safety Program.

The Contractor shall designate a responsible member of the Contractor's organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the University and Design Professional.

The Contractor shall require each and every one of its subcontractors and Trade Contractors to comply with all of the provisions of this section.

The Contractor shall not load or permit any part of the construction or site to be loaded so as to endanger its safety.

In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury or loss. Additional compensation or extension of time claimed by the Contractor on account of an emergency shall be determined as provided in the Contract.

4.02.13 Hazardous Condition

The University and/or the Design Professional may bring to the attention of the Contractor a possible hazardous situation in the field regarding the safety of personnel on the site. The Contractor shall be responsible for verifying that all local, state, and federal workplace safety guidelines are being observed. In no case shall this right to notify the Contractor absolve the Contractor of its responsibility for monitoring safety conditions. Such notification shall not imply that anyone other than the Contractor has assumed any responsibility for field safety operations.

Explosives shall not be used without first obtaining written permission from the University and then shall be used only with the utmost care and within the limitations set in the written permission and in accordance with prudence and safety standards required by law. Storage of explosives on the Project site or University is prohibited. Powder activated tools are not explosive for purposes of this Article; however, such tools shall only be used in conformance with State safety regulations.

The Contractor shall report in writing to the University's Representative, within eight (8) hours, all accidents whatsoever arising out of, or in connection with, the performance of the Work, whether occurring on or off the Site, which caused death, personal injury or property damage, giving full details and statements of witnesses. In addition, if death or serious injuries or serious damages are caused, the accident shall be reported immediately by telephone or messenger to the University Representative and the University Police at (313) 577-2222. If any claim is made by anyone against the Contractor or any subcontractor on account of any accident, the Contractor shall report promptly the facts in writing to the University's Representative, giving full details of the claim.

4.02.14 Cutting, Patching and Sequencing

The Contractor shall be responsible for all cutting, fitting or patching required to complete the Work and to ensure the complete and effective coordination of the Work.

The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the University or separate Contractors by cutting, patching or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter such construction by the University or a separate Contractor except with written consent of the University and of such separate Contractor; such consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold from the University or a separate Contractor the Contractor's consent to cutting or otherwise altering the Work.

4.02.15 Access to Site

The Contractor shall at all times permit the University and the Design Professional to visit and observe the Work, and the shops where Work is in preparation, and shall maintain proper facilities and provide safe access for such observation. Work requiring testing, observation or verification shall not be covered up without such test, observation, or approval. Appropriate advance coordination of such testing, observation or verification is expected. University must provide prior written approval for any work to be performed on a Saturday, Sunday, or holiday. In the event that Contractor desires to perform Work on a weekend or holiday, Contractor shall provide a minimum of 48 hours written notice to the University of such desire prior to performing such Work. However, if the Work involves an actual or potential interruption to a utility or service, the Contactor shall provide no less than seven (7) days' written notice to the University.

The Contractor acknowledges that during the performance of the Work, the affected building and surrounding campus buildings will remain occupied and will require access by the public. The Contractor further acknowledges that other Contractors will be working on or near the Project site to accomplish the University's purposes and projects. To the greatest extent possible, the Contractor shall cooperate fully with the University and its guests, students, employees, invitees, and other Contractors in performing the Work required under the Contract. The Contract Sum includes any and all reasonably necessary costs expended to minimize interference with the University's activities as well as to coordinate schedules with other contractors' projects as required by the University.

4.02.16 Burden for Damage

From the issuance of the official Notice to Proceed until the formal acceptance of the Project by the University, the Contractor shall have the charge and care of and shall bear all risk of damage to the Project

and materials and equipment for the Project other than damage directly caused by the University or the University's other contractors.

4.02.17 Payments by Contractor

The Contractor agrees to promptly pay all subcontractors upon receipt of each progress payment, unless otherwise agreed in writing by the parties, the respective amounts allowed Contractor on account of the Work performed by its subcontractors to the extent of each such subcontractor's interest therein.

In the event the University becomes informed that the Contractor has not paid a subcontractor as herein provided, the University shall have the right, but not the duty, to issue future checks in payment to the Contractor of amounts otherwise due hereunder naming the Contractor and such subcontractor as joint payees. Such joint check procedure, if employed by the University, shall create no rights in favor of any person or entity beyond the right of the named payees to payment of the check and shall not be deemed to commit or obligate the University to repeat the procedure in the future. This provision shall not supersede the procedures set forth in Article 8.00 of these General Conditions.

4.02.18 Responsibility to Secure and Pay for Permits, Licenses, Utility Connections, Etc.

The Contractor shall secure all permits and licenses required for any operations required under this Contract and shall pay all costs relating thereto as well as all other fees and charges that are required by the United States, the State, the county, the city, a public utility, telephone company, special district, or quasigovernmental entity. It is the responsibility of the Contractor to ascertain the necessity of such permits and licenses in preparing its bid, Contract Sum and include in its bid, Contract Sum the cost thereof, as well as any time requirements for securing such permits and licenses.

4.02.19 Patented or Copyrighted Materials

The Contractor shall pay all royalties and license fees for the use of patented or copyrighted processes or materials. The Contractor shall defend suits or claims for infringement of patent rights and shall hold the University and Design Professional harmless from loss on account thereof, but shall not be responsible for such defense or loss when a particular design, process or product of a particular manufacturer or manufacturers is required by the Contract Documents. However, if the Contractor has reason to believe that the required design, process or product is an infringement of a patent, the Contractor shall be responsible for such loss unless such information is promptly furnished to the Design Professional and University in writing.

4.02.20 Property Rights in Materials and Equipment

Nothing in the Contract shall be construed as vesting in the Contractor any property right in the materials or equipment after the materials or equipment have been attached to or permanently placed in or upon the Work or the soil or after payment has been made for fifty percent or more of the value of the materials or equipment delivered to the site of the Work whether or not they have been so attached or placed. All such materials or equipment shall become the property of University upon being so attached or placed, or upon payment of fifty percent or more of the value of the materials or equipment delivered or the site but not yet installed and the Contractor warrants that all such property shall pass to the University free and clear of all liens, claims, security interests, or encumbrances.

4.02.21 Utilities

The Contractor shall refer to and abide by the policies included in the Supplementary General Conditions and shall provide the notices as required by University's Utility Disturbance and Interruption Request form.

The Contractor shall provide as-built drawings of all utilities encountered and constructed for the University, indicating the size, horizontal location, and vertical location based on the Project bench mark or a stable datum.

Unless otherwise specifically stated, the Contractor shall provide or otherwise make all arrangements for utilities required to deliver the Work.

4.02.22 Asbestos and Hazardous Materials

The Contractor is prohibited from installing any asbestos containing materials or products, and other prohibited and hazardous materials in the Work. The Contractor shall be responsible for removal and replacement costs should it be determined this provision has been violated, regardless of whether the job has been completed.

4.02.23 Photographic Site Survey

Contractor shall perform a photographic survey of construction site and adjoining structures prior to commencing Work. The survey shall be provided to the University and shall include photographs of pathways, flat concrete paving, foundations, walls, landscaping.

4.02.24 Compliance with University Policies on Drugs, Alcohol and Tobacco.

The University requires Contractors, Subcontractors and sub-subcontractors with access to the work site to abide by the University's policies on drugs, alcohol and tobacco, which can be found at: http://bog.wayne.edu/2_20_04.php and http://bog.wayne.edu/2_20.php and <a href="http://bog.wayne.edu/2_

- 1. The Contractor and University shall reserve the right to test any and/or all site personnel at random periods and without notice.
 - a. The Contractor shall be responsible for all costs including wages for those individuals testing drug or alcohol-free at the Contractor's direction.
 - b. Subcontractors shall be responsible for all costs including wages for those individuals not testing drug or alcohol-free at the direction of the Contractor, and the Subcontractor shall immediately remove those individuals from the site.
- 2. Any individual not testing drug or alcohol-free shall not be allowed to return to the site under any circumstances.

4.03 Design Professional

4.03.1 Design Professional's Administration of Contract

The Design Professional will provide one or more Project Representatives to assist in the administration of the Contract as described in the Contract Documents, and to assist the University's Representative (1) during the construction, (2) until final payment is due and (3) with the University's concurrence, from time to time during the correction and warranty period. The Design Professional will advise and consult with the University on issues relating to contract performance and interpretation. The Design Professional will have no authority to act on behalf of the University except as provided in the Contract Documents, unless otherwise modified by written instrument in accordance with other provisions of the Contract.

The Design Professional will visit the site at intervals defined in the Design Professional's Proposal to become familiar with the progress and quality of the completed Work and to determine if the Work is being performed in a manner indicating that the Work, when completed, will be in accordance with the Contract Documents. On the basis of on-site observations, the Design Professional will keep the University and Contractor informed of progress of the Work by written field reports, and will endeavor to guard the University against defects and deficiencies in the Work.

The Design Professional will not have control over or charge of and will not be responsible for construction means, methods, techniques, sequences or procedures, or for safety precautions and programs in connection with the Work, since these are solely the Contractor's responsibility. The Design Professional will not be responsible for the Contractor's failure to carry out the Work in accordance with the Contract Documents. The Design Professional will not have control over or charge of and will not be responsible for acts or omissions of the Contractor, subcontractors, or their agents or employees, or of any other persons performing portions of the Work.

4.03.2 Communications Facilitating Contract Administration

The Design Professional and Contractor shall communicate directly concerning the Project and shall keep the University advised of their communications. Communications by and with the Design Professional's consultants shall be through the Design Professional. Communications by and with subcontractors and material suppliers shall be through the Contractor. Communications by and with separate Contractors shall be through the University.

4.03.3 Evaluation of Applications for Payment

Based on the Design Professional's observations and evaluations of the Contractor's Applications for Payment, the Design Professional must approve and sign any Contractor Applications for Payment as an express condition precedent to release of any progress or final payment. In the absence of Design Professional, the University will review and authorize applications for payment.

The Design Professional will have authority to reject Work which does not conform to the Contract Documents. Whenever the Design Professional considers it necessary or advisable for implementation of the intent of the Contract Documents, the Design Professional will have authority to require additional observation or testing of the Work in accordance with section 5.06, whether or not such Work is fabricated, installed or completed. However, neither this authority of the Design Professional nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Design Professional to the Contractor, subcontractors, material and equipment suppliers, their agents or employees, or other persons performing portions of the Work.

4.03.4 Review of Shop Drawings, Product Data and Samples

The Design Professional shall review and approve or take other appropriate action upon the Contractor's submittal of Shop Drawings, Product Data and Samples. The Design Professional's action will be taken within 10 days from receipt so as not to cause delay in the Work or in the activities of the University, Contractor or separate Contractors, while allowing sufficient time in the Design Professional's professional judgment to permit adequate review. Review of such submittal is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contractor of the obligations under Article 5.04. The Design Professional's review shall not constitute approval of safety precautions or, unless otherwise specifically stated by the Design Professional, of any construction means, methods, techniques, sequences or procedures. The Design Professional's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

4.03.5 Site Observations to Determine Substantial and Final Completion

The Design Professional will conduct observations to determine the date or dates of Substantial Completion and the date of Final Completion, will receive and forward to the University for the University's review and retention all written warranties and related documents required by the Contract and assembled by the Contractor, and will issue an approval of final payment upon compliance with the requirements of the Contract Documents.

4.04 Delegation of Performance and Assignment of Money Earned

The performance of all or any part of this Contract may not be delegated by the Contractor or Design Professional without the written consent of the University. Consent will not be given to any proposed delegation which would relieve the Design Professional, the Contractor or its surety of their responsibilities under the Contract.

The Contractor may assign moneys due or to become due under the Contract, only upon written consent of the University. Assignments of moneys earned by the Contractor shall be subject to proper retention in favor of the University and to all deductions provided for in the Contract and such moneys shall be subject to being used by the University for the completion of the Work in the event the Contractor is in default. Any assignment attempted without the written consent of the University shall be void.

4.05 Contractor's Insurance

The Contractor shall not commence Work under this Contract until it has obtained all the insurance required by the Contract Documents and such insurance has been approved by the University; likewise, no subcontractor or subconsultant shall be allowed to commence Work until the insurance required has been obtained. The Contractor shall, at its expense, purchase and maintain in full force and effect such insurance as will protect itself and the University from claims, such as for bodily injury, death, and property damage, which may arise out of or result from the Work required by the Contract Documents, whether such Work is done by the Contractor, by any subcontractor, by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable. The types of such insurance and any additional insurance requirements are specified herein with the amounts and limits set forth in the Supplementary General Conditions.

4.05.1 Policies and Coverage

The following policies and coverages shall be furnished by the Contractor:

- (1) Comprehensive or Commercial Form General Liability Insurance on an "Occurrence" form covering all Work done by or on behalf of the Contractor and providing insurance for bodily injury, personal injury, property damage, and Contractual liability. Except with respect to bodily injury and property damage included within the products and completed operations hazards, the aggregate limit shall apply separately to work required of the Contractor by these Contract Documents. This insurance shall include the contractual obligations assumed under the Contract Documents and specifically section 4.06.
- (2) Business Automobile Liability Insurance on an "Occurrence" form covering owned, hired, leased, and non-owned automobiles used by or on behalf of the Contractor and providing insurance for bodily injury, property damage, and Contractual liability.
- (3) 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. The Contractor acknowledges and shall abide by the University's prohibition on the use of 1099 independent contractors and owner/operator business entities wherein such individuals are not able

to secure and maintain such insurance. The Contractor shall ensure that all classifications of laborers and construction mechanics performing Work on the Project job site are traditional employees of the Contractor or any Trade Contractor for any tier thereof, and that each is covered by such insurance.

- (4) The Umbrella Excess Liability insurance must be consistent with and follow the form of the primary policies, except that Umbrella Excess Liability insurance shall not be required for the Medical Expense Limit.
- (5) Builder's Risk Insurance: The Contractor, at his sole expense, shall purchase and maintain property insurance upon the entire Project for the full replacement cost at the time of any loss. This insurance shall include "All Risk" coverage against physical loss or damage including the perils of Fire and Extended Coverage, Theft, Vandalism, and Malicious Mischief, Transit and Collapse. The Contractor will be responsible for any co-insurance penalties and/or deductibles.
- (6) Professional Liability (Errors and Omissions) including tail-coverage for claims made after final completion.

4.05.2 Proof of Coverage

Certificates of Insurance or Declarations pages as may be requested by the University, as evidence of the insurance required by these Contract Documents, shall be submitted by the Contractor to the University. The Certificates of Insurance and Declarations shall state the scope of coverage and deductible, and list the University as an additional insured as required by Section 4.05.04 below. Any deductible shall be the Contractor's liability. The Declarations shall provide for no cancellation or modification of coverage without thirty (30) days prior written notice to the University. Acceptance of Certificates of Insurance or Declarations pages by the University shall not in any way limit the Contractor's liabilities under the Contract Documents. The Contractor shall maintain required insurance for the entire duration of the Contract. In the event the Contractor does not comply with these insurance requirements, the University may, at its option, provide insurance coverage to protect the University; the cost of such insurance shall be deducted from the Contract Sum or otherwise paid by the Contractor. Renewal certifications shall be filed in a timely manner for all coverage until the Project is accepted as complete as requested by the University. Upon the University's request, the Contractor shall provide copies of the policies obtained from the insurers.

4.05.3 Subcontractor's Insurance

The Contractor shall either require Subcontractors to carry insurance as set forth in the CCIP Insurance Manual and the Subcontract, or the Contractor shall insure the activities of the Subcontractors in the amount, types and form of insurance required under by the Contract Documents. If the Contractor elects to have its Subcontractors purchase individual insurance policies, the Contractor shall cause its trade contracts and subcontracts to include a clause requiring that copies of any insurance policies which provide coverage to the Work shall be furnished to the University upon request. The Contractor shall supply the University with a list of all Subcontractors, including those enrolled in the CCIP coverage, and copies of the enrolled Subcontractors' certificates of insurance evidencing coverage, showing whether or not they have individual insurance policies are insured by the Contractor.

4.05.4 Scope of Insurance Coverage

The Contractor's insurance as required by the Contract Documents (including subcontractors' insurance), by endorsement to the policies and the Certificates of Insurance, shall include the following and may be presented in the form of a rider attached to the Certificates of Insurance:

- (1) The Board of Governors of Wayne State University, the University, their officers, employees, representatives and agents including the Design Professional, shall be included as additional insured under the general liability, builder's risk and automobile liability policies for and relating to the Work to be performed by the Contractor and subcontractors. This shall apply to all claims, costs, injuries, or damages.
- (2) A Severability of Interest Clause stating that, "The term 'insured' is hereby used severally and not collectively, but the inclusion herein of more than one insured shall not operate to increase the limits of the insurer's or insurers' liability."
- (3) A Cross Liability Clause stating that, "In the event of claims being made under any of the coverages of the policy or policies referred to herein by one or more insured hereunder for which another or other insured hereunder may be liable, then the policy or policies shall cover such insured or insured against whom a claim is made or may be made in the same manner as if separate policies had been issued to each insured hereunder. Nothing contained herein, however, shall operate to increase the insurer's limits of liability as set forth in the insuring agreements."
- (4) The Board of Governors of Wayne State University, the University, their officers, employees, representatives and agents, shall not by reason of their inclusion as insured incur liability to the insurance carriers for payment of premiums for such insurance. However, the Board of Governors of Wayne State University may, in their sole discretion after receiving a notice of cancellation for nonpayment, elect to pay the premium due and deduct such payment from any sums due to the Contractor or recover the amount paid from the Contractor if the sums remaining are insufficient.
- (5) Coverage provided is primary and is not in excess of or contributing with any insurance or selfinsurance maintained by the Board of Governors of Wayne State University, the University, their officers, employees, representatives and agents.

4.05.5 Miscellaneous Insurance Provisions

The form and substance of all insurance policies required to be obtained by the Contractor shall be subject to approval by the University. All such policies shall be issued by companies lawfully authorized to do business in Michigan and be acceptable to the University. All property insurance policies to be obtained by the Contractor shall name the University as loss payee as its interest, from time to time, may appear.

The Contractor shall, by mutual agreement with the University and at the University's cost, furnish any additional insurance as may be required by the University. The Contractor shall provide Certificates of Insurance evidencing such additional insurance.

Should the Project involve asbestos abatement, the Contractor or subcontractor, as appropriate, shall provide asbestos liability insurance.

The Contractor acknowledges that the University is self-insured and participates in the Michigan Universities Self-Insurance Corporation program and the Contractor agrees that the University is not required to provide or purchase any additional insurance with respect to this Project or the Work required by the Contractor for the Project.

4.05.6 Loss Adjustment

Any insured loss is to be adjusted with the Contractor and made payable jointly to the University and the Contractor. The Contractor shall cooperate with the University in a determination of the actual cash value or replacement value of any insured loss. Any deductible amount shall be the responsibility of the Contractor.

4.05.7 Compensation Distribution

The University upon the occurrence of an insured loss shall account for any money so received and shall distribute it in accordance with such agreement as the interested parties may reach. Claim payments received shall be distributed proportionately according to the actual percentages of losses to both. If after such loss no other special agreement is made, replacement of damaged work shall be covered by an appropriate contract change order. Any dispute shall be resolved by the University.

4.05.8 Waivers of Subrogation

The University and Contractor waive all rights against (1) each other and any of their subcontractors, subcontractors, agents and employees, each of the other, and (2) the Design Professional, Design Professional's consultants, separate Contractors if any, and any of their subcontractors, sub-subcontractors, agents and employees, for damages caused by fire or other perils to the extent covered by property insurance obtained pursuant to this paragraph or other property insurance applicable to the Work, except such rights as they have to proceeds of such insurance held by the University as fiduciary. The University or Contractor, as appropriate, shall require of the Design Professional, Design Professional's consultants, separate Contractors, if any, and the subcontractors, sub-subcontractors, agents and employees of any of them, by appropriate agreements, written where legally required for validity, similar waivers each in favor of other parties enumerated herein. The policies shall provide such waivers of subrogation by endorsement or otherwise. A waiver of subrogation shall be effective as to a person or entity even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, did not pay the insurance premium directly or indirectly, and whether or not the person or entity had an insurable interest in the property damaged.

4.06 Indemnification

4.06.1

To the fullest extent permitted by law, the Contractor shall hold harmless, defend, and indemnify the Board of Governors of Wayne State University, the University, and officers, employees, representatives and agents of each of them, from and against any and all claims or losses arising out of or are alleged to be resulting from, or relating to (1) the failure of the Contractor to perform its obligations under the Contract or the performance of its obligation in a willful or negligent manner; (2) the inaccuracy of any representation or warranty by the Contractor given in accordance with or contained in the Contract Documents; and (3) any claim of damage or loss by any subcontractor, or supplier, or laborer against the University arising out of any alleged act or omission of the Contractor or any other subcontractor, or anyone directly or indirectly employed by the Contractor or any subcontractor.

4.06.2

To the fullest extent permitted by law, the Contractor shall be liable for and hereby agrees to defend, discharge, fully indemnify and hold the University harmless from and against any and all claims, demands, damages, liability, actions, causes of action, losses, judgments, costs and expenses of every nature (including investigation costs and/or expenses, settlement costs, and attorney fees and expenses incident thereto) sustained by or asserted against the University arising out of, resulting from, or attributable to the performance or nonperformance of any Work and/or obligation covered by the Contract or to be undertaken in connection with the construction of the Project contemplated by the Contract (collectively, "Claim"), including, but not limited to, any Claim for: (a) any personal or bodily injury, illness or disease, including death at any time resulting therefrom of any person, (including, but not limited to, employees of the University, the Contractor, any subcontractor, and any materialman and the general public); (b) any loss, damage or destruction of any property; (c) any loss or damage to the University's operations, arising out of, resulting from, or attributable in whole or in part to (i) any negligence or other act or omission of the Contractor, and any subcontractor, any other person or any of the directors, officers, employees or agents of any of them or (ii) any defects in material or equipment furnished hereunder; (d) any payments

allegedly owed to subcontractors, sub-subcontractors or materialmen; (e) any acts or omissions relative to conditions of safety and protection of persons on the Project site; and/or (f) any act or omission relative to the Contractor's breach of obligations and regarding non-discrimination as set forth in these General Conditions. The Contractor shall not be liable hereunder to indemnify the University against liability for damages arising out of bodily injury to persons or damage to property caused by or resulting from the sole negligence or willful misconduct of the University, its agents or employees. The Contractor, at its own cost and expense, shall take out and maintain at all times during the effective period of the Contract, contractual liability insurance insuring the performance by the Contractor of its contractual duties and obligations under this Article, which insurance shall name the University as additional insured and shall be in form and amount and from an insurance company satisfactory to the University. The Contractor's duty to fully indemnify the University shall not be limited in any way by the existence of this insurance coverage.

4.06.3

The Contractor shall also be liable for and hereby agrees to pay, reimburse, fully indemnify and hold the University harmless from and against all costs and expenses of every nature (including attorney fees and expenses incident thereto) incurred by the University in collecting the amounts due from the Contractor, or otherwise enforcing its rights, under the indemnifications described in this Article.

4.06.4

In claims against any person or entity indemnified under this Article made by an employee of the Contractor or a subcontractor, or indirectly employed by either of them, or anyone for whose acts either made by liable, the indemnification obligation under this Article shall not be limited by any limitation on amount or type of damages, compensation, or benefits payable by or for the Contractor or a subcontractor under workers compensation laws, disability benefit laws, or other laws providing employee benefits.

4.06.5

The indemnification obligations under this Article shall not be limited by any assertion or finding that the person or entity indemnified is liable by reason of a non-delegable duty.

4.06.6

The Contractor shall hold harmless, defend, and indemnify the University from and against losses resulting from any claim of damage made by any separate Contractor of the University against the University arising out of any alleged acts or omissions of the Contractor, a subcontractor, anyone directly or indirectly employed by either the Contractor or subcontractor, or anyone for whose acts either the Contractor or subcontractor may be liable.

4.06.7

The Contractor shall hold harmless, defend and indemnify the Design Professional and the separate Contractors of the University from and against losses to the extent they arise from the negligent acts or omissions or willful misconduct of the Contractor, a subcontractor, anyone directly or indirectly employed by the Contractor or subcontractor, or anyone for whose acts the Contractor or subcontractor may be liable.

4.07 Occupancy by University Prior to Acceptance

The University may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor, provided such occupancy or use is consented to by public authorities having jurisdiction over the Work. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the University and Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage if any, security,

maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the Contract Documents. When the Contractor considers a portion substantially complete, the Contractor shall prepare and submit a description of the area substantially complete to the Design Professional. Consent of the Contractor to partial occupancy or use shall not be unreasonably withheld. The stage of the progress of the Work shall be determined by written agreement between the University and Contractor or, if no agreement is reached, by decision of the Design Professional.

Immediately prior to such partial occupancy or use, the University together with the Contractor and Design Professional shall jointly observe and/or inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work.

Unless otherwise agreed upon, partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents. Likewise, partial occupancy or use of a portion or portions of the Work shall not alter, change or modify the requirements for Substantial or Final Completion within Contract Time.

4.08 Contract Time

4.08.1 Time of the Essence

All time limits specified in this Contract are of the essence of the Contract.

4.08.2 Starting and Completion Date

The University shall designate in the Notice to Proceed the starting date of the Contract on which the Contractor shall immediately begin and thereafter diligently prosecute the Work to completion. The Contractor agrees to complete the Work on the date specified for completion of the Contractor's performance in the Contract unless such time is adjusted, in writing, by change order issued by the University. The Contractor may complete the Work before the completion date if it will not interfere with the University or their other Contractors engaged in related or adjacent Work. The date of Substantial Completion shall be used as the commencement date of the guarantee.

4.08.3 Delay

Within ten (10) days from the commencement of a delay, Contractor shall submit to the University's Representative a written notice of the delay. Such notice of delay shall describe the nature and cause of the delay, provide a preliminary estimate of the impact of said delay on the construction schedule and provide a recovery plan to mitigate the delay. The Contractor's failure to give such notice to the University shall constitute a waiver by the Contractor of its ability to request an extension of time. In the case of a continuing cause of delay, only one claim shall be necessary. The giving of such notice shall not of itself establish the validity of the cause of delay or of the extension of the time for completion. Submission of reports and/or updates required at regularly scheduled meetings or as a part of a regularly submitted report shall not constitute such required notice.

The Contractor expressly agrees that delays to construction activities which do not affect the overall time of completion of the Work shall not entitle the Contractor to an extension of the Contract Time or provide a basis for additional cost or damages. No delay, obstruction, interference, hindrance, or disruption, from whatever source or cause in the progress of the Contractor's Work shall be a basis for an extension of time unless the delay, obstruction, interference, hindrance, or disruption of the responsibility of the Contractor and directly affects the overall completion of the Work as reflected in the Contractor's updated and accepted Project schedule.

Within fifteen (15) days from the submittal to the University of the notice of delay detailed in the previous paragraphs, Contractor shall submit to the University's Representative a request for an extension of time which shall include all documentation supporting the request. Such submittal shall include a detailed description of all changes in activity duration, logic, sequence, or otherwise in the Project schedule. The filing of such a request for an extension of time shall not of itself establish the validity of the cause of delay or of the extension of time for completion. Submission of construction reports and/or updates required by these General and Supplementary Conditions shall not constitute such a request.

4.08.4 Adjustment of Contract Time and Cost

If the Contractor is delayed, obstructed or hindered at any time in the progress of the Work by any act or neglect of the University or by any contractor employed by the University, or by changes ordered in the scope of the Work, or by fire, adverse weather conditions not reasonably anticipated, or any other causes beyond the control of the Contractor with the exception of labor disputes or strikes of the Contractor's or a Subcontractor's own personnel, then the duration set forth in the Master Project Schedule, and established for Substantial and Final Completion may be extended as agreed to by the University, Contractor and Design Professional. When such delays result in an agreement to adjust the Time of Completion, then the Contract Sum for Project costs directly attributable to the delay pursuant to Article 6.00, CHANGES IN THE WORK. It will be the Contractor's obligation to demonstrate to the complete satisfaction of the University, that the direct Project costs associated with such delays are justified, fair, and reasonable.

The University will not recognize labor disputes, strikes, work stoppages, picketing or boycotting by employees of or under the control or direction of the Contractor or its subcontractors, to be cause for extending the Construction Project Schedule or the Contract Time or adjusting the Contract Sum. The University may recognize labor disputes, strikes, work stoppages, picketing or boycotting that are not within the Contractor's or its subcontractors' control as cause for extending the Construction Project Schedule or Contract Time. Pursuant to section 9.01.1 such labor disputes, strikes, work stoppages, picketing or boycotts may constitute grounds for termination of the Contractor.

4.08.5 Contractor to Fully Prosecute Work

No extension of time will be granted unless the Contractor demonstrates to the satisfaction of the University that the Contractor has made every reasonable effort to complete all Work under the Contract not later than the date prescribed.

4.08.6 University's Adjustment of Contract Time

Even though the Contractor has no right to an extension of time for completion, the University may in the exercise of its sole discretion extend the time at the request of the Contractor if it determines it to be in the best interest of the University.

4.08.7 Adjustment of Contract Time and Cost Due to Reasons Beyond University Control

Should the University be prevented or enjoined from proceeding with Work either before or after the start of construction by reason of any litigation or other reason beyond its control, the Contractor may request an adjustment in the Time of Completion and/or Contract Sum by reason of said delay. The University may make a reasonable adjustment in the Time of Completion and/or Contract Sum for time and costs directly attributable to the delay. It will be the Contractors obligation to demonstrate to the complete satisfaction of the University, that all Time of Completion and Contract Sum adjustments associated with such delays are justified, fair, and reasonable.

4.09 Progress Schedule

4.09.1

The Contractor shall prepare and submit to the University the Contractor's Construction Schedule utilizing the Critical Path Method within ten (10) days after starting date on the Notice to Proceed. It shall be the Contractor's responsibility to use its best efforts and to act with due diligence to maintain the progress of the Work in accordance with the schedule. The time for completion may be extended only by a written Change Order executed by the University and the Contractor. The work activities making up the schedule shall be of sufficient detail to assure that adequate planning has been done for proper execution of the Work and such that, in the sole judgment of the University, it provides an appropriate basis for monitoring and evaluating the progress of the Work. The Construction Schedule shall include the time periods required for utility and service interruptions, including compliance with the notice periods stated in the Utility Disturbance and Disruption Request. The Contractor shall also submit a separate progress schedule listing all submittals required under the Contract and the date by which each submittal will be submitted allowing 10 days for the Design Professional's review ("submittal schedule").

4.09.4

Float, slack time, or contingency within the schedule at the activity level and total float within the overall schedule, is not for the exclusive use of either the University or the Contractor, but is jointly owned by both and is a resource available to and shared by both parties as needed to meet Contract milestones and the Contract completion date.

4.09.5

The Contractor shall not sequester shared float through such strategies as extending activity duration estimates to consume available float, using preferential logic, or using extensive crew/resource sequencing, etc. Since float time within the construction schedule is jointly owned, it is acknowledged that University caused delays on the Project may be offset by University caused time savings (i.e., critical path submittals returned in less time than allowed by the Contract, approval of substitution requests which result in a savings of time to the Contractor, etc.). In such an event, the Contractor shall not be entitled to receive a time extension until all University caused time savings are exceeded and the Contract completion date is also exceeded.

4.09.6

Regardless of which schedule method the Contractor elects to use in formulating the Contractor's Construction Schedule, an updated construction schedule shall be submitted to the University five (5) days prior to the submittal of the Contractor's monthly payment request. The submission of the updated construction schedule satisfying the requirements of this Article, accurately reflects the status of the Work, and incorporates all changes into the schedule, including actual dates, shall be a condition precedent to the processing of monthly payment applications. Updated schedules shall also be submitted at such other times as the University may direct. Upon approval of a change order or issuance of a direction to proceed with a change, the approved change shall be reflected in the next schedule update submitted by the Contractor.

4.09.7

If completion of any part of the Work, the delivery of equipment or materials, or issuance of the Contractor submittals is behind the updated Construction Schedule and will cause the end date of the Work to be later than the Contract completion date, the Contractor shall submit in writing a plan acceptable to the University for completing the Work on or before the current Contract completion date.

4.09.8

No time extensions shall be granted unless the delay can be clearly demonstrated by the Contractor on the basis of the updated Construction Schedule current as of the month the change is issued or the delay occurred, and the delay cannot be mitigated, offset, or eliminated through such actions as revising the intended sequence of Work or other means.

4.09.9

As a condition precedent to the release of retained funds, the Contractor shall, after completion of the Work has been achieved, submit a final Construction Schedule which accurately reflects the manner in which the Project was constructed and includes actual start and completion dates for all Work activities on the Project schedule together with a full and unconditional waiver and release of claims for payment in a form acceptable to the University.

4.10 Coordination With Other Work

The University reserves the right to do other Work in connection with the Project or adjacent thereto and the Contractor shall at all times conduct the Work so as to impose no hardship on the University or others engaged in the University's Work nor to cause any unreasonable delay or hindrance thereto.

Where two or more Contractors are employed on related or adjacent work, each shall conduct their operation in such a manner as not to cause delay or additional expense to the other.

The Contractor shall be responsible to others engaged in the related or adjacent work for all damage to Work, to persons and to property, and for loss caused by failure to complete the Work within the specified time for completion. The Contractor shall coordinate its Work with the Work of others so that no discrepancies shall result in the Project.

4.11 As-built Drawings Reflecting Actual Construction

During the course of construction, the Contractor shall maintain drawings kept up each day to show the Project as it is actually constructed. Every sheet of the plans and specifications which differs from the actual construction shall be marked and sheets so changed shall be noted on the title sheets of the plans and specifications. All change orders shall be shown by reference to sketch drawings, and any supplementary drawings or change order drawings shall be included. The Contractor shall review the "As-built" drawings with the University at least once a month to demonstrate that all changes that have occurred are being fully and accurately recorded. The altered Contract drawings shall be sufficiently detailed so that future Work on the Project or in adjacent areas may be conducted with a minimum of difficulty. Prior to the completion of the Project, and prior to release of the final retention payments, the "As-built" drawings and specifications shall be transmitted in hard copy and electronic format as directed by the University to the University or the Design Professional for further review. A copy of the transmittal shall be sent to the University and included in the formal Close-out documents.

4.12 Cleanup of Project and Site

The Contractor shall, on a daily basis, keep the premises and surrounding area free from accumulation of waste materials, combustibles, or rubbish caused by operations under the Contract. At completion of the Work, the Contractor shall remove from and about the Project waste materials, combustibles, rubbish, the Contractor's tools, construction equipment, machinery and surplus materials.

If the Contractor fails to clean up as provided in the Contract Documents, the University may do so and the cost thereof shall be charged to the Contractor. Any additional cleaning requirements are as stated in the Supplementary General Conditions.

Upon completion of the Work, the Contractor shall promptly remove from the premises construction equipment and any waste materials not previously disposed of, leaving the premises thoroughly clean and ready for occupancy.

When two or more Contractors are engaged in work at or near the site, each shall be responsible for cleanup and removal of its own rubbish, equipment, and any waste materials not previously disposed.

In the event the Contractor does not maintain the Project or the site clear of debris and rubbish in a manner acceptable to the Design Professional or University, the University may, at its option, cause the Project or site to be properly cleaned and may withhold the incurred expense from payments due the Contractor or otherwise receive reimbursement from the Contractor.

4.13 [Not used]

4.14 Project Sign, Advertising

If included as a requirement in the project documents, Contractor shall furnish and install a project sign as designed by the Design Professional and accepted by the University as part of the Work under the Contract. As a minimum, the sign shall be four feet by eight feet, made from three-quarter inch plywood. The sign shall identify the Project name, the University including the individual members of the Board of Governors, the Design Professional, and the Contractor. No advertising is permitted on the Project or site without written permission from the University. If the Project is funded by a State of Michigan capital appropriation, the Contractor shall also provide a project sign which satisfies the requirements of the State of Michigan as stipulated in the Department of Technology Management and Budget's Major Project Design Manual, current edition.

5.00 INTERPRETATION OF AND ADHERENCE TO CONTRACT REQUIREMENTS

5.01 Interpretation of Contract Requirements

5.01.1 Conflicts

In the event of conflict in the Contract Documents, the priorities stated below shall govern:

- (1) Addenda shall govern over all other Contract Documents and subsequent addenda shall govern over prior addenda only to the extent that they modify prior addenda. Such addenda shall only govern the scope of Work, Contract Sum, and Time of Completion, and shall not be deemed to amend the Contract, General Conditions of Construction, or Supplementary General Conditions of Construction.
- (2) In case of conflict between plans and specifications, the specifications take precedence over drawings for the specific type or quality of materials or the quality of installation; the drawings take precedence over the specifications with regard to quantities, locations or detail of installation.
- (3) Conflicts within the plans:
 - (a) Schedules, when identified as such, shall govern over all other portions of the plans.
 - (b) Specific notes shall govern over all other notes and all other portions of the plans except the schedules described in Article 5.01.1, above.
 - (c) Larger scale drawings shall govern over smaller scale drawings.
 - (d) Figured or numerical dimensions shall govern over dimensions obtained by scaling. Scaling the drawings is prohibited.
- (4) Conflicts within the specifications: "General Conditions for Construction" shall govern over all sections of the specifications except for specific modifications thereto that may be stated in Supplementary General Conditions or addenda. No other section of the specifications shall modify the General Conditions for Construction.
- (5) In the event provisions of codes, safety orders, Contract Documents, referenced manufacturer's specifications or industry standards are in conflict, the more restrictive or higher quality shall govern.

5.01.2 Omissions

If the Contract Documents are not complete as to any minor detail of a required construction system or with regard to the manner of combining or installing of parts, materials, or equipment, but there exists an accepted trade standard for good and skillful construction, such detail shall be deemed to be an implied requirement of the Contract Documents in accordance with such standard. "Minor Detail" shall include the concept of substantially identical components, where the price of each such component is small even though the aggregate cost or importance is substantial, and shall include a single component which is incidental, even though its cost or importance may be substantial.

The quality and quantity of the parts or material so supplied shall conform to trade standards and be compatible with the type, composition, strength, size, and profile of the parts of materials otherwise set forth in the Contract Documents.

5.01.3 Miscellaneous

Portions of the Work which can be best illustrated by the Drawings may not be included in the Specifications and portions best described by the Specifications may not be depicted on the Drawings.

If an item or system is either shown or specified, all material and equipment normally furnished with such items and needed to make a complete operating installation shall be provided whether mentioned or not, even though such materials and equipment are not shown on the drawings or described in the specifications, omitting only such parts as are specifically excepted. Words and abbreviations which have well-known technical or trade meanings are used in the Contract Documents in accordance with such recognized meanings.

The General Conditions and Supplementary General Conditions are a part of each and every section of the Specifications.

All drawings, Project Plans and Specifications, renderings and models or other documentation, and copies thereof, furnished by the University or any agent, employee or consultant of the University, or Design Professional, are and shall remain the property of the University. They are to be used only with respect to this Project and are not to be used on any other project.

5.01.4 Interpreter of Documents

The University's Representative shall be the Interpreter, with the advice of the Design Professional, of the Contract Documents and shall be the judge of the performance of the Contractor and subcontractors. Subject to the provisions Article 7, claims, disputes and other matters of controversy relating to the Contract Documents or the Work shall be decided by the University's Representative. The decision of the University's Representative shall be final.

5.02 Issuance of Interpretations, Clarifications, Additional Instructions (Requests for Information)

Should the Contractor discover any conflicts, omissions, or errors in the Contract or have any question concerning interpretation or clarification of the Contract Documents, the Contractor shall request in writing an interpretation, clarification, or additional detailed instructions before proceeding with the Work affected. The written request shall be given to the Design Professional and University within 5 days of discovery.

The Design Professional, with review as required by the University, shall, within 10 days or other reasonable time, issue in writing the interpretation, clarification, or additional detailed instructions requested. In the event that the Contractor believes that the progress of the Work is being delayed by a Request for Information or a response to a Request for Information, Contractor shall comply with the procedures stated in section 4.08 of these General Conditions for an extension of time.

Should the Contractor proceed with the Work affected before receipt of the interpretation, clarification, or instructions from the Design Professional, the Contractor shall replace or adjust any Work not in conformance therewith and shall be responsible for any resultant damage or added cost.

Should any interpretation, clarification, or additional detailed instructions, in the opinion of the Contractor, constitute Work beyond the scope of the Contract, the Contractor must submit written notice thereof to the Design Professional and University within five (5) calendar days following receipt of such interpretation, clarification, or additional detailed instructions and in any event prior to commencement of Work thereon. The Contractor shall submit an explanation of how the interpretation, clarification, or additional detailed instructions and in any event prior to commencement of Work thereon. The Contractor shall submit an explanation of how the interpretation, clarification, or additional detailed instruction constitutes work beyond the scope of the Contract, along with a detailed cost breakdown and an explanation of any delay impacts. The Design Professional shall consider such notice and make a recommendation to the University. If, in the judgment of the University, the notice is justified, the interpretation, clarification or additional detailed instructions shall either be revised or the extra work authorized by Contract change order or by field instruction with a change order to follow. If the University

decides that the request is not justified and the Contractor does not agree, the Contractor shall nevertheless perform such Work upon receipt from the University of written authorization to do so. In such case, the Contractor shall have the right to have the Claim later determined only pursuant to the requirements of this Contract. However, any such Claim for additional compensation because of such interpretation, clarification, or additional detailed instruction is waived, unless the Contractor gives written notice to the Design Professional and University within five (5) calendar days as specified above.

5.03 Product and Reference Standards

5.03.1 Product Designation

When descriptive catalog designations, including the manufacturer's name, product brand name, or model number are referred to in the Contract Documents, such designations shall be considered as being those found in industry publications of current issue at the date of Contract execution.

5.03.2 Reference Standards

When standards of the federal government, trade societies, or trade associations are referred to in the Contract Documents by specific date of issue, these shall be considered a part of this Contract. When such references do not bear a date of issue, the current and most recently published edition at the date of Contract execution shall be considered a part of this Contract.

5.04 Shop Drawings, Samples, Alternatives or Equals, Substitutions

5.04.1 Submittal Procedure

Shop drawings include drawings, diagrams, illustrations, schedules, performance charts, brochures and catalogs and other data prepared by the Contractor or any subcontractor, manufacturer, supplier or distributor, and which illustrate some portion of the Work. In accordance with the submittal schedule, the Contractor shall promptly review and approve all shop drawings and then submit the shop drawings to the Design Professional together with samples as required by the Contract Documents and shall also submit any offers of alternatives or substitutions. The Design Professional shall have 10 days to respond with an acknowledgement of approval, clearly defined exceptions, or rejections. Rejections shall be cause for resubmission and no contract time adjustments will be granted for such requirements. At least six copies of brochures, one copy of shop drawings and one PDF digital file of shop drawings shall be submitted as well as additional copies as required by Design Professional. All such submittals shall be sent to Design Professional at the address given in the instructions to the Contractor at the job start meeting. A letter shall accompany the submitted items which shall contain a list of all matters submitted and shall identify all deviations shown in the shop drawings and samples from the requirements of the Contract Documents. Failure by the Contractor to identify all deviations may render void any action taken by the Design Professional on the materials submitted. Whether to void such action shall be in the discretion of the Design Professional. The letter and all items accompanying it shall be fully identified as to project name and location, the Contractor's name, and the University's Project number. By submitting the approved shop drawings and samples, the Contractor warrants and represents that the data contained therein have been verified with conditions as they actually exist and that the shop drawings and samples have been checked and coordinated with the Contract Documents.

5.04.2 Samples

Samples are physical examples furnished by the Contractor to illustrate materials, equipment, color, texture, or worker ship, and to establish standards by which the Work will be judged. Unless otherwise approved, at least two samples will be submitted for each item requiring samples to be submitted.

The Work shall be in accordance with the samples and reviewed by Design Professional. Samples shall be removed by the Contractor from the site when directed. Samples not removed by the Contractor, will become the property of the University and will be removed or disposed of by the University at the Contractor's expense.

5.04.2.1 Mock-ups as may be required by the Contract Documents

Mock-ups, models or temporary construction as may be required by the University shall be removed and disposed of by the Contractor at Contractor's sole cost and expense from the site when directed.

5.04.3

5.04.3 Substitutions

For convenience in designation on the plans or in the specifications, certain materials or equipment may be designated by a brand or trade name or the name of the manufacturer together with catalog designation or other identifying information, hereinafter referred to generically as "designated by brand name." Alternative material or equipment which is of equal quality and of the required characteristics for the purpose intended may be proposed for use provided the Contractor complies with the requirements stated in this section. If the Contractor proposes a product that is of lesser or greater quality or performance than the specified material or equipment, Contractor must both comply with the provisions of section 5.04 and submit any cost impact. The Contractor shall submit its proposal to University and the Design Professional for an alternative in writing within the time limit designated in the Contract, or if not so designated, then within a period which will cause no delay in the Work. By submitting a substitute, the Contractor waives any rights to claim a delay due to the processing of this substitution.

The Contractor may offer a substitution of a specified or indicated item if it presents complete information concerning the substitution and the benefits thereof to the University by reason of lower cost or improved performance, or both, over the specified or indicated item. However, such submission of a proposed substitution does not relieve the Contractor from its obligations under the Contract. In proposing a substitution, the Contractor warrants that the substitution is, at a minimum, equivalent in performance to the specified or indicated item. A substitution shall not be effective unless accepted in writing by the University.

Any additional costs and changes to the Work (including, but not limited to the Work of other Contractors and additional design costs which may be affected thereby) which may result from the proposed substitution shall be disclosed at the time the substitution is proposed to the University. Changes to the Work and any additional costs therefrom shall be the sole responsibility of the Contractor and shall not increase the Contract Sum.

The Contractor's substitution proposals shall include written descriptions of the items to be substituted (including drawings and/or specifications) and referenced information of the proposed substitution. The Design Professional and University's Representative's signature on this proposal is required for acceptance. Shop Drawings will not be considered a substitution proposal pursuant to this section. Verbal approvals or approved Shop Drawings will <u>not</u> be considered as acceptance of proposed substitutions.

5.05 Quality of Materials, Articles and Equipment

Materials, articles and equipment furnished by the Contractor for incorporation into the Work shall be new unless otherwise specified in the Contract Documents. When the Contract requires that materials, articles or equipment be furnished, but the quality or kind thereof is not specified, the Contractor shall furnish materials, articles or equipment at least equal to the kind or quality or both of materials, articles or equipment which are specified.

5.06 Testing Materials, Articles, Equipment and Work

Materials, articles, equipment or other Work requiring tests are specified in the Contract Documents. Materials, articles and equipment requiring tests shall be delivered to the site in ample time before intended use to allow for testing and shall not be used prior to testing and receipt of written approval. The Contractor shall be solely responsible for notifying the University where and when materials, articles, equipment and Work are ready for testing. Should any such materials, articles, equipment or Work be covered without testing and approval, if required, they shall be uncovered at the Contractor's expense. The University has the right to order the testing of any other materials, articles, equipment or Work at any time during the progress of the Work. Unless otherwise directed, all samples for testing shall be taken by the University from materials, articles or equipment to be used on the project or from Work performed. All tests will be under the supervision of, and at locations convenient to, the University. The University shall select the laboratories for all tests. Decisions regarding the adequacy of materials, articles, equipment or Work shall be issued to the University in writing. The University may decide to take further samples and tests, and if the results show that the Work was not defective, the University shall bear the costs of such samples and tests. In the event the results of such additional samples and tests show that the Work was defective, the Contractor shall bear the cost of such samples and tests. Samples that are of value after testing shall remain the property of the Contractor. All retesting and reinspection costs may be back charged to the Contractor by the University.

5.07 Rejection

Should any portion of the Work or any materials, articles or equipment delivered to the Project fail to comply with the requirements of the Contract Documents, such Work, materials, articles or equipment shall be rejected in writing and the Contractor shall immediately correct the deficiency to the satisfaction of the Design Professional and the University at no additional expense to the University. Any Work, materials, articles or equipment which is rejected shall immediately be removed from the premises at the expense of the Contractor. The University may retain one and one-fourth times the cost of the rejected materials, articles, equipment, and Work from any payments due the Contractor until such time as the deficiency is made acceptable to the Design Professional and University.

5.08 Responsibility for Quality

The testing and inspection provided by the University shall not relieve the Contractor of its responsibility for the quality of materials and workmanship provided by the Contractor, and the Contractor shall make good all defective Work discovered during or after completion of the Project.

6.00 CHANGES IN THE WORK

6.01 Change Orders

6.01.1 Generally

The University reserves the right to issue written orders whether through a formal Change Order or Preliminary Project Cost and Schedule Impact Report, directing changes in the Contract at any time prior to the acceptance of the Project without voiding the Contract, and Contractor shall promptly comply with such order or direction. The Contractor may request changes in the Work, but shall not act on the changes until approved in writing by the University. Any change made without authority in writing from the University shall be the responsibility of the Contractor.

Any such changes in the Work that have a cost impact shall only be authorized by Change Orders approved by the University. No action, conduct, omission, prior failure or course of dealing by the University shall act to waive, modify, change or alter the requirement that Change Orders must be in writing and signed by the University and Contractor and that such written Change Orders are the exclusive method for changing or altering the Contract Sum or Contract Time. The University and Contractor understand and agree that the Contract Sum and Contract Time cannot be changed by implication, oral agreements, actions, inactions, course of conduct or Preliminary Project Cost and Schedule Impact Report.

On the basis set forth herein, the Contract Sum may be adjusted for any Change Order requiring a different quantity or quality of labor, materials or equipment from that originally required, and the partial payments to the Contractor, set forth in section 8.01, may be adjusted to reflect the change. Whenever the necessity for a change arises, and when so ordered by the University in writing, the Contractor shall take all necessary steps to mitigate the effect of the ultimate change on the other Work in the area of the change. Changed Work shall be performed in accordance with the original Contract requirements except as modified by the Change Order. Except as herein provided, the Contractor shall have no claim for any other compensation including lost productivity or increased overhead expenses due to changes in the Work.

6.01.2 Proposed Change Orders

The Design Professional, with approval of the University, shall issue to the Contractor a cost request Bulletin for a proposed change order describing the intended change and shall require the Contractor to indicate thereon a proposed amount to be added to or subtracted from the Contract Sum due to the change supported by a detailed estimate of cost. Upon request by the University, the Contractor shall permit inspection of the original Contract estimate, Trade Contract agreements, or purchase orders relating to the change. Any request for adjustment in Contract Time which is directly attributable to the changed Work shall be included with substantiating detailed explanation by the Contractor in its response to the cost request bulletin. Failure by Contractor to request adjustment of Contract Time on the response to the cost request Bulletin shall waive any right to subsequently claim an adjustment of the Contract Time based on the changed Work. The Contractor shall submit the response to the cost request Bulletin with detailed estimates and any time extension request thereon to the Design Professional within ten (10) days after issuance of the cost request Bulletin. Upon its submission, the Design Professional will review it and advise the University who will make the decision regarding the request. The University retains sole discretion to accept, reject, or modify the proposed change. If the Contractor fails to submit the response within the required ten (10) days. and the Contractor has not obtained the Design Professional's and the University's permission for a delay in submission, the University may order the Contractor in writing to begin the Work immediately, and the Contract Sum shall be adjusted in accordance with the University's estimate of cost. In that event, the Contractor, within fifteen days following completion of the changed Work, may present information to the University that the University's estimate was in error; the University, in its sole discretion, may adjust the Contract Sum. The Contractor must keep and submit to the University time and materials records verified by the University to substantiate its costs. The University may require the Contractor to proceed immediately

with the changed Work in accordance with section 6.01.4, "Failure to Agree as to Cost" or section 6.02 "Emergency Changes."

When the University and the Contractor agree on the amount to be added to or deducted from the Contract Sum and the time to be added to or deducted from the Contract Time and a Contract Change Order is signed by the University and the Contractor, the Contractor shall proceed with the changed Work. If agreement is reached as to the adjustment in compensation for the performance of changed Work but agreement is not reached as to the time adjustment for such Work, the Contractor shall proceed with the Work at the agreed price, reserving the right to further pursue its Claim for a time adjustment. Any costs incurred to acquire information relative to a proposed Change Order shall not be borne by the University.

6.01.3 Allowable Costs Upon Change Orders

The identification of and manner in which costs will be allowed because of changed Work shall be computed as described by this section.

6.01.3.1 Labor

Costs are allowed for the actual payroll cost to the Contractor for direct labor, engineering or technical services directly required for the performance of the changed Work, (but not site management such as field office estimating, clerical, project engineering, management or supervision) including payments, assessments, or benefits required by lawful labor union collective bargaining agreements, compensation insurance payments, contributions made to the State pursuant to the Unemployment Insurance Code, and for taxes paid to the federal government required by the Social Security Act of 1935, as amended, unless the time of completion adjustments affect the general condition inclusion of the Contract Sum.

No labor cost will be recognized at a rate that deviates from the WSU Wages in the locality of Wayne County, Michigan as provided by the University at the time the Work is performed, or of wage and benefit rates associated with trade union collective bargaining agreements prevailing at the time of the change, and the the use of a classification which would increase the labor cost may not be permitted unless the Contractor established to the satisfaction of the University the necessity for payment at a higher rate.

6.01.3.2 Materials

Costs are allowed for the actual cost to the Contractor for the materials directly required for the performance of the changed Work. Such cost of materials may include the costs of transportation, sales tax, and delivery if necessarily incurred. However, overhead costs shall not be included. If a trade discount by the actual supplier is available to the Contractor, it shall be credited to the University. If the materials are obtained from a supply or source owned wholly or in part by the Contractor, payment therefor will not exceed the current wholesale price for such materials.

If, in the opinion of the University, the cost of materials is excessive, or if the Contractor fails to furnish satisfactory evidence of the cost from the actual suppliers thereof, then in either case the cost of the materials shall be deemed to be the lowest wholesale price at which similar materials are available in the quantities required at the time they were needed.

6.01.3.3 Equipment

Costs are allowed for the actual cost to the Contractor for the use of equipment directly required in the performance of the changed Work except that no payment will be made for time while equipment is inoperative due to breakdowns or for non-working days. The total rental cost shall not exceed seventy-five percent (75%) of the market value of the rented equipment. The rental time shall include the time required to move the equipment to the Project site from the nearest available source for rental of such equipment, and to return it to the source. If such equipment is not moved by its own power, then loading and transportation

costs will be paid. However, neither moving time nor loading and transportation costs will be paid if the equipment is used on the Project in any other way than upon the changed Work. Individual pieces of equipment having a replacement value of \$500.00 or less shall be considered to be tools or small equipment, and no payment therefor will be made.

For equipment owned or furnished by the Contractor, no cost therefor shall be recognized in excess of the rental rates established by distributors or equipment rental agencies in the locality where the Work is performed. Blue Book rates shall not be used for any purpose.

The amount to be paid to the Contractor for the use of equipment as set forth above shall constitute full compensation to the Contractor for the cost of fuel, power, oil, lubrication, supplies, small tools, small equipment, necessary attachments, repairs and maintenance of any kind, depreciation, storage, insurance, labor (except for equipment operators who shall be paid for as provided in Article 6.01.3.1) and any and all costs to the Contractor incidental to the use of such equipment.

6.01.3.4 Change Order Mark-up Allowance

For Change Order scope whose cost is derived according to the Cost of Work plus a Fee as defined in 6.01.3.1 through 6.01.3.3, the mark-up allowance shall be as defined in the Contract. Lump-sum conditions shall include the mark-up allowance. When agreement as to cost cannot be reached, the Contractor shall execute the Work according to time and materials with the Contractor and University acknowledging such costs by signature on a daily basis, and as set forth below.

6.01.3.5 Credit for Deleted Work

For proposed change orders which involve both added and deleted Work, the Contractor shall separately estimate the cost of the added Work before mark-ups, and separately estimate the cost of the deleted Work before allowance of a credit. If the difference between the costs results in an increase to the Contract Sum, the mark-up for added Work shall be applied to the difference, and if the difference in the costs results in a decrease, then the mark-up for deleted Work shall be applied to the difference.

6.01.3.6 Market Values

Cost for added Work shall be no more than market values prevailing at the time of the change, unless the Contractor can establish to the satisfaction of the University that it investigated all possible means of obtaining Work at prevailing market values and that the excess cost could not be avoided.

When a change order deletes Work from the Contract, the computation of the cost thereof shall be the values which prevailed at the time bids for the Work were opened or the Contract Sum established.

6.01.4 Failure to Agree as to Cost

6.01.4.1 For Added Work

Notwithstanding the failure of the University and the Contractor to agree as to the cost of the proposed Change Order, the Contractor, upon written order from the University, shall proceed immediately with the changed Work. A Preliminary Project Cost and Schedule Impact Report or letter signed by the University shall be used for this written order. At the start of each day's Work on the change, the Contractor shall notify the University in writing as to the size of the labor force to be used for the changed Work and its location. Failure to so notify may result in the non-acceptance of the costs for that day. At the completion of each day's Work, the Contractor shall furnish to the University a detailed summary of all labor, materials, and equipment employed in the changed Work. The University will compare his/her records with Contractor's daily summary and may make any necessary adjustments to the summary. After the University and the Contractor agree upon and sign the daily summary, the summary shall become the basis for determining

costs for the additional Work. The sum of these costs when added to an appropriate mark-up will constitute the payment for the changed Work. Subsequent adjustments, however, may be made based on later audits by the University. When changed Work is performed at locations away from the job site, the Contractor shall furnish in lieu of the daily summary, a summary submitted at the completion of the Work containing a detailed statement of labor, material, and equipment used in the Work. This latter summary shall be signed by the Contractor who shall certify thereon that the information is true.

The Contractor shall maintain and furnish on demand of the University itemized statements of cost from all vendors and subcontractors who perform changed Work or furnish materials and equipment for such Work. All statements must be signed by the vendors and the subcontractors.

6.01.4.2 For Deleted Work

When a proposed Change Order contains a deletion of any Work, and the University and the Contractor are unable to agree upon the cost thereof, the University's estimate shall be deducted from the Contract Sum and may be withheld from any payment due the Contractor until the Contractor presents adequate substantial information to the University that the University's estimate was in error. The amount to be deducted shall be the actual costs to the Contractor for labor, materials, and equipment which would have been used on the deleted Work together with an amount for mark-up as defined in the Contract Documents.

6.01.5 Allowable Time Extensions

For any change in the Work, the Contractor shall only be entitled to such adjustments in Contract Time due solely to performance of the changed Work. The procedure for obtaining an extension of time is set forth in Section 4.08 of these General Conditions. No extension of time shall be granted for a change in the Work unless the Contractor demonstrates to the satisfaction of the University that the Work is on the critical path and submits an updated Critical Path Method schedule showing that an extension of time is required and that the Contractor is making, or has made, every reasonable effort to guarantee completion of the additional Work called for by the change within the time originally allotted for the Contract. Failure by the Contract Time.

Any adjustment in Contract time shall specify the exact impact on the date of Substantial Completion and Final Completion.

6.02 Emergency Changes

Changes in the Work made necessary due to unforeseen site conditions, discovery of errors in plans or specifications requiring immediate clarification in order to avoid a serious Work stoppage, changes of a kind where the extent cannot be determined until completed, or under any circumstances whatsoever when deemed necessary by the University are kinds of emergency changes which may be authorized by the University in writing to the Contractor. The Contractor shall commence performance of the emergency change immediately upon receipt of Preliminary Project Cost and Schedule Impact Report issued by the University.

If agreement is reached as to compensation adjustment for the purpose of any emergency change, then compensation will be as provided in this section relating to ordinary changes. If agreement is not reached as to compensation at the time of commencing the emergency change, then compensation will be as provided in section 6.01.4, that is, time and materials records and summaries shall be witnessed and maintained until either a lump sum payment is agreed upon, or the changed Work is completed.

6.03 Preliminary Project Cost and Schedule Impact Report

The Contractor shall perform Work as directed by the University through a Preliminary Project Cost and Schedule Impact Report. The cost of the changed Work is to be determined as stated in the Preliminary Project Cost and Schedule Impact Report or pursuant to section 6.01.4.

7.00 CLAIMS AND DISPUTES

7.01 Policy of Cooperation

The parties shall endeavor to resolve all of their claims and disputes amicably and informally through open communication and discussion of all issues relating to the Project. To the greatest extent possible, the parties shall avoid invoking the formal dispute resolution procedures contained in the Contract Documents.

7.02 Recommendation of Design Professional

Claims, including those alleging an error or omission by the Design Professional, must be referred initially to the Design Professional for action as provided in paragraph 7.09 as an express condition precedent to proceeding further in resolving any claim.

7.03 Time Limits on Claims

Claims must be made within 5 days after occurrence of the event giving rise to such Claim or within 5 days after the claimant first recognizes the condition giving rise to the Claim, whichever is later. Claims must be made by written notice. An additional Claim made after the initial Claim has been resolved by Change Order will not be valid.

7.04 Continuing Contract Performance

Pending final resolution of a Claim, unless otherwise agreed in writing, the Contractor shall proceed diligently with performance of the Contract and the University shall continue to make payments in accordance with the Contract Documents subject to the University's rights relative to payments, withholding of payments, termination, or all other rights afforded it in the Contract Documents.

7.05 Claims for Concealed or Unknown Conditions

If conditions are encountered at the site which are (1) subsurface or otherwise concealed physical conditions which differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature, which differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents. then written notice by the observing party shall be given to the other party promptly before conditions are disturbed and in no event later than 48 hours after first observance of the conditions. The Design Professional will promptly investigate such conditions and, if the conditions differ materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any part of the Work, the Design Professional will recommend an equitable adjustment in the Contract Sum or Contract Time, or both. If the Design Professional determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Design Professional shall so notify the University and Contractor in writing, stating the reasons. Claims by either party in opposition to such determination must be made within 10 days after the Design Professional has issued such determination. If the University and Contractor cannot agree on an adjustment in the Contract Sum or Contract Time, the adjustment shall be referred to the Design Professional for initial determination, subject to further proceedings pursuant to Paragraph 7.09.

7.06 Claims for Additional Cost

Any Claim by the Contractor for an increase in the Contract Sum shall be submitted in writing as required by the Contract Documents before proceeding to execute the Work. If the Contractor believes additional cost is involved for reasons including but not limited to (1) a written interpretation from the Design Professional, (2) an order by the University to stop the Work where the Contractor was not at fault, (3) a written order for a minor change in the Work issued by the Design Professional, (4) failure of payment by the University, (5) termination of the Contract by the University, (6) University's suspension or (7) changes in the scope of Work, the Contractor's claim shall be filed in strict accordance with the procedure established herein.

7.07 Claims for Additional Time

Any Claim by Contractor for an increase in the Contract Time shall be submitted in writing as required by the Contract Documents. The Contractor's Claim shall include an estimate of the probable effect of delay on progress of the Work. In the case of a continuing delay only one Claim is necessary.

If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data substantiating that weather conditions were abnormal for the period of time and could not have been reasonably anticipated, and that weather conditions had an adverse effect on the scheduled construction.

7.08 Injury or Damage to Person or Property

If either party to the Contract suffers injury or damage to person or property because of an act or omission of the other party, of any of the other party's employees or agents, or of others for whose acts such party is legally liable, written notice of such injury or damage, whether or not insured, shall be given to the other party within a reasonable time not exceeding 5 days after first observance. The notice shall provide sufficient detail to enable the other party to investigate the matter. If a Claim for additional cost or time related to this Claim is to be asserted, it shall be filed as provided in the Contract Documents.

7.09 Resolution of Claims and Disputes

7.09.1 Review by Design Professional

Design Professional will review all Claims and take one or more of the following preliminary actions within 10 days of receipt of a Claim: (1) request additional supporting data from the Claimant, (2) submit a schedule to the parties indicating when the Design Professional expects take action, (3) reject the Claim in whole or in part, stating reasons for rejection, (4) recommend approval of the Claim by the other party or (5) suggest a compromise. The Design Professional may also, but is not obligated to, notify the surety, if any, of the nature and amount of the Claim.

If a Claim has been resolved, the Design Professional will prepare or obtain appropriate documentation. If a Claim has not been resolved, the party making the Claim shall, within 10 days after the Design Professional's preliminary response, take one or more of the following actions: (1) submit additional supporting data requested by the Design Professional, (2) modify the initial Claim or (3) notify the Design Professional that the initial Claim stands.

If a Claim has not been resolved after consideration of the foregoing and of further evidence presented by the parties or requested by the Design Professional, the Design Professional will notify the parties in writing that the Design Professional's opinion will be rendered within 5 days. Upon expiration of such time period, the Design Professional will render to the parties the Design Professional's determination relative to the Claim, including any change in the Contract Sum or Contract Time or both. If there is a surety and there appears to be a possibility of a Contractor's default, the Design Professional may, but is not obligated to, notify the surety and request the surety's assistance in resolving the controversy. The determination by the Design Professional shall be subject to the review and approval of the Associate Vice President of Facilities Planning and Management at Wayne State University.

7.09.2 Review by Associate Vice President of Facilities Planning and Management

The determination by the Design Professional shall be subject to the review and approval of the Associate Vice President of Facilities Planning and Management at Wayne State University who may request additional information from the Claimant for review and consideration. The Associate Vice President of Facilities Planning and Management may issue a schedule for further discussions, review or decision. Upon decision by the Associate Vice President of Facilities Planning and Management, if the Claimant seeks further review, the matter shall be submitted to the Vice-President of Finance and Business Operations.

7.09.3 Review Vice-President of Finance and Business Operations

If the determination by the Design Professional and the decision of the Associate Vice President does not resolve the Claim, the Claimant may appeal to the Vice President of Finance and Business Operations who shall review such determination and the supporting information submitted by the parties for the purpose of upholding, modifying, or rejecting the determination. The Vice President of Finance and Business Operations shall render a decision within forty-five days of the completion of any submissions by the parties. The decision of the Vice President of Finance and Business Operations is final unless it is challenged by either party by filing a lawsuit in the Court of Claims of the State of Michigan within one year of the issuance of the decision.

7.09.4 Jurisdiction

Sole and exclusive 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 the 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.

7.09.5 Condition Precedent

The process and procedures described in Article 7.09 are an express condition precedent to the Contractor filing or pursuing any legal remedy, including litigation. Pursuing litigation by the Contractor prior to exhaustion of the procedures set forth herein shall be premature and a material breach of this Agreement.

8.00 PAYMENT AND COMPLETION

8.01 Progress Payments

To assist in computing partial payments, the Contractor shall submit to the Design Professional and University a detailed "Schedule of Values" for review and approval by the University. The cost breakdowns shall be in sufficient detail for use in estimating the Work to be completed each month and shall be submitted within 10 days after the date of commencement of Work given in the Notice to Proceed.

Once each month during the progress of the Work, the Contractor shall submit to the Design Professional a partial payment request for review and approval. The partial payment request shall be based on the cost of the Work completed plus the acceptable materials delivered to or stored on the site under the control of the Contractor and not yet installed. The Design Professional and University shall review and certify by signature as to the validity of the request, and approving payment. Partial payments shall not be construed as acceptance of any Work which is not in accordance with the requirements of the Contract. Once the partial payment request has been certified by the Design Professional, it shall be submitted to the University for approval and processing.

The Contractor warrants that title to the Work, materials and equipment covered by an Application for Payment shall pass to the University upon the earlier of either incorporation in construction or receipt of payment by Contractor; that Work, materials and equipment covered by previous Applications for Payment are free and clear of liens, claims, security interests or encumbrances; and that no Work, materials or equipment covered by an Application for Payment will have been acquired by Contractor or by any other person performing Work at the Project or furnishing materials or equipment for the Project subject to an agreement under which an interest or encumbrance is retained by the seller or otherwise imposed on the Contractor or buyer.

All Applications for Payment shall be accompanied by sworn statements and waivers executed by Contractor, Subcontractors and suppliers whose work is included in the Application for Payment, as well as other documentation that may be required by the University, stating that all have been paid in full for Work performed through the last or most recent progress payment: The Contractor and each subcontractor shall also provide properly completed certified payroll form WH-347 to the University's with each application for payment request.

8.02 Format of Application for Payment

In addition to a schedule of values or detailed outline for the Cost of Work that is acceptable to the Contractor and University, other specific requirements for Application for Payment format and calculations include.

- Applications for Payment shall first present the itemized Cost of Work.
 - For any portion of the Work being performed according to unit pricing or time and materials pricing, invoicing and Applications for Payment must be accompanied by acceptable supporting documentation to evidence accurate quantities of actual labor, materials and equipment. Any allowed mark-ups to the actual cost of Work performed will be added to these costs separately and not included in the actual cost.
 - O Change Orders executed between the Contractor and University shall be reported as separate line items within the Application for Payment and directly under applicable Subcontractor Cost of Work items. Change Orders affecting multiple Subontractors' Cost of Work items shall be similarly numbered to permit ease of tracking. These requirements shall run through Subcontractor Applications for Payment to the Contractor to permit ease of tracking. Change Orders within a Subcontractor Application for Payment shall be appropriately labeled as being initiated by the Contractor or University to permit ease of tracking.

• The Contractor's General Conditions, Overhead and Profit shall next be calculated as the balance of the Application for Payment.

8.03 Substantial Completion, Incomplete Construction List and Punchlist

When the Contractor considers that the Work, or a portion thereof which the University agrees to accept separately, is substantially complete, the Contractor shall prepare and submit to the Design Professional a comprehensive Incomplete Construction List of items to be completed or corrected, in a form agreed by the University and the Design Professional. The Contractor shall proceed promptly to complete and correct items on the Incomplete Construction List. Failure to include an item on such Incomplete Construction List does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents. Upon receipt of the Contractor's Incomplete Construction List, the Design Professional, with the University's Representative, will make an observation to determine whether the Work or designated portion thereof is substantially complete and will identify observable items inconsistent with the Contract Documents to be included in the Punchlist. If the Design Professional's or University Representative's observation discloses any item, whether or not included on the Contract Documents, the Contractor shall, before issuance of the Certificate of Substantial Completion, complete or correct such item, upon notification by the Design Professional.

The Contractor shall then submit a request for another observation by the Design Professional to determine Substantial Completion. When the Work or designated portion thereof is substantially complete, the Design Professional will prepare a Certificate of Substantial Completion which shall establish the date of Substantial Completion, shall establish responsibilities of the University and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance, and shall fix the time, generally 45 days, within which the Contractor shall finish all remaining Incomplete Construction List and Punchlist items accompanying the Certificate. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion. The Certificate of Substantial Completion shall be submitted to the University and Contractor for their written acceptance of responsibilities assigned to them in such Certificate.

8.03.1 Partial Completion

From time to time, as portions of the Work are completed by the Contractor, the University shall have the right, upon giving the Contractor prior written notice, to accept any portion of the Work that the University desires to use and occupy. Such partial acceptance shall be made in writing and thereafter the Contractor shall have no further obligation with respect to the Work accepted, except to correct the Work subsequently found to have been improperly done, to replace defective materials or equipment, or as defined by Substantial Completion, Incomplete Construction List and Punchlist requirements.

8.04 Completion and Final Payment

Upon the Final Completion of the Work by the Contractor, the acceptance of the Work by the University, and the release of all claims against the University and the Work by the Contractor and its subcontractors and suppliers (which releases shall be evidenced by final waivers and releases or other documents acceptable to the University), the Contractor shall file a request for Final Payment.

8.04.1 Final Application for Payment

Upon the receipt of the Contractor's Final Application for Payment, including any and all waivers required by the University and the Contractor's provision of all Close-out Documents, and training requirements, the University shall promptly make a final inspection, and if the University finds the Work acceptable and complete in strict accordance with the Contract Documents, the University shall issue Final Payment. Final

Payment shall be made upon Completion of the Work and shall indicate the University's Final Acceptance of the Work and its acknowledgment that the Work (excluding any further warranty and guaranty obligations) has been completed and is accepted under the terms and conditions of the Contract Documents. If prior to the making of Final Payment the University finds deficiencies in the Work, the University shall promptly notify the Contractor thereof in writing, describing such deficiencies in detail. After the Contractor has remedied any deficiencies noted by the University, the Contractor shall request a final inspection and the University shall make such inspection and follow the procedure set forth in this Paragraph.

8.04.2 Final Payment by the University

The making of Final Payment shall constitute a waiver of all claims by the University except those arising from: (1) unsettled liens; (2) faulty or defective work appearing after completion; (3) failure of the work to comply with the requirements of the Contract Documents; (4) terms of any special or extended warranties required by the Contract Documents; or (5) the obligations of the Contractor under the indemnification provisions of Paragraph 4.06 hereof.

The acceptance of Final Payment shall constitute a waiver of all claims by the Contractor.

8.05 Guarantee

The Contractor unconditionally guarantees the Work under this Contract to be in conformance with the Contract Documents and to be and remain free of defects in workmanship and materials not inherent in the quality required or permitted for a period required by the contract documents beginning from the date of Substantial Completion. The Subcontractors unconditionally guaranty the Work under the subcontracts to be in conformance with the Contract Documents and to be and remain free of defects in workmanship and materials for the same period from the date of Substantial Completion, unless a longer guarantee period is stipulated in the Contract Documents. By this guarantee the Contractor and Subcontractors agree, within their respective guarantee periods, to repair or replace any Work, together with any adjacent Work which may be displaced in so doing which is not in accordance with the requirements of the Contract or which is defective in its workmanship or material, all without any expense whatsoever to the University. The Contractor shall be responsible for the coordination of all such guarantee work performance or repairs.

Special guarantees that are required by the Contract Documents shall be signed by the Contractor or Subcontractor who performs the work.

Within their respective guaranty periods, the Contractor and Subcontractors further agree that within five calendar days after being notified in writing by the University of any Work not in accordance with the requirements of the Contract Documents or of any defects in the Work, it shall commence and prosecute with due diligence all Work necessary to fulfill the terms of this guarantee and to complete the Work in accordance with the requirements of the Contract with sufficient manpower and material to complete the repairs as expeditiously as possible. The Contractor, in the event of failure to so comply, does hereby authorize the University to proceed to have the Work done at the Contractor's expense, and it agrees to pay the cost thereof upon demand. The University shall be entitled to reimbursement of all costs necessarily incurred upon the Contractor's or Subcontractor's refusal to pay the above cost.

Notwithstanding the foregoing paragraph, in the event of an emergency constituting an immediate hazard to health, safety or damage of the University's employees, property, or licenses, the University may undertake at the Contractor's or Subcontractor's respective expense, without prior notice, all Work necessary to correct such hazardous conditions caused by the Work of the Contractor not being in accordance with the requirements of this Contract.

The Contractor and Subcontractor shall require a similar guarantee in all subcontracts, including the requirement that the University be reimbursed for any damage or loss to the Work or to other Work resulting from such defects.
9.00 TERMINATION

9.01 Termination by the University for Cause

9.01.1

The University may terminate the Contract if the Contractor: (a) becomes insolvent; (b) files or has filed against it any Petition in Bankruptcy or makes a general assignment for the benefit of its creditors; (c) fails to pay, when due, for materials, supplies, labor, or other items purchased or used in connection with the Work; (d) refuses or fails to prosecute the Work, or any separable part thereof, with such diligence as will ensure the completion of the Work in accordance with the Master Project Schedule; (e) in the University's opinion, fails, refuses or neglects to supply sufficient labor, material or supervision in the prosecution of the Work; (f) interferes with or disrupts, or threatens to interfere with or disrupt the operations of the University, or any other Contractor, supplier, subcontractor, or other person working on the Project, whether by reason of any labor dispute, picketing, boycotting or by any other reason; or (g) commits any other breach of the Contract Documents.

When any of the above reasons exist, the University may, without prejudice to any other rights or remedies of the University and after giving the Contractor and the Contractor's surety, if any, three days written notice and a reasonable opportunity to cure, terminate employment of the Contractor and may, subject to any prior rights of the surety: (1) take possession of the site and of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor; (2) accept assignment of subcontracts; and (3) finish the Work by whatever reasonable method the University may deem expedient.

9.01.2

If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Design Professional's services and expenses made necessary thereby, the remaining balance shall be paid to the Contractor. If such costs exceed the unpaid balance, the Contractor shall pay the difference to the University. The amount to be paid to the Contractor or University, as the case may be, shall be certified by the Design Professional, upon application, and this obligation for payment shall survive termination of the Contract. The Contractor shall not be paid on account of loss of anticipated profits or revenue or other economic loss or consequential damages arising out of or resulting from such termination. However, the University shall be entitled to retain whatever amount is remaining unpaid to the Contractor in order to correct the cause for termination; such action is in addition to any other right or remedy which the University may have.

9.02 Suspension by the University for Convenience

9.02.1

The University may, without cause, order the Contractor in writing to suspend, delay or interrupt the Work in whole or in part for such period of time as the University may determine.

9.02.2

An adjustment shall be made for increases in the Contract Sum and/or Time of Completion of the Contract, including profit on the increased cost of performance, caused by suspension, delay or interruption. No adjustment shall be made to the extent: (1) that performance is, was or would have been so suspended, delayed or interrupted by another cause for which the Contractor is responsible; or (2) that an equitable

adjustment is made or denied under another provision of this Contract. The Contractor shall not be paid on account of loss of anticipated profits or revenue or other economic loss or consequential damages arising out of or resulting from such termination.

Adjustments made in the cost of performance may have a mutually agreed fixed or percentage fee.

9.03 Termination By The University For Convenience

9.03.1

The University, with or without cause, may terminate all or any portion of the services by the Contractor under this Agreement, upon giving the Contractor 30 days written notice of such termination. In the event of termination, the Contractor shall deliver to the University all reports, estimates, schedules, subcontracts, Contract assignments, purchase order assignments, and other documents and data prepared by it, or for it, pursuant to this Agreement.

9.03.2

Unless the termination is for cause, the Contractor shall be entitled to receive only the payments provided for in Article 8, pro-rated to the date of termination (including payment for the period of the 30 day notice) plus reimbursement for approved and actual costs and expenses incurred by the Contractor to the date of termination. Prior to payment, the Contractor shall furnish the University with a release of all claims against the University. The Contractor shall not be paid on account of loss of anticipated profits or revenue or other economic loss or consequential damages arising out of or resulting from such termination.

9.04 Termination By The Contractor

9.04.1

The Contractor may terminate the Contract if the Work is stopped for a period of 60 days through no act or fault of the Contractor or a subcontractor, sub-subcontractor or their agents or employees or any other persons performing portions of the Work under Contract with the Contractor, for any of the following reasons: (1) issuance of an order of a court or other public authority having jurisdiction; (2) an act of government, such as a declaration of national emergency, making material unavailable; (3) because the Design Professional has not issued a Certificate for Payment and has not notified the Contractor of the reason for withholding certification, or because the University has not made payment on a Certificate for Payment within forty-five (45) days of the time stated in the Contract Documents; (4) if repeated suspensions, delays or interruptions by the University constitute in the aggregate more than 100 percent of the total number of days scheduled for completion, or 120 days in any 365-day period, whichever is less.

If one of the above reasons exists, the Contractor may, upon fourteen (14) additional days' written notice to the University and Design Professional, terminate the Contract and recover from the University payment for Work executed and for proven loss with respect to materials, equipment, tools, and construction equipment and machinery, including reasonable overhead and profit.

9.04.2

If the Work is stopped for a period of 60 days through no act or fault of the Contractor or a subcontractor or their agents or employees or any other persons performing portions of the Work under Contract with the Contractor due to University actions or inaction, the Contractor may, upon fourteen additional days' written notice to the University and the Design Professional, terminate the Contract and recover from the University as provided in Subparagraph 9.03.2

10.00 MISCELLANEOUS

10.01

These Contract Documents supersede all previous agreements between the University and the Contractor concerning this Work.

10.02

No action or failure to act by the University shall constitute a waiver of a right afforded it under these General Conditions, nor shall such action or failure to act constitute approval or acquiescence of a breach of these General Conditions, except as may be specifically agreed in writing.

10.03

The invalidity or unenforceability of any provision of these General Conditions shall not affect the validity or enforceability of any other provision.

-End of General Conditions for Construction-

-End of General Conditions for Construction-

SUPPLEMENTARY GENERAL CONDITIONS

OF

CONSTRUCTION

Facilities Planning & Management - Design & Construction Services

Wayne State University

Complete Documents can be downloaded at http://www.forms.procurement.wayne.edu/RFPs/Supplementary General Conditions General Contractor 1-3-2017.docx

SUPPLEMENTARY GENERAL CONDITIONS OF CONSTRUCTION (REVISED 7-2018)

Where any article of the General Conditions of the Contract for Construction is supplemented in these Supplementary General Conditions, the original article shall remain in full force and effect and all supplementary provisions shall be considered as added thereto. Where any such article is modified, superseded or deleted here, provisions of such article not so specifically modified, superseded or deleted shall remain in full force and effect.

4.00 RESPONSIBILITIES OF THE PARTIES

Add the following to 4.02.3

.1 Temporary Facilities

The Contractor shall be responsible for arranging and providing general services and .a temporary facilities as specified herein and as required for the Design Professional, the University. all Subcontractors, Separate Contractors and Contractor's staff for the proper and expeditious prosecution of the Work, including, but not limited to, temporary offices and toilets; temporary storage; temporary electrical lighting and power; temporary voice and data communications, temporary water; temporary enclosures; temporary heating and ventilation; temporary openings; material hoists; temporary ladders, ramps and runways; temporary fire protection, protective coverings; temporary fire protection, protective coverings; and construction sign(s). The Contractor shall, at its own expense but included within the Cost of the Work, make all temporary connections to utilities and services in locations acceptable to the University, Design Professional and local authorities having jurisdiction thereof; furnish all necessary labor and materials, and make all installations in a manner subject to the acceptance of such authorities and the Design Professional: maintain such connections; remove the temporary installation and connections when no longer required; and restore the services and sources of supply to proper operating conditions.

.b The Contractor shall make all arrangements with the University and/or the local electrical utility company for temporary electrical service to the Site, shall provide all equipment necessary for temporary power and lighting, and shall pay all charges for this equipment and installation thereof. The electrical service shall be of adequate capacity for all construction tools and equipment without overloading the temporary facilities and shall be made available to all trades. The Contractor shall furnish, install and maintain a temporary lighting system to satisfy minimum requirements of safety and security.

.c Temporary weathertight enclosures and temporary heating shall be provided by the Contractor as required pursuant to the Construction Schedule or Master Project Schedule to complete the Work on or before the Completion Date, to make the building weathertight and suitable working conditions for the construction operations of all trades. Under no circumstances shall the temperature be allowed to reach a level which will cause damage to any portion of the Work which may be subject to damage by low temperatures. Unless otherwise indicated in the Construction Documents, the Contractor shall pay for all fuel, maintenance and attendance required in connection with the portable unit heaters without additional cost or expense to University. Any surface, interior or exterior, damaged by the use of these space heaters shall be replaced by new materials or be refinished to the satisfaction of the Design Professional and University without additional cost to the University.

.d All temporary equipment and conduits for same shall be in accordance with the applicable provisions of the governing codes. All temporary wiring and power conduits shall be maintained in a safe manner and utilized so as not to constitute a hazard to persons or property. All temporary equipment, wiring and conduits shall be completely removed after they are no longer necessary and prior to completion. At the conclusion of use or at the conclusion of the project, any materials or products purchased for the temporary facilities and temporary utilities and paid for, either

directly or indirectly, by the University shall become the property of the University and shall, at the option of the University, be delivered to the University's designated location.

.e Where temporary facilities and associated utilities, and for utilities used in performance of this Agreement can be reasonably provided from existing University services, the University shall bear the cost of such utility consumption. However, for conditions that require the Contractor to use electrical generators or equipment fueled by an independent fuel source, the Contractor shall bear all such costs.

Add the following to 4.02.12

.1 Safety and Protection

.a Contractor shall provide fences, pedestrian walks, barriers, etc. to ensure safety of the general public and Contractor's personnel or as directed by University.

.b Contractor will provide perimeter protection at wall and floor openings, elevator shafts, stairwells, and floor perimeters in accordance with MIOSHA requirements.

.c Combustible rubbish shall be removed <u>daily</u> and shall not be disposed of by burning on site. The entire premises and area adjoining and around the operation shall be kept in a safe and sanitary condition and free of accumulation of trash, rubbish, nuts, bolts, small tools, and other equipment not in use. Contractor is responsible to provide trash containers and fund the removal/disposal of construction debris and general trash.

.d Contractor will regularly ensure that 1) excess material/trash are removed from work sites; 2) passageways (e.g., sidewalks, hallways) are cleared of obstructions; 3) equipment is shut down and secured; and 4) lighted barricades are erected where necessary.

.e All existing means of egress, including stairways, egress doors, panic hardware, aisles, corridors, passageways, and similar means of egress shall, at all times, be maintained in a safe condition and shall be available for immediate use and free of all obstructions.

.f The space under the temporary trailer shall not be used for the storage or placement therein of flammable gases, liquids, or gas and liquid fuel powered equipment. This area shall be kept free of accumulations of any rubbish or trash.

.g In temporary trailers, all exit doors shall be open for egress whenever the unit is occupied. Draw bolts, hooks and other similar locking devices shall be prohibited on all egress doors.

.h On site storage of combustible or flammable liquids shall be limited to one day supply. Indoor storage of propane containers is prohibited.

.i Prior to working in confined spaces on campus, the Contractor must have its written Confined Spaces Program and Permit System reviewed by the University and the documents must meet minimum acceptable standards under the current MIOSHA regulation(s). The Contractor must provide its own atmospheric testing, personal protection, ventilating and rescue equipment as required. The Contractor should seek information from University on any known hazards of the confined spaces to be entered. All manholes and utility tunnels are considered confined spaces.

.j Compressed gas cylinders belonging to Contractor must be properly segregated and secured (with chains or similarly reliable restraining devices) to wall or floor mounted support systems, cylinder storage racks etc., when not in transit. Protective caps must be in place during transit or when not in use.

.k Contractor must follow all of OSHA's lockout/tagout requirements of 29 CFR 1910.147, provide its own lockout/tagout supplies, and be able to demonstrate that its employees have received formal instruction in "lock-tag-try" procedures. Copies of Contractor's written Lockout/Tagout Program shall be made available to the University upon request.

.I Contractor may not use any University sinks, drains or catch basins for the washing of any equipment, tools or supplies, or the disposal of any liquids, (excluding consumable products and hand-soap/water) without the express permission of University. This restriction applies to all sinks (including water fountains) in laboratories, offices and maintenance areas. Additionally, no polluting or hazardous liquids (such as motor oils, cleaners, solvents, paints, diesel fuels, antifreeze, etc.) may be drained onto roads, parking lots, ditches, wetlands, dirt piles or other soil, or into storm or sanitary sewers.

.m Contractor transporting hazardous materials (e.g. reclaimed materials, chemicals, fuels, oils, concrete) to and from campus must follow all applicable Department of Transportation [State or Federal] regulations. This includes proper shipping papers, placarding, material segregation and weight limits.

.n Contractor is also responsible for the proper collection, labeling, transporting, manifesting and disposal of polluting or hazardous wastes such as solvents, paints, oil or antifreeze (and rags contaminated with any of these materials) which are the result of Contractor's activities, as required by State and Federal laws and regulations. Copies of all manifests should remain available for University review upon request. Under no circumstances may hazardous wastes be disposed of in University-owned dumpsters, waste containers, drains or sewers, or drained onto roads, parking lots, ditches, wetlands, dirt piles or other soil.

.o Neither the University nor the Design Professional is responsible for conducting safety inspections or observations, but may make recommendations concerning safety to the Contractor.

.p Fire Protection

(1) All reasonable precautions shall be taken against fire throughout all the Contractor's and Trade Contractors' operations. Flammable material shall be kept at an absolute minimum. Any such materials shall be properly handled and stored.

(2) Construction practices, including cutting, welding and grinding, and protection during construction shall be in accordance with the applicable published standards. During such operations the Contractor shall provide a fire watch person. The University requires a "Hot Work" permit for such activities. The Contractor shall provide a sufficient number of approved portable fire extinguishers, distributed about the Project and in cold weather, non-freeze type portable fire extinguishers shall be used.

(3) Gasoline and other flammable liquids shall be stored in and dispensed from Underwriter's Laboratories listed safety containers in conformance with the National Board of Fire Underwriters recommendations and applicable State laws. Storage, however, shall not be within or immediately adjacent to the building. Storage shall be in a lockable, non-combustible, suitably rated cabinet or structure no less than 25 feet distant from any University building.

- (4) The Contractor shall schedule the Work so that the permanent standpipe system shall be installed and made operable at the earliest possible date.
- 4) All tarpaulins that may be used for any purpose during construction of the Work shall be made of material which is water and weather resistant and fire retardant treated. All tarpaulins shall be Underwriters' Laboratories labeled with flame spread rating of fifteen (15) or less and shall be approved by the University's Representative prior to use.

Add the following to 4.02.13

Hazard Communication: University requires the Contractor to be in full compliance with all applicable Federal and State of Michigan regulations regarding Material Safety Data Sheets ("MSDS"). Upon request, copies of these MSDS must <u>also</u> be provided to the University no less than two weeks prior to the onset of activities. Failure to submit MSDS may result in suspension of Work activities until the MSDS are obtained. If Contractor is to work with hazardous products, it shall notify and update the Project Manager of a) proposed work schedules, b) what to expect in terms of noises/odors, and c) how to access MSDS. The Contractor must also be able to demonstrate that its employees have received "Haz Com" (i.e. Michigan Right-to-Know), and thereby possess a broad understanding of MSDS language. Contractor-owned chemical containers must be labeled with the product name and hazards.

Hazardous Materials: In addition to complying with the Michigan Right-to-Know Law, the Contractor must use and store hazardous materials in accordance with all local, state and federal regulations. Special attention must be paid to the segregation of incompatible materials and the handling/storage of flammable and/or volatile materials. At the end of each work day, hazardous materials must be properly secured, stored in MIOSHA approved containers, and placed in locations authorized by the University or removed from University's property.

Add the following to 4.02.21

.1 Excavation Policy

The policy prescribed herein shall be adhered to for all earth excavation, manual or power, on the University campus that penetrates the surface of the soil by a depth of 6 inches or greater.

.a Non-emergency Situation

- (1) In <u>non-emergency situations (i.e.</u>, scheduled maintenance or construction) the Contractor shall contact the University a minimum of seven days in advance of the scheduled excavation.
- (2) The Contractor shall contact Miss Dig, as defined by Public Act 174 of 2013, being MCL 460.721 – MCL 460.733, at least three full business days prior to the scheduled excavation, to ascertain and stake the actual location for all utilities within 50 feet of the limits of the proposed excavation. Actual staking shall be performed not more than three (3) days prior to the excavation.
- (3) Excavation shall commence only with the approval of the University Representative after a complete examination of the site utility drawings and a field observation of the staked site.

.b <u>Emergency Situation</u>

- 1. In <u>an emergency situation (i.e.</u>, loss of services on campus or to a building), the Contractor shall immediately contact the University Representative, examine the site utility drawings to determine the potential interferences, and contact Miss Dig and private stakers, if appropriate, to ascertain and stake the actual location of all utilities within 50 feet of the limits of the proposed excavation. The Contractor shall also immediately contact the local natural gas supplier in addition to Miss Dig, upon a natural gas line failure.
- 2. Contact the University's Police Department at the emergency number: (313) 577-2222.
- 3. Excavation shall recommence only with the approval of the University's Representative who will grant approval only after a complete examination of the site utility drawings and a field observation of the staked site and clearance from the utility and University Police Department.
- .c Pumping and Draining

The Contractor shall provide and maintain a temporary drainage system and pumping equipment as required to keep all excavation areas within the Site free from water from any source. As the Work progresses, all water shall be removed from basement areas, tunnels, pits, trenches and similar areas as required for proper performance of the Work and to prevent damage to any part of the construction utility. Permanent sump pumps shall not be used for this purpose; however, the Contractor may install temporary pumps in the sump pits until the permanent pumps are installed, providing that it cleans sump pits and drain lines satisfactorily after temporary use. The Contractor shall provide and maintain all pumping and draining equipment as required for the installation of all underground piping and utility conduit systems. Pumping and draining shall be performed in a manner to avoid endangering concrete footings or any adjacent construction or property. Such methods shall be subject to the review of the Design Professional.

.d Post-Excavation

- (1) Provide appropriate pipe protection (wraps, and/or cathodic protection) as originally installed.
- (2) Provide backfill material and compaction in 12-inch lifts to a minimum 95% Maximum Dry Density or higher as required by the Specifications.
- (3) Backfill material shall be as specified; or engineered fill free of all deleterious materials and rubbish of any type. Reuse of excavated material, unless otherwise specifically noted on the drawings, is unacceptable.
- (4) Provide plastic tape trace 24" (12" for shallow trenches) above all utilities indicating utility type by Miss Dig color code and name defined as follows:

<u>Utility</u>	<u>Color</u>	<u>Lettering</u>
Electric	Red	Elect
Oil/Natural Gas	Yellow	Gas
Telephone & Fiber Optic	Orange	Tele
Cable TV	Brown	TV
Water	Blue	Water
Steam	Yellow	Steam
Sewer	Green	Sewer

(5) Return grade to pre-excavation condition.

Add the following to 4.05.1

The insurance furnished by the Contractor under this Article 4.05.1 shall provide coverage not less than the following:

- .1 Workers' Compensation with Employers' Liability & Alternate Employers Endorsement: (a) Statutory Limits & Employer's Liability \$1,000,000
- .2 Commercial General Liability
 - (a) \$1,000,000 per occurrence and \$2,000,000 aggregate
 - (b) University added as additionally insured on
- .3 Contractors' Pollution Liability: (a) \$1,000,000 per claim
- .4 Professional Liability: (a) \$2,000,000 per claim and \$4,000,000 aggregate
- .5 Auto Liability with Pollution & Legal Liability

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- (a) \$1,000,000
- (b) University added as additionally insured on
- .6 Excess Liability (Umbrella): (a) \$2,000,000
- .7 Builder's Risk Insurance in the amount equal to the Contract Sum.

Any deductible or self-insured reserve shall not be refunded to the Contractor from project contingency or other project funds.

Add the following to 4.12

Elevator shafts, electrical closets, pipe and duct shafts, chases, furred spaces and similar spaces which are generally unfinished, shall be cleaned by the Contractor and left free from rubbish, loose plaster, mortar drippings, extraneous construction materials, dirt and dust before preliminary inspection of the Work.

All areas of the Project in which painting and finishing work is to be performed shall be cleaned throughout just prior to the start of this work, and these areas shall be maintained in satisfactory condition for painting and finishing. This cleaning shall include the removal of trash and rubbish from these areas; broom cleaning of floors; the removal of any plaster, mortar, dust and other extraneous materials from all finished surfaces, including but not limited to, all exposed structural steel, miscellaneous metal, woodwork, plaster, masonry, concrete, mechanical and electrical equipment, piping, duct work, conduit, and also all surfaces visible after all permanent fixtures, induction unit covers, covers for finned tube radiation, grilles, registers, and other such fixtures or devices are in place.

In addition to all cleaning specified above and the more specific cleaning which may be required, the Project shall be prepared for occupancy by a thorough final cleaning throughout including washing or cleaning of all surfaces on which dirt or dust has collected. Glass and curtain wall shall be washed and cleaned on both sides by a window cleaning subcontractor specializing in such work. Contractor shall, at University's request, delay such washing of exterior surfaces to such time as requested by University. Recleaning will not be required after the Work has been inspected and accepted unless later operations of the Contractor, in the opinion of the University, make re-cleaning of certain portions necessary.

5.00 INTERPRETATION OF AND ADHERENCE TO CONTRACT REQUIREMENTS

Add the following to 5.04.1

.1 Contractor Requirements

- .a Signature: Each item submitted shall be thoroughly reviewed by the Contractor and have a stamp or note describing the Contractor's action, signed by the person authorized by the Contractor to do the checking with that person's name clearly printed.
- .b Contractor Responsibility: Contractor shall review each submittal for completeness, conformance to the Contract Documents and coordination with other parts of the Work and the Construction Schedule. By providing and submitting to the Design Professional shop drawings, product data, warranties and samples, the Contractor is representing that he or his Subcontractor, has determined and verified (a) the availability of all materials, and (b) field measurements and field construction criteria related thereto, and (c) that he has checked and coordinated the information contained within such submittals with the requirements of the Work, the Contract Documents and

the Construction Schedule and that such shop drawings, samples, warranties and data conform to the Contract Documents.

- .c Limited Acceptance by University and Design Professional: Acceptance is for general design only. Quantities, size, field dimensions and locations are some of the required characteristics which are not part of the acceptance and will not be checked. Accordingly, the limited acceptance shall in no way relieve the Contractor from his obligation to conform his work to required characteristics and to the requirements of the Contract Documents.
- .d Delays: The Design Professional may return incomplete submittals with no action taken. The Contractor shall have no claim for any damages or for an extension of time due to delay in the Work resulting from the rejection of materials or from the rejection, correction, and resubmittal of Shop Drawings, samples and other data, or from the untimely submission thereof.

.2 Approvals

The Design Professional's approval shall not indicate approval of dimensions, quantities or fabrication processes unless specific notations are made by the Design Professional regarding same. The Design Professional will check one of the following notations on the Shop Drawing and Sample Review Stamp:

- .a "REVIEWED-NO EXCEPTIONS NOTED", indicating final action by the Design Professional. When reviewing resubmitted shop drawings the Design Professional assumes that there are no revisions from the previous submittal, except as provided by 5.04.1 and his review of resubmittals is only for the corrections requested with the approval of the balance of the shop drawing being based on the original submission. Where the Contractor directs specific action to revisions, as provided by 5.04.1 the approval includes these also.
- .b "REVIEWED WITH CORRECTIONS NOTED", indicating final action by the Design Professional with the same conditions as "REVIEWED-NO EXCEPTIONS NOTED". Unless he takes exception to the corrections noted, the Contractor may begin that portion of the Work for which the shop drawing was required.
- .c "REVISE AND SEND RECORD COPY", requiring that the Design Professional be sent a copy of the revised shop drawing in accordance with the noted corrections, at the same time it is issued for the Work.
- .d "NOT APPROVED-RESUBMIT", indicating that the Contractor shall not begin that portion of the Work until the reason indicated for disapproval has been corrected and the revised shop drawing submitted, reviewed and approved by the Design Professional.
- .e "NO ACTION REQUIRED", indicating that Contract Documents do not require the Design Professional to review or take any action with this submittal.
- .f Where more than one action has been checked, each shall apply to that portion of the shop drawing for which the action is indicated.

8.00 PAYMENT AND COMPLETION

Add the following to 8.01

8.01.1 Monthly Payment Applications

At a meeting mutually agreed upon between the University's Representative and the Contractor, but no less than monthly, the Contractor shall distribute, in triplicate, draft copies of the proposed Payment Application for review and comment. The review, comment and mutual concurrence will be an agenda item at that meeting. The Contractor will prepare the formal Application for submission from the comments made on the Draft and will present the formal application as provided for herein, including all required back-up materials, such as waivers of claim, release of claim on bond, sworn statement, documentation for stored materials, certified payroll reports and other documents required by the University Representative.

8.01.2 Offsite Materials

If an Application for Payment is made for materials not installed in the Work, but suitably stored offsite at a location acceptable to the University's Representative, such application shall be accompanied by legally acceptable paid invoices or conditional bills of sale and copies of delivery tickets, signed by the Contractor, indicating the Contractor verified that the materials shown on the delivery tickets are at the location accepted by the University and are adequately insured. Failure of the Contractor to furnish paid invoices, conditional bills of sale and proof of insurance shall be cause for withholding such amounts from payment until such paid invoices or bills of sale have been received by the University. The University reserves the right to examine the stored items prior to payment.

Add the following to subparagraph 8.03

The following submittals shall be bound in three (3) sets, plus one electronic file of all materials:

.1 Project Closeout Documents

- .a The Contractor shall submit to the Design Professional, a written guarantee, which shall be in accordance with Section 8.04 and such additional guarantees, in writing, as are required by the Specifications.
- .b The Contractor shall submit complete instruction for the care and maintenance of all finish materials under the contract, including, but not limited to floor finishes and coverings, wainscot and wall finishes, acoustical treatment, metal finishes, painted surfaces, flooring, hardware, and finishes on mechanical and electrical equipment. Instructions shall contain the manufacturer's or supplier's recommendations with respect to cleaning agents, preservative treatment and such other instructions as may be beneficial to the maintenance, usage, appearance and durability of the product. The recommendations shall further contain cautions on the use of certain cleaners and coatings which may be detrimental to the product.
- .c The Contractor shall prepare and submit operating and maintenance instructions, coordination drawings, and shop drawings for all mechanical and electrical equipment, and other special items, as called for in the specifications.
- .d All of the above described documents shall be checked by Contractor for conformance with the specifications and shall be submitted in uniform size, bound and indexed for cross-reference.
- .e The Contractor shall also submit "As-Built" drawings as specified in Section 4.11.
- .f Copies of all "Attic Stock" transmittals signed by appropriate University personnel accepting the attic stock material.

.2 Project Closeout Training

- a. The University and the Contractor will coordinate, schedule and present formal training for University personnel for all equipment, systems, devices, and building features.
- b. Training shall be scripted to include all important aspects of the equipment and its installation and maintenance. Trainers shall be suitably prepared and experienced in the features of the

equipment and the equipment's installation within the project.

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- c. The Contractor, all product vendors, subcontractors, suppliers and materialmen shall consent to and participate in the recording of the training as determined by the University and the Contractor.
- d. The University may supplement training with outside providers to meet the training requirements of the project should a vendor, subcontractor, or supplier fail to provide the required training. The University shall be reimbursed by the Contractor for any such costs for supplemental training.

DRAWINGS

The Technical Specifications dated **January 9**, **2023** and the following List of Drawings represent the scope of work as defined in the Contract Documents from Article 4.

DRAWINGS

Drawing No.: Description

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 General Conditions, Article 4.02.18

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

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

- 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: https://computing.wayne.edu/docs/wsucommunications-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 the purpose of system maintenance.

PROTECTION OF OCCUPANCY

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 during construction.

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

GENERAL REQUIREMENTS

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 313-577-2222, 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 313-577-2222, 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

No use of the Owner's 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 <u>reasonable amounts</u> of water used for construction purposes.

GENERAL REQUIREMENTS

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 <u>unless</u> 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 <u>Working Drawings</u> 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.

GENERAL REQUIREMENTS

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. <u>These</u> instructions shall be custom-prepared for this job -- catalog cuts will **not** be accepted. Equipment shall be cross-referenced to Section of Specifications and to location shown and scheduled on drawings.

Include Test-Adjust-Balance Report in the Manual.

C. FINAL INSPECTION

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

D. GUARANTEES (See Sections 00510 and 01781)

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

E. SWORN STATEMENT AND WAIVER OF LIENS

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 \$10,000. 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

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.

<u>KEYS</u>

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

SUMMARY OF WORK

SUMMARY OF WORK

PROJECT: Art Building Elevator Replacement

WSU PROJECT NO.: 040-348980

PROJECT MANAGER: Lana Vrubel

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: The freight elevator will be replaced in the existing shaft with the new nonproprietary hydraulic passenger elevator. The elevator will be extended to reach the 3rd floor and will require rework of that floor and the roof. The machine room will also need to be relocated from its existing non-compliant location under the stairs. Structural, mechanical, electrical, and plumbing scope to support new elevator.
- 3. The building is located at

Wayne State University 5400 Gullen Mall, Detroit, MI 48202 Detroit, Michigan 48202 **Project Manual for**

Art Building Elevator Replacement Wayne State University

Detroit, **MI**

Stantec Project No. 214100597 WSU Project No. 040-348980

Stantec Architecture Inc. 2338 Coolidge Highway Berkley, MI 48072

BID SET

December 09, 2022

SECTION 00 01 07 - SEALS PAGE

DESIGN PROFESSIONAL SEALS

1.1 CERTIFICATIONS

- A. Each of the design firms listed below certify that they have prepared or directly supervised the preparation of their respective Drawings and Specifications, and that each is currently and legally licensed as an Architect or Engineer in Michigan.
- B. Each of the design firms below is responsible only for the content of the Drawings and Specifications which were prepared or directly supervised by each design firm, as briefly described below each seal, and does not accept responsibility for the content of any Drawings or Specifications which were not prepared or supervised by each design firm.





Name: Michael Decoster Firm: Stantec Design Responsibility: Architectural



Name: Caz Zalewski Firm: Stantec Design Responsibility: Mechanical Name: Athanacios N. Nasr Firm: IMEG Corp Design Responsibility: Structural



Name: Jason Decheck Firm: Stantec Design Responsibility: Electrical

END OF SECTION 00 01 07

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SECTION 000110 - TABLE OF CONTENTS

DOCUMENT ISSUE DESCRIPTION/PURPOSE

ISSUE ID

DATE

DATE

PROCUREMENT AND CONTRACTING REQUIREMENTS GROUP

NUMBER TITLE

ISSUE ID

DIVISION 00 - PROCUREMENT AND CONTRACTING REQUIREMENTS

INTRODUCTORY INFORMATION

00 01 01Project Title Page	BID SET 12-09-2022
00 01 07Seals Page	BID SET 12-09-2022
00 01 10	BID SET 12-09-2022

PROCUREMENT AND CONTRACTING REQUIREMENTS

Subcontract Procurement and Contracting Documents prepared by the Construction Manager are bound separately, and are not enumerated herein.

SPECIFICATIONS GROUP

General Requirements Subgroup

DIVISION 01 - GENERAL REQUIREMENTS	
01 33 00Submittal Procedures	BID SET 12-09-2022
DIVISION 02 - EXISTING CONDITIONS	
02 41 19Selective Demolition	OWNER REVIEW 12-09-2022
DIVISION 03 - CONCRETE	
03 01 30Maintenance of Cast-in-Place Concrete 03 20 00Concrete Reinforcement 03 30 00Cast-in-Place Concrete	BID SET12-09-2022 BID SET12-09-2022 BID SET12-09-2022
DIVISION 04 - MASONRY	
04 05 13Mortar 04 20 00Unit Masonry 04 22 00Reinforced Unit Masonry	BID SET12-09-2022 BID SET12-09-2022 BID SET12-09-2022 BID SET12-09-2022
DIVISION 05 - METALS	
05 05 23Welding 05 12 23Structural Steel 05 31 00Steel Deck 05 53 00Steel Grating and Steel Floor Plates	BID SET
DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES	
06 10 00Rough Carpentry	BID SET12-09-2022

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

DIVISION 08 - OPENINGS

08 11 13	.Hollow Metal Doors and Frames	BID	SET	.12-09-2022
08 71 00	.Door Hardware	BID	SET	.12-09-2022

DIVISION 09 - FINISHES

09 65 13BID SET 12-09-202
09 65 19BID SET12-09-202
09 91 00
09 91 00.13Paint System Schedule
09 91 00.15 MPI Paint Product Number Schedule BID SET 12-09-202

DIVISION 10 - SPECIALTIES

None issued

DIVISION 11 - EQUIPMENT

None issued

DIVISION 12 - FURNISHINGS

None issued

DIVISION 13 - SPECIAL CONSTRUCTION

None issued

DIVISION 14 -CONVEYING EQUIPMENT

14 24 00 Hydraulic Elevators BID SET 12-09-2022

DIVISION 15-19 - RESERVED

Facility Services Subgroup

DIVISION 20 - COMMON MECHANCIAL

20 05 00Common Work Results for Mechanical	BID SET 12-09-2022
20 05 13Common Motor Requirements for Mechanical Equipment	BID SET12-09-2022
20 05 29 Hangers and Supports	BID SET12-09-2022
20 05 48Vibration Controls	BID SET12-09-2022
20 05 53Mechanical Identification	BID SET12-09-2022
20 05 93 Testing Adjusting and Balancing	BID SET12-09-2022

20 07 00BID SET12-09-2022

DIVISION 21 - FIRE SUPPRESSION

None issued

DIVISION 22 - PLUMBING

22 13 16Sanitary Waste and Vent Piping	BID SET	12-09-2022
22 13 19Sanitary Waste Piping Specialties	BID SET	12-09-2022
22 14 29Sump Pumps	BID SET	12-09-2022

DIVISION 23 - HEATING, VENTILATING, AND AIR-CONDITIONING (HVAC)

23 09 00Instrumentation and Control for HVAC	BID SET	12-09-2022
23 31 13	BID SET	12-09-2022
23 33 00Air Duct Accessories	BID SET	12-09-2022
23 34 23HVAC Power Ventilators	BID SET	12-09-2022
23 81 16Split-System Air-Conditioners	BID SET	12-09-2022

DIVISION 24 - RESERVED

DIVISION 25 - INTEGRATED AUTOMATION

None issued

DIVISION 26 - ELECTRICAL

26 05 05Selective Demolition for Electrical.26 05 19Low-Voltage Electrical Power Conductors and Cables26 05 26Grounding and Bonding for Electrical Systems26 05 29Hangers and Supports for Electrical Systems26 05 33.13Conduit for Electrical Systems26 05 33.16Boxes for Electrical Systems26 05 53Identification for Electrical Systems26 05 73Power System Studies26 09 23Lighting Control Devices26 27 26Wiring Devices26 28 13Fuses26 28 16Enclosed Switches	BID SET
26 28 16 26 51 00 Interior Lighting	BID SET 12-09-2022 BID SET 12-09-2022

DIVISION 27 - COMMUNICATIONS

None issued

DIVISION 28 - ELECTRONIC SAFETY AND SECURITY

28 46 00Fire Detection and Alarm12-09-2022

DIVISION 29 - RESERVED

Site and Infrastructure Subgroup

DIVISION 30 - RESERVED

DIVISION 31 - EARTHWORK

DIVISION 32 – 39

None issued

Process Equipment Subgroup

DIVISION 40 - 49

None issued

END OF SECTION 000110

SECTION 01 3300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.
- B. Related Sections include the following:
 - 1. Division 01 Section "Project Management and Coordination" for submitting and distributing meeting and conference minutes and for submitting Coordination Drawings.
 - 2. Division 01 Section "Quality Requirements" for submitting test and inspection reports.
 - 3. Division 01 Section "Closeout Procedures" for submitting warranties.
 - 4. Divisions 02 through 49 Sections for specific requirements for submittals in those Sections.

1.3 DEFINITIONS

- A. Submittal Compliance Certificate: Certificate submitted by Construction Manager indicating that the Basis of Design product listed in the specifications will be installed. If accepted by Architect, Construction Manager need not submit each Action or Informational Submittal listed in the specification unless otherwise noted.
- B. Action Submittals: Written and graphic information that requires Architect's responsive action.
- C. Informational Submittals: Written information that does not require Architect's responsive action. Submittals may be rejected for not complying with requirements.

1.4 SUBMITTAL SCHEDULE

- A. Submittal Schedule: Submit electronic PDF of schedule. Arrange the following information in a tabular format:
 - 1. Scheduled date for each submittal required by the Contract Documents.
 - a. Indicate if large submittals, such as HVAC or fire protection, will be divided into multiple parts. Include scheduled dates for each separate part.
 - 2. Specification Section number and title.
 - 3. Submittal category (action or informational) and type (product data, sample, test report, etc.).
 - 4. Name of Subcontractor.
 - 5. Description of the Work covered.
 - 6. Scheduled dates for Architect's final release or approval.

B. Preparation:

- 1. Coordinate Submittal Schedule with list of subcontracts, the Schedule of Values, and Construction Manager's Construction Schedule.
- 2. Preliminary Submittal Schedule: Submit within the first 30 days of construction. List submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacturer or fabrication.
- 3. Complete Submittal Schedule: Submit concurrently with first application for payment.
- 4. Updated Submittal Schedule: Submit with each subsequent application for payment to reflect current status and changes in timing for submittals.

1.5 SUBMITTAL FORMATS

- A. Submittal Information: Include the following information in each submittal:
 - 1. Project name.
 - 2. Date.
 - 3. Name of Architect.
 - 4. Name of Subcontractor/Construction Manager.
 - 5. Name of firm or entity that prepared submittal.
 - 6. Names of subcontractor, manufacturer, and supplier.
 - 7. Unique submittal number, including revision identifier. Include Specification Section number followed by a decimal point and then a sequential number (i.e. 061000.01). Resubmittals shall include an alphanumeric suffix after another decimal point (i.e. 061000.01.A).
 - 8. Category and type of submittal.
 - 9. Submittal purpose and description.
 - 10. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
 - 11. Drawing number and detail references, as appropriate.
 - 12. Indication of full or partial submittal.
 - 13. Location(s) where product is to be installed, as appropriate.
 - 14. Other necessary identification.
 - 15. Remarks.
 - 16. Signature of transmitter.
- B. Options: Identify options requiring selection by Architect.
- C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.
- D. PDF Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.
- E. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will discard submittals received from sources other than Construction Manager.
 - 1. Transmittal Form: Provide locations on form for the following information:
 - a. Project name.
 - b. Date.
 - c. Destination (To:).
 - d. Source (From:).

- e. Names of subcontractor, manufacturer, and supplier.
- f. Category and type of submittal.
- g. Submittal purpose and description.
- h. Specification Section number and title.
- i. Drawing number and detail references, as appropriate.
- j. Transmittal number, numbered consecutively.
- k. Submittal and transmittal distribution record.
- I. Remarks.
- m. Signature of transmitter.
- 2. On an attached separate sheet, prepared on Construction Manager's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same label information as related submittal.

1.6 SUBMITTAL PROCEDURES

- A. General: Electronic copies of 2D CAD Drawings of the Contract Drawings will not be provided by Architect for subcontractor's use in preparing submittals. When requested in writing, Architect will furnish Construction Manager digital data files for use in preparing coordination drawings only.
 - 1. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to the Drawings.
 - 2. The digital data files are available in the version of software program they were created in. No translation by the Architect will be provided.
 - 3. Construction Manager shall execute a data licensing agreement in the form of Agreement included in Section 00 3100.13 BIM Release Form.
 - a. Subcontractors, and other parties granted access by Construction Manager to Architect's digital data files shall execute a data licensing agreement in the form of Agreement included in Section 00 3100.13 BIM Release Form.
- B. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
 - 1. Email: Prepare submittals as PDF package, and transmit to Architect by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Architect.
 - 2. Architect shall not be required to download and upload files to Construction Manager's web-based Project software.
- C. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
 - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 - 2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 - 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
 - 4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

- a. Architect and Construction Manager reserve the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- D. Submittals Schedule: Comply with applicable Division 01 requirements for list of submittals and time requirements for scheduled performance of related construction activities.
- E. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
 - 1. Initial Review: Allow **10** business days for initial review of each submittal. Allow additional time if processing must be delayed to permit coordination with subsequent submittals is required. Architect will advise Construction Manager when a submittal being processed must be delayed for coordination.
 - 2. Concurrent Review: Where concurrent review of submittals by the Architect's consultants, Owner, or other parties is required, allow **10** business days for initial review of each.
 - 3. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 - 4. Resubmittal Review: Allow **10** business days for review of each resubmittal.
 - 5. No extension of Contract Time will be authorized because of failure to transmit submittals enough in advance or the Work to permit processing.
- F. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
 - 1. Note date and content of previous submittal.
 - 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
 - 3. Resubmit submittals until they are marked "REVIEWED" or "REVIEWED AS NOTED".
 - a. The Architect's review of the Construction Manager's submittal will be limited to examination of an initial submission and one resubmittal.
 - 1) The Architect's review of additional submittals will be made only with the consent of the Owner after notification by the Architect.
 - 2) Construction Manager shall reimburse Owner for Architect's account for time spent in processing additional submittals at the hourly billing rate.
 - 3) Cost will be deducted from trade contractor's retention as a deduct Change Order.
- G. Distribution: Furnish electronic PDF and sample copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- H. Use for Construction: Use only final submittals with mark indicating action taken by Architect and Construction Manager in connection with construction.

1.7 SUBMITTAL COMPLIANCE CERTIFICATES

- A. General: If submitting a product listed as Basis of Design in the specifications, the Construction Manager may submit a Submittal Compliance Certificate in lieu of submitting individual Action and Informational Submittals.
 - 1. Certificate: See Section 01 3300.13 Submittal Compliance Certificate.
B. Acceptance: Architect will review each Submittal Compliance Certificate and will indicate whether certificate is accepted in lieu of individual submittal requirements listed in each specification. Exceptions will be noted by Architect.

1.8 ACTION SUBMITTALS

- A. General: Prepare and submit electronic Action Submittals required by individual Specification Sections.
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 - 1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
 - 2. Mark each copy of each submittal to show which products and options are applicable.
 - 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
 - 4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams that show factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
 - 5. Submit Product Data before Shop Drawings, and before or concurrent with Samples.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
 - 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
 - 2. BIM Incorporation: Construction Manager will incorporate subcontractor's Shop Drawing files into BIM established for Project.

- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other materials.
 - 1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 - 2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
 - a. Project name and submittal number.
 - b. Generic description of Sample.
 - c. Product name and name of manufacturer.
 - d. Sample source.
 - e. Number and title of applicable Specification Section.
 - f. Specification paragraph number and generic name of each item.
 - 3. Format: Provide PDF transmittal. Include digital image file illustrating Sample characteristics, and identification information for record.
 - 4. Disposition: Maintain sets of approved Samples at Project site, available for qualitycontrol comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Construction Manager.
 - 5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit two full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
 - 6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit three sets of Samples. Architect and Construction Manager will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record Sample.
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- E. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

- 1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Construction Manager if none is indicated.
- 2. Manufacturer and product name, and model number if applicable.
- 3. Number and name of room or space.
- 4. Location within room or space.
- F. NOT USED
- G. Material Safety Data Sheets (MSDSs): Will not be accepted as a submittal.

1.9 INFORMATIONAL SUBMITTALS

- A. General: Prepare and submit electronic Informational Submittals required by other Specification Sections.
 - 1. Architect will not return a reviewed electronic PDF.
- B. Coordination Drawings: Comply with requirements specified in Section 01 31 00 Project Management and Coordination.
- C. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- D. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.
- E. Certificates:
 - 1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
 - 2. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
 - 3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
 - 4. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
 - 5. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
 - 6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.
- F. Test and Research Reports:
 - 1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests

performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

- 2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
- 3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- 4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- 5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- 6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - a. Name of evaluation organization.
 - b. Date of evaluation.
 - c. Time period when report is in effect.
 - d. Product and manufacturers' names.
 - e. Description of product.
 - f. Test procedures and results.
 - g. Limitations of use.

1.10 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of subcontractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 - 1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to contractor to be designed or certified by a design professional.
 - 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.
- C. BIM Incorporation: Construction Manager will incorporate delegated-design drawing and data files into BIM established for Project.

1.11 CONSTRUCTION MANAGER'S REVIEW

- A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Construction Manager's Approval: Indicate Construction Manager's approval for each submittal with a uniform approval stamp. Include name of reviewer, date of Construction Manager's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.
 - 1. Architect will not review submittals received from Construction Manager that do not have Construction Manager's review and approval.
 - 2. Construction Manager's approval indicates that deviations from the Contract Documents, if any, have been specifically and prominently identified as such.

1.12 ARCHITECT'S REVIEW

- A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken.
 - 1. Architect will not review submittals that do not bear Construction Manager's approval stamp and will return without action.
- B. Architect's Action Code: Architect's review is only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. Approval of a specific item does not indicate approval of an assembly of which the item may be a component. Review does not constitute acceptance of deviations from the Contract Documents unless such deviations are clearly and prominently identified as such. Results of the Architect's review are indicated below. Final Action code by Architect governs.
 - 1. Final Release: Where submittals are marked "REVIEWED," that part of the Work covered by the submittal may proceed provided it complies with requirements of the Contract Documents; final acceptance will depend upon that compliance.
 - 2. Final But Restricted Release: When submittals are marked "REVIEWED AS NOTED" or "Make Corrections Noted", that part of the Work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and requirements of the Contract Documents; final acceptance will depend on that compliance.
 - 3. Returned for Resubmittal: When submittal is marked "REVISE AND RESUBMIT", do not proceed with that part of the Work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal in accordance with the notations; resubmit without delay. Repeat if necessary to obtain a different action mark.
 - a. Do not permit submittals marked "Revise and Resubmit" to be used at the Project site, or elsewhere where Work is in progress.
- C. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect and Construction Manager will forward each submittal to appropriate party.
- D. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.

- E. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- F. Architect will return without review submittals received from sources other than Construction Manager.
- G. Submittals not required by the Contract Documents will be returned by Architect without action.
- 1.13 CONSTRUCTION MANAGER'S RESPONSIBILITY
 - A. Upon return of reviewed submittals, review correction or modification markings and comments on submittal. Do not begin Work for which submittals are required until submittals have been reviewed and returned with action markings permitting release to proceed.
 - B. Verify field measurements as required prior to fabrication of materials.

PART 2 - PRODUCTS (not used)

PART 3 - EXECUTION (not used)

END OF SECTION 01 3300

SECTION 02 4100 - SELECTIVE DEMOLITION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. Selective demolition of building elements for alteration purposes.
- 1.3 RELATED REQUIREMENTS
 - A. NOT USED

1.4 DEFINITIONS

- A. Demolish (Demo): Dismantle a defined component of existing construction, remove it from the Site, and dispose of it either as specified or in lawful manner.
- B. Dispose: Remove from the Project Site in lawful manner.
- C. Reinstall: Install a removed component of existing construction into new construction as indicated. Restore to pre-demolition operational condition or to newly defined operational capacity if noted.
- D. Remove: Dismantle a defined component of existing construction in a manner which protects and preserves the component for future use/installation; definition includes lawful disposal, unless otherwise specifically indicated to be reinstalled, salvaged, or other described action.
- E. Salvage: Remove in a manner preserving the existing condition and integrity of the component, set aside, store and protect for future reinstallation.
- F. Protect: Prevent damage to existing materials and systems, including functionality of devices, operable parts and integration with overall systems.

1.5 REFERENCE STANDARDS

- A. 29 CFR 1926 U.S. Occupational Safety and Health Standards.
- B. NFPA 241 Standard for Safeguarding Construction, Alteration, and Demolition Operations.

1.6 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.
- 1.7 QUALITY ASSURANCE
 - A. Demolition Firm Qualifications: Company specializing in the type of work required.
 - 1. Minimum of five years of documented experience.
- PART 2 PRODUCTS -- NOT USED

PART 3 EXECUTION

3.1 SCOPE

- A. Remove other items as specifically indicated on Drawings.
- B. Remove items specifically indicated for salvage, relocation, and recycling.

3.2 GENERAL PROCEDURES AND PROJECT CONDITIONS

- A. Comply with other requirements specified in Section 01 7000.
- B. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
 - 1. Obtain required permits.
 - 2. Comply with applicable requirements of NFPA 241.
 - 3. Use of explosives is not permitted.
 - 4. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
 - 5. Provide, erect, and maintain temporary barriers and security devices.
 - 6. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
 - 7. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
 - 8. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
- C. Do not begin removal until receipt of notification to proceed from Owner.
- D. Do not begin removal until existing elements to be salvaged or relocated have been removed.

- E. Protect existing structures and other elements that are not to be removed.
 - 1. Provide bracing and shoring.
 - 2. Prevent movement or settlement of adjacent structures.
 - 3. Stop work immediately if adjacent structures appear to be in danger.
- F. Minimize production of dust due to demolition operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.
- G. If hazardous materials are discovered during removal operations, stop work and notify Architect and Owner; hazardous materials include regulated asbestos containing materials, lead, PCB's, and mercury.
- H. Perform demolition in a manner that maximizes salvage and recycling of materials.
 - 1. Comply with requirements of Section 01 7419.
 - 2. Set aside reusable, recyclable, and salvageable materials; store and deliver to collection point or point of reuse.

3.3 EXISTING UTILITIES

- A. Protect existing utilities to remain from damage.
- B. Do not disrupt public utilities without permit from authority having jurisdiction.
- C. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.
- D. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.
- E. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.
- F. Prepare building demolition areas by disconnecting and capping utilities outside the demolition zone; identify and mark utilities to be subsequently reconnected, in same manner as other utilities to remain.

3.4 SELECTIVE DEMOLITION FOR ALTERATIONS

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
 - 1. Verify that construction and utility arrangements are as indicated.
 - 2. Report discrepancies to Architect before disturbing existing installation.
 - 3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.
- B. Separate areas in which demolition is being conducted from other areas that are still occupied.

- C. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
- D. Remove existing work as indicated and as required to accomplish new work.
 - 1. Remove items indicated on Drawings.
- E. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Support existing ceiling supported systems and equipment as indicated.
 - 1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.
 - 2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
 - 3. Verify that abandoned services serve only abandoned facilities before removal.
 - 4. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification.
 - 5. Verify and document operational condition of systems and devices to be protected or removed and reinstalled prior to starting demolition. Report any non-functioning devices or systems to Owner. Confirm operation of existing devices and systems to the same or improved level of service at the conclusion of construction. Repair or replace non-functioning items that were negatively affected by construction activities.
- F. Protect existing work to remain.
 - 1. Prevent movement of structure; provide shoring and bracing if necessary.
 - 2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
 - 3. Repair adjacent construction and finishes damaged during removal work.
 - 4. Patch as specified for patching new work.
 - 5. Prevent devices and systems from failure or reduction of service due to demolition and/or construction activities.

3.5 DEBRIS AND WASTE REMOVAL

- A. Remove debris and trash from site.
- B. Remove from site all materials not to be reused on site; do not burn or bury.
- C. Leave site in clean condition, ready for subsequent work.
- D. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION 02 4100

SECTION 03 01 30 - MAINTENANCE OF CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. All items required for executing and completing the following:
 - 1. Removal of deteriorated concrete and subsequent replacement and patching.
 - 2. Floor joint repair.
 - 3. Epoxy crack injection.
 - 4. Corrosion-inhibiting treatment.
- B. Cast-in-place concrete, steel reinforcement, and placement of nonprestressed steel reinforcement are specified in Division 3.
- C. Structural notes indicated on the drawings regarding maintenance or repair of cast-in-place concrete shall be considered a part of this specification.

1.2 RELATED WORK

- A. Pertinent Sections of Division 01.
- B. Section 03 20 00 Concrete Reinforcement.
- C. Section 03 30 00 Cast-in-Place Concrete.
- D. Section 05 12 23 Structural Steel.
- E. Section 05 50 00 Metal Fabrications.

1.3 REFERENCES

- A. Codes and Standards: Comply with the provisions of the following codes, specifications, and standards, except where more stringent requirements are shown or specified. Where any provision of other pertinent codes and standards conflict with this specification, the more stringent provision shall govern.
 - 1. ACI 503.4 Standard Specifications for Repairing Concrete with Epoxy Mortars.
 - 2. ACI 503.7 Specification for Crack Repair by Epoxy Injection.
 - 3. ASTM C33 Standard Specification for Concrete Aggregates.
 - 4. ASTM C109 Standard Test Method for Compressive Strength of Hydraulic Cement Mortars.
 - 5. ASTM C150 Standard Specification for Portland Cement.
 - 6. ASTM C881 Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
- 1.4 QUALITY ASSURANCE
 - A. Manufacturer and Installation Qualifications:

MAINTENANCE OF CAST-IN-PLACE CONCRETE

- 1. Manufacturer:
 - a. Each manufactured bonding agent, cementitious patching mortar and crack injection adhesive manufacturer shall employ factory-trained technical representatives who are available for consultation and on-site inspections and assistance at no additional cost.
- 2. Installer: An entity that employs installers and supervisors who are trained and approved by the manufacturer to apply packaged patching mortar materials and epoxy crack injection materials.
- B. Maintenance Program: Prepare a written plan for maintenance of cast-in-place concrete, including each phase or process, protection of surrounding materials during operations, and control of debris during the work. Describe in detail materials, methods, equipment and sequence of operations to be used for each phase of the work.
- C. Mockups: Building mockups to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Deck Removal and Patching: Remove and repair approximately 50 square feet of deteriorated concrete deck.
 - 2. Floor Joint Repair: Cut out and reinstall joints in two separate areas approximately 4 feet long.
 - 3. Epoxy Crack Injection: Perform in two separate areas approximately 4 feet long.
 - 4. Approval of mockups does not constitute approval of deviations from the drawings unless Architect/Engineer specifically approves deviations in writing.

1.5 BID REQUIREMENTS

- A. Unit prices shall be issued to the Architect/Engineer prior to construction as part of the submittal package. Provide the following unit costs:
 - 1. Concrete Removal and Replacement or Patching (\$/cubic foot)
 - 2. Epoxy Crack Injection (\$/linear foot)
 - 3. Polymer Overlays (\$/square foot)

1.6 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, chemical composition, physical properties, test data and mixing, preparation and application instructions for each type of product.
- B. Samples: Cured samples for each exposed product and for each color or texture specified.
 - 1. Initial Selection:
 - a. Have each set of samples contain a close color range of at least three samples showing different mixes of materials that match the variations in the existing construction.
- C. Material Certificates: For each type of Portland cement and aggregate supplied for mixing or adding to products at site.

- D. Testing Agency Qualifications: When requested, the proposed testing agency shall submit data on qualifications for acceptance.
- E. Test Reports: Submit laboratory test reports for all products.
- F. Field quality control reports.
- G. Maintenance Program: Submit before work begins.
- 1.7 DELIVERY, STORAGE, AND HANDLING
 - A. Comply with manufacturer's written instructions for minimum and maximum temperature requirements and other conditions for storage.
 - B. Store cementitious materials off the ground, under cover, and in a dry location.
 - C. Store aggregates covered and in a dry location; maintain grading and other required characteristics and prevent contamination.

1.8 FIELD CONDITIONS

- A. Environmental Limitations for Epoxies: Do not apply when air and substrate temperatures are outside limits permitted by manufacturer. During hot weather, cool epoxy components before mixing, store mixed products in shade, and cool unused mixed products to retard setting. Do not apply to wet substrates unless approved by manufacturer.
 - 1. Use only Class A epoxies when substrate temperatures are below or are expected to go below 40°F within 8 hours.
 - 2. Use only Class A or B epoxies when substrate temperatures are below or are expected to go below 60°F within 8 hours.
 - 3. Use only Class C epoxies when substrate temperatures are above and are expected to stay above 60°F for 8 hours.
- B. Cold Weather Requirements for Cementitious Materials: Do not apply unless concrete surface and air temperatures are above 40°F and will remain so for at least 48 hours after completion of work.
- C. Cold Weather Requirements for Cementitious Materials: Comply with the following procedures:
 - 1. When air temperature is below 40°F, heat patching material ingredients and existing concrete to produce temperatures between 40°F and 90°F.
 - 2. When mean daily air temperature is between 25°F and 40°F, cover completed work with weather resistant insulating blankets for 48 hours after repair or provide enclosure and heat to maintain temperatures above 32°F for 48 hours after the repair.
 - 3. When mean daily air temperature is below 25°F, provide enclosure and heat to maintain temperatures above 32°F for 48 hours after the repair.

- D. Hot Weather Requirements for Cementitious Materials: Protect repair work when temperature and humidity conditions produce excessive evaporation of water from patching materials.
 Provide artificial shade and wind breaks and use cooled materials as required. Do not apply to substrates with temperatures of 90°F and above.
- E. Environmental Limitations for High-Molecular-Weight Methacrylate Sealers: Do not apply when concrete surface temperature is below 55°F or above 75°F. Apply only to substrates that have been dry for at least 72 hours.

PART 2 - PRODUCTS

2.1 BONDING AGENTS

- A. Epoxy-Modified, Cementitious Bonding and Anticorrosion Agent: Manufactured product consisting of water-insensitive epoxy adhesive, Portland cement and water-based solution of corrosion inhibiting chemicals forming a protective film on steel reinforcement.
 - 1. Products: Subject to compliance with requirements, that may be incorporated into the work include, but are not limited to, the following:
 - a. BASF Corporation MasterEmaco P124
 - b. Sika Chemical Corporation Armatec 110 EpoCem
 - 2. Epoxy Bonding Agent: ASTM C881, Type V and free of VOCs.
 - a. Manufacturers: Subject to compliance with requirements. Available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - 1) BASF Corporation
 - 2) Sika Chemical Corporation

2.2 PATCHING MORTAR

- A. General:
 - 1. Only use patching mortars that are recommended by manufacturer for each applicable horizontal, vertical or overhead use.
 - 2. Color and Aggregate Texture: Provide patching mortar and aggregates of colors and sizes necessary to produce patching mortar that matches existing, adjacent, exposed concrete. Blend several aggregates, if necessary, achieve suitable matches.
 - 3. Coarse Aggregate for Patching Mortar: ASTM C33, washed aggregate, Size No. 8, Class 5S. Add to patching mortar mix only as permitted by manufacturer.
- B. Cementitious Patching Mortar: Packaged, dry mix for repair of concrete.
 - 1. Manufacturers: Subject to compliance with requirements. Available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. BASF Corporation

- b. Sika Chemical Corporation
- 2. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C109.

2.3 JOINT FILLER

- A. Epoxy Joint Filler: Two-component, semi-rigid, 100 percent solids, epoxy resin with a Type A Shore durometer hardness of at least 80 according to ASTM D2240.
 - 1. Products: Subject to compliance with requirements. Available products that may be incorporated into the work include, but are not limited to, the following:
 - a. BASF Corporation MasterSeal CR 190
 - b. Sika Chemical Corporation Sikadur 51 NS
- B. Polyurea Joint Filler: Two-component, semi-rigid, 100 percent solids, polyurea resin with a Type A Shore durometer hardness of at least 80 according to ASTM D2240.
 - 1. Color: Matching existing joint filler.

2.4 EPOXY CRACK-INJECTION MATERIALS

- A. Epoxy Crack-Injection Adhesive: ASTM C881, Type IV, free of VOCs.
 - 1. Manufacturers: Subject to compliance with requirements. Available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. BASF Corporation
 - b. Sika Chemical Corporation

2.5 OTHER MATERIALS

- A. Corrosion Inhibiting Treatment: Waterborne solution of alkaline corrosion inhibiting chemicals for concrete surface application that penetrates concrete by diffusion and forms a protective film on steel reinforcement.
 - 1. Products: Subject to compliance with requirements. Available products that may be incorporated into the work include, but are not limited to, the following:
 - a. Sika Chemical Corporation Sika FerroGard 903
- B. Polymer Overlay: Epoxy adhesive complying with ASTM C881, Type III, with surface-applied aggregate for skid resistance; free of VOCs.
 - 1. Manufacturers: Subject to compliance with requirements. Available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. Sika Chemical Corporation

- C. Polymer Sealer: Low-viscosity epoxy or high-molecular-weight methacrylate penetrating sealer and crack filler recommended by manufacturer for penetrating and sealing cracks in exterior concrete traffic surfaces; free of VOCs.
 - 1. Products: Subject to compliance with requirements. Available products that may be incorporated into the work include, but are not limited to, the following:
 - a. Color: As selected by Architect/Engineer from full range of industry colors.

2.6 MIXES

- A. General: Mix products, in clean containers, according to manufacturer's written instructions.
 - 1. Do not add water, thinners or additives unless recommended by manufacturer.
 - 2. When practical, use manufacturer's premeasured packages to ensure materials are mixed in proper proportions. When premeasured packages are not used, measure ingredients using graduated measuring containers; do not estimate quantities or use shovel and trowel as unit of measure.
 - 3. Do not mix more materials than can be used within time limits recommended by manufacturer. Discard materials that have begun to set.
- B. Concrete: Comply with Division 03 Section 03 30 00 Cast-in-Place Concrete.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Notify Architect/Engineer seven (7) days in advance of dates when areas of deteriorated or delaminated concrete and deteriorated reinforcing bars will be located.
- B. Locate areas of deteriorated or delaminated concrete using hammer or chain-drag sounding and mark boundaries. Mark areas for removal by simplifying and squaring off boundaries. At columns and walls, make boundaries level and plumb unless otherwise indicated.
- C. Pachometer Testing: Locate at least three (3) reinforcing bars using a pachometer, and drill test holes to determine depth of cover. Calibrate pachometer using depth of cover measurements and verify depth of cover in removal areas using pachometer.
- D. Perform surveys as the work progresses to detect hazards resulting from concrete maintenance work.

3.2 PREPARATION

- A. Ensure supervisory personnel are on site and on duty when concrete maintenance work begins and during its progress.
- B. Preparation for Removal of Deteriorated Concrete: Examine construction to be repaired to determine best methods to safely and effectively perform concrete maintenance work. Examine adjacent work to determine what protective measures will be necessary. Make explorations, probes, and inquiries as necessary to determine condition of construction to be removed during repair.

- 1. Verify that affected utilities have been disconnected and capped.
- 2. Inventory and record the condition of items to be removed for reinstallation or salvage.
- 3. Provide and maintain shoring, bracing, and temporary structural supports as required to preserve stability and prevent unexpected or uncontrolled movement, settlement, or collapse of construction being demolished and construction and finishes to remain.
- C. Protect persons, motor vehicles, surrounding surfaces of building being restored, building site, plants, and surrounding buildings from harm resulting from concrete maintenance work.
 - 1. Comply with each product manufacturer's written instructions for protections and precautions. Protect against adverse effects of products and procedures on people and adjacent materials, components, and vegetation.
 - 2. Use only proven protection methods appropriate to each area and surface being protected.
 - 3. Provide barricades, barriers, and temporary directional signage to exclude the public from areas where concrete maintenance work is being performed.
 - 4. Erect temporary protective covers over walkways and at points of pedestrian and vehicular entrance and exit that must remain in service during course of concrete maintenance work.
 - 5. Contain dust and debris generated by concrete maintenance work and prevent it from reaching the public or adjacent surfaces.
 - 6. Use water-mist sprinkling and other wet methods to control dust only with adequate, approved procedures and equipment, ensuring water will not create a hazard or adversely affect other building areas or materials.
 - 7. Protect floors and other surfaces along haul routes from damage, wear, and staining.
 - 8. Provide supplemental sound control treatment to isolate removal and dismantling work from other areas of the building.
 - 9. Protect adjacent surfaces and equipment by covering them with heavy polyethylene film and waterproof masking tape or a liquid strippable masking agent. If practical, remove items, store, and reinstall after potentially damaging operations are complete.
 - 10. Neutralize and collect alkaline and acid wastes for disposal off Owner's property.
 - 11. Dispose of debris and runoff from operations by legal means and in a manner that prevents soil erosion, undermining of paving and foundations, damage to landscape, and water penetration into building interiors.
- D. Existing Drains: Prior to the start of work in an area, test drainage system to ensure it is functioning properly. Notify Architect/Engineer immediately of inadequate drainage or blockage. Do not begin work in an area until the drainage system is in working order.
 - 1. Prevent solids such as aggregate or mortar residue from entering the drainage system. Clean out drains and drain lines that become sluggish or blocked by sand or other materials resulting from concrete maintenance work.
 - 2. Protect drains from pollutants. Block drains or filter out sediments, allowing only clean water to pass.
- E. Concrete Removal:
 - 1. Provide shoring, bracing, and supports, as necessary. Strengthen or add new supports when required during progress of removal work. Do not overload structural elements with debris.
 - 2. Saw-cut perimeter of areas indicated for removal to a depth of at least 1/2 inch. Make cuts perpendicular to concrete surfaces and no deeper than cover on reinforcement.

- 3. Remove deteriorated and delaminated concrete by breaking up and dislodging from reinforcement.
- 4. Remove additional concrete, if necessary, to provide a depth of removal of at least 1/2 inch over entire removal area.
- 5. Where half or more of the perimeter of reinforcing bar is exposed, bond between reinforcing bar and surrounding concrete is broken or reinforcing bar is corroded, remove concrete from entire perimeter of bar and to provide at least a 3/4-inch clearance around the bar.
- 6. Test areas where concrete has been removed by tapping with hammer and remove additional concrete until unsound and debonded concrete is completely removed.
- 7. Provide surfaces with a fractured profile of at least 1/8 inch that are approximately perpendicular or parallel to original concrete surfaces. At columns and walls, make top and bottom surfaces level unless otherwise directed.
- 8. Thoroughly clean removal areas of loose concrete, dust and debris.
- F. Reinforcing Bar Preparation: Remove loose and flaking rust from reinforcing bars by wire brushing until only tightly adhered light rust remains.
 - 1. Where section loss of reinforcing bar is more than 20 percent, or 15 percent in two or more adjacent bars, cut bars and remove and replace. Remove additional concrete as necessary to provide at least 3/4-inch clearance at existing and replacement bars. Splice replacement bars to existing bars according to ACI 318 by lapping, welding, or using mechanical couplings.
- G. Preparation of Floor Joints for Repair: Saw cut joints full width to edges and depth of spalls, but not less than 3/4 inch deep. Clean out debris and loose concrete, vacuum or blow clear with compressed air.
- H. Surface Preparation for Corrosion Inhibiting Treatment: Clean concrete to remove dirt, oils, films, and other materials detrimental to treatment application.
- I. Surface Preparation for Overlays:
 - 1. Remove delaminated material and deteriorated concrete surface material.
 - 2. Roughen surface of concrete to produce a surface profile matching CSP [3][4][5][6][7][8][9] according to ICRI 03732.
- J. Surface Preparation for Sealers: Acid etch surface of concrete to produce a surface profile matching CSP 1 according to ICRI 03732. Prepare surface for acid etching by detergent scrubbing to remove oils and films that may prevent acid penetration.
 - 1. Remove excess acid solution, reaction products, and debris by squeegeeing or vacuuming.
 - 2. Scrub surface with an alkaline detergent, rinse, and squeegee or vacuum.
 - 3. Check acidity or surface with pH test paper and continue rinsing until pH is acceptable to written requirements of sealer manufacturer.
 - 4. When pH is acceptable to written requirements of sealer manufacturer and surface is clean, vacuum dry.
- K. Surface Preparation for Sealers: Clean concrete to remove dirt, oils, films, and other materials detrimental to sealer application.

3.3 APPLICATION

- A. General: Comply with manufacturer's written instructions and recommendations for application of products, including surface preparation.
- B. Mortar Scrub Coat for Job Mixed Patching Mortar and Concrete Dampen repair area and surrounding concrete 6 inches beyond repair area. Remove standing water and apply scrub coat with a brush, scrubbing it into surface and throughly coating repair area. If scrub coat dries, recoat before placing patching mortar or concrete.
- C. Dry Pack Mortar: Use for deep cavities and where indicated. Place as follows unless otherwise recommended in writing by manufacturer:
 - 1. Provide forms where necessary to confine patch to required shape.
 - 2. Wet substrate and forms thoroughly and then remove standing water.
 - 3. Place dry-pack mortar into cavity by hand and compact tightly into place. Do not place more material at a time than can be properly compacted. Continue placing and compacting until patch is approximately level with surrounding surface.
 - 4. After cavity is filled and patch is compacted, trowel surface to match profile and finish of surrounding concrete. A thin coat of patching mortar may be troweled into the surface of patch to help obtain required finish.
 - 5. Wet-cure patch for not less than seven days by water-fog spray or water-saturated absorptive cover.
- D. Concrete: Place according to Division 03, Section 03 30 00 Cast-in-Place Concrete and as follows:
 - 1. Pretreatment: Apply epoxy-modified, cementitious bonding and anticorrosion agent to reinforcement and concrete substrate.
 - 2. Pretreatment: Apply latex bonding agent to concrete substrate.
 - 3. Standard Placement:
 - a. Use vibrators to consolidate concrete as it is placed.
 - b. At unformed surfaces, screed concrete to produce a surface when finished with patching mortar will match required profile and surrounding concrete.
 - 4. Form and Pump Placement: Place concrete were indicated by form and pump method.
 - a. Design and construct forms to resist pumping pressure in addition to wet concrete weight. Seal joints and seams in forms and where forms abut existing concrete.
 - b. Pump concrete into place from bottom to top, releasing air from forms as concrete is introduced. When formed space is full, close air vents and pressurize to 14 psi.
 - 5. Wet-cure concrete for not less than seven days by leaving forms in place or keeping surfaces continuously wet by water-fog spray or water-saturated absorptive cover.
 - 6. Fill placement cavities with dry-pack mortar and repair voids with patching mortar. Finish to match surrounding concrete.
- E. Grouted Preplaced Aggregate Concrete: Use where indicated. Place as follows:

- 1. Design and construct forms to resist pumping pressure in addition to wet grout weight. Seal joints and seams in forms and where forms abut existing concrete.
- 2. Apply [epoxy-modified cementitious bonding and anticorrosion agent][epoxy bonding agent] to reinforcement and concrete substrate.
- 3. Place aggregate in forms, consolidating aggregate in lifts as it is placed. Pack aggregates into upper areas of forms to achieve intimate contact with concrete surfaces.
- 4. Fill forms with water to thoroughly dampen aggregate and substrates. Drain water from forms before placing grout.
- 5. Pump grout into place at bottom of preplaced aggregate, forcing grout upward. Release air from forms at top as grout is introduced. When formed space is full and grout flows from air vents, close vents and pressurize to 14 psi.
- 6. Wet-cure concrete for not less than seven days by leaving forms in place or keeping surfaces continuously wet by water-fog or water-saturated absorptive cover.
- 7. Repair voids with patching mortar and finish to match surrounding concrete.
- F. Floor Joint Repair: Cut out deteriorated concrete [and reconstruct sides of joint with patching mortar] as indicated on the drawings. Install joint filler in nonmoving floor joints were indicated and as follows:
 - 1. Depth: Install joint filler to a depth of at least [3/4 inch] [1 inch] [2 inches]. Use fine silica sand no more than [1/4-inch] deep to close base of joint. Do not use sealant backer rods or compressible fillers below joint filler.
 - 2. Top Surface: Install joint filler so when cured, it is flush at top surface of adjacent concrete. If necessary, overfill joint and remove excess when filler has cured.
- G. Epoxy Crack Injection:
 - 1. Clean areas to receive capping adhesive of oil, dirt, and other substances that would interfere with bond, and clean cracks with oil-free compressed air or low-pressure water to remove loose particles.
 - 2. Place injection ports as recommended by epoxy manufacturer, spacing no farther apart than thickness of member being injected. Seal injection ports in place with capping adhesive.
 - 3. Seal cracks at exposed surfaces with a ribbon of capping adhesive at least [1/4 inch by 1 inch] wider than crack.
 - 4. Inject cracks wider than [0.003 inch to a depth of 8 inches].
 - 5. Inject epoxy adhesive, beginning at widest part of crack and working toward narrower parts. Inject adhesive into ports to refusal, capping adjacent ports when they extrude epoxy. Cap injected ports and inject through adjacent ports until crack is filled.
 - 6. After epoxy adhesive has set, remove injection ports, and grind surface smooth.
- H. Corrosion Inhibiting Treatment: Apply by brush, roller, or airless spray in two coats at manufacturer's recommended application rate. Remove film of excess treatment by high-pressure washing before patching treated concrete or applying a sealer or overlay.

END OF SECTION

SECTION 03 20 00 - CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Fabrication and placement of reinforcing steel for concrete and all related accessories.
- B. Reinforcing steel for use in bond beams, masonry columns, and lintels is specified in Division 4 and is not a part of the work in this section.
- C. Structural notes indicated on the drawings regarding concrete reinforcement shall be considered a part of this specification.

1.2 RELATED WORK

- A. Pertinent Sections of Division 01.
- B. Section 03 10 00 Concrete Formwork.
- C. Section 03 30 00 Cast-in-Place Concrete.

1.3 REFERENCES

- A. Codes and Standards: Comply with the provisions of the following codes, specifications, and standards, except where more stringent requirements are shown or specified. Where provisions of other pertinent codes and standards conflict with this specification, the more stringent provision shall govern.
 - 1. ACI 117 Specification for Tolerances for Concrete Construction and Materials.
 - 2. ACI 301 Specifications for Structural Concrete.
 - 3. ACI 318 Building Code Requirements for Structural Concrete.
 - 4. ACI SP-066 ACI Detailing Manual.
 - 5. ASTM A184 Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement.
 - 6. ASTM A370 Standard Test Methods and Definitions for Mechanical Testing of Steel Products
 - 7. ASTM A615 Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - 8. ASTM A706 Standard Specification for Deformed and Plain Low-Allow Steel Bars for Concrete Reinforcement.
 - 9. ASTM A775 Standard Specification for Epoxy-Coated Steel Reinforcing Bars.
 - 10. ASTM A934 Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars
 - 11. ASTM D3963 Standard Specification for Fabrication and Jobsite Handling of Epoxy-Coated Steel Reinforcing Bars.
 - 12. AWS D1.4 Structural Welding Code Reinforcing Steel.
 - 13. AWD D1.8 Structural Welding Code Seismic Supplement.
 - 14. Concrete Reinforcing Steel Institute (CRSI) Manual of Standard Practice.

1.4 SUBMITTALS

- A. Placing Drawings: Submit placing drawings showing fabrication dimensions and locations for placement of reinforcement and reinforcement accessories. Indicate bar sizes, spacing, locations, and quantities of reinforcing steel, bending and cutting diagrams, anchors, and supporting and spacing devices. Dowels shall be shown in placing drawings for the element that is to be placed first. Reinforcing steel descriptions or shop drawings shall be inch-pound sizes.
- B. Splices: Submit request for splices not indicated in the Contract Documents. Request shall indicate locations, types, and lengths of splices for approval.
- C. Field Bending: Submit requests and procedure for field bending or straightening of reinforcement partially embedded in concrete not described in the Contract Documents.
- D. Reinforcement Relocation: Submit requests to adjust reinforcement spacing necessitated by conflicts with other reinforcement, conduits, etc. for approval.
- E. Mechanical Connections: Submit request for the use of mechanical connections not shown on the project drawings. Include engineering data on proprietary connection devices for approval.
- F. Welding Procedure Specifications: For welding of reinforcing steel, include designations of processes (e.g. SMAW, GAMW, FCAW, etc.), weld symbols, and details. All WPS shall be qualified by current Procedure Qualification Record (PQR) per AWS D1.4 and approved by the Structural Engineer [and HCAI].
- G. Epoxy Coating: Submit product data for the proposed coating material.
- H. Supports for Coated Reinforcement: Submit description of reinforcement supports and material for fastening coated reinforcement.
- I. Alternative Reinforcement: Submit request to relocate any reinforcing bars that exceeds placement tolerances.

1.5 COORDINATION

A. Coordinate reinforcement installation with the placement of formwork and other embedded items such as inserts, conduit, pipe sleeves, drains, metal supports, anchor rods, etc.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver reinforcement to the jobsite in bundles sorted and labeled with durable tags indicating bar size, length, and shop drawing mark. Bundles shall also bear testing laboratory tags indicating identified steel.
- B. Store elevated clear of ground and protect at all times from contamination and deterioration.
- C. Prevent bending, coating with earth, oil, or other material, or otherwise damaging the reinforcement.

- D. For handling coated reinforcement, use equipment having contact areas padded to avoid damaging the coating. Lift bundles of coated reinforcement at multiple pick points to prevent bar-to-bar abrasion from sags in the bundles.
- E. Do not drop or drag coated reinforcement. Take all necessary steps to minimize damage to coating. Damaged coatings shall be patched.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Bar Deformations: Bars used for reinforcement shall be deformed except column spirals and welded wire reinforcement, which may be plain.
- B. Reinforcing Steel: Reinforcing steel shall conform to the ASTM standard and grade indicated in the General Notes on the drawings.
- C. Epoxy Patching Material: Use only patching material approved by epoxy coating manufacturer, compatible with epoxy coating and inert in fresh and hardened concrete. The maximum amount of repaired damaged areas shall not exceed 2 percent of the surface area in each lineal foot of each bar. Bars with damaged epoxy-coating areas exceeding this limit are to be rejected.
- D. Welded Wire Reinforcement: Welded wire reinforcement shall conform to the ASTM standard indicated in the General Notes on the drawings.
- E. Epoxy-Coated Joint Dowel Bars: Plain steel bars. Cut bars true to length with square ends and free of burrs. Patch with epoxy material.
- F. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, precast concrete, or fiber-reinforced concrete of greater compressive strength than concrete, and as follows:
 - 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected or CRSI Class 2 stainless-steel bar supports.
 - 2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
 - 3. Concrete cast against earth: Bars may be supported by precast concrete bricks or approved prefabricated wire bar supports complying with CRSI recommendations with footpads large enough to support the weight of the bars and construction traffic without being pushed into underlying grade. Precast concrete blocks shall have a minimum compressive strength of 6,000 psi.

2.2 FABRICATION

- A. Fabrication Tolerances: Reinforcing steel shall be shop fabricated within tolerances according to ACI 117 and other applicable codes, and shall conform in size, shape, quantity, dimensions, etc. to the construction drawings and approved shop drawings.
- B. Bar Condition: Bars shall be free from mill scale, excessive rust, and other coatings, which would reduce or destroy the bond with the concrete. Wipe oil from forms before reinforcement is placed on or adjacent to so that oil will not be tracked over or in any way come into contact with the reinforcement.
- C. Bars Bending: Bars shall be bent cold, and no method of fabrication shall be used which would be injurious to the material. Heating of bars for bending is not permitted.
- D. Identification: After fabrication, bars shall be sorted, bundled, and tagged with metal tags bearing the bar mark before delivery to the jobsite.
- E. Splicing:
 - 1. Continuous reinforcing in beams and grade beams shall be lapped as follows unless noted otherwise:
 - a. Top bars: Midspan
 - b. Bottom bars: Directly over support
 - 2. Column splice reinforcing bars shall have shop fabricated offset bends at splices. Column lap splices shall be [**30 bar diameters**] unless noted otherwise.
 - 3. Locate reinforcing splices not indicated on drawings at point of minimum stress. Review location of splices with the Structural Engineer and obtain written approval prior to proceeding.
- F. Where beams and grade beams are simple span, top bars shall be continuous for full length and hooked down at each end.
- G. Reinforcing for continuous footings shall extend into spread footings a minimum of 2'-0".
- H. Bending of Epoxy-Coated Bars: Bending of epoxy coated reinforcing bars shall conform to the epoxy manufacturer's specified requirements.
- I. Dowels between footings and walls or columns shall be the same grade, size and spacing or number as the vertical reinforcing respectively, unless noted otherwise.
- J. Welding: Do not weld crossing bars (tack welding) for assembly of reinforcement, supports, or embedded items.
- K. Epoxy Coating Applications: Prepare bar in accordance with requirements of epoxy manufacturer. Coating shall be applied to the cleaned surface as soon as possible after cleaning and before visible oxidation of the surface occurs, but in no case shall more than eight hours elapse.

- L. Epoxy Coating Thickness: Electrostatically apply coating as specified by powder coating supplier.
 - 1. Thickness after curing: 7 mils with a tolerance of plus 3 mils and minus 2 mils.
 - 2. Check coating visually after cure for continuity. It shall be free from holes, voids, contamination, cracks, and damaged areas. Patch defects in accordance with manufacturer's recommendations.

PART 3 - EXECUTION

3.1 PLACING

- A. Reinforcement Relocation: When necessary to move reinforcement beyond the specified spacing to avoid interference with other reinforcement, or embedded items, submit resulting arrangement of reinforcement to Structural Engineer for approval.
- B. Reinforcement Cutting: Cutting of reinforcement which conflicts with embedded objects is not acceptable.
- C. Column Dowels: Furnish and use templates for placement of column dowels unless approved in writing by the Structural Engineer.
- D. Wire Tie Orientation: Set wire ties so ends are directed away from the concrete surface.
- E. Slab on Grade Reinforcement Placement: Place shrinkage and temperature reinforcement 1/3 of the slab thickness from the top surface of the slabs on grade unless noted otherwise on the drawings.
- F. Do not cut, displace, or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- G. Support for Reinforcement: Unless noted otherwise, supports for reinforcement shall have Class 2 protection as defined in the CRSI Manual of Standard Practice. Submit data on supports indicating class of protection at all different locations for approval. Supports shall not be used as bases for runways for concrete-conveying equipment and similar construction loads. Do not place reinforcing bars more than 2" beyond last leg of any continuous bar support.
- H. Support for Coated Reinforcement: Supports for coated reinforcement shall have Class 1 protection as defined in the CRSI Manual of Standard Practice. Submit data on supports and coatings for approval.
- I. Support for Bars in Concrete Cast on Ground: Bar supports for slabs on grade, grade beams, footings, and all other concrete cast directly onto grade shall be supported at an average spacing of 4 feet or less in each direction.
- J. Securing Reinforcing Bars: All bars must be placed, spaced, secured, and supported prior to casting concrete. Bars embedded in hardened or partially hardened concrete shall not be bent unless approved in writing prior to placement by the Structural Engineer.

- K. Foot Traffic: Restrict foot traffic over the slab on grade reinforcing after it has been properly positioned.
- L. Reinforcement at Expansion Joints: Do not continue reinforcement or other embedded metal items bonded to concrete through expansion joints. Dowels bonded on only one side of a joint and waterstops may extend through joint.
- M. Pumping Concrete: When using a pump to place concrete, pump hose shall be supported directly on forms. Do not allow hose to rest on reinforcing bars if doing so could cause displacement of bars.

END OF SECTION

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. All items required for executing and completing the cast-in-place concrete work and related work shown on the drawings or specified herein. Work shall include installation of items furnished in other sections of these specifications.
- B. Structural notes indicated on the drawings regarding cast-in-place concrete shall be considered a part of this specification.

1.2 RELATED WORK

- A. Pertinent Sections of Division 01.
- B. Section 03 10 00 Concrete Formwork.
- C. Section 03 20 00 Concrete Reinforcement.
- D. Section 03 38 10 Unbonded Post-Tensioned Concrete.
- E. Section 05 31 00 Steel Deck.

1.3 REFERENCES

- A. Codes and Standards: Comply with the provisions of the following codes, specifications, and standards, except where more stringent requirements are shown or specified. Where any provision of other pertinent codes and standards conflict with this specification, the more stringent provision shall govern.
 - 1. ACI 117 Specification for Tolerances for Concrete Construction and Materials.
 - 2. ACI 301 Specifications for Structural Concrete.
 - 3. ACI 302.1R Guide to Concrete Floor and Slab Construction.
 - 4. ACI 302.2R Guide for Concrete Slabs that Received Moisture-Sensitive Flooring Materials.
 - 5. ACI 303.1 Standard Specification for Cast-in-Place Architectural Concrete.
 - 6. ACI 304R Guide to Measuring, Mixing, Transporting, and Placing Concrete.
 - 7. ACI 305.1 Specification for Hot Weather Concreting.
 - 8. ACI 306.1 Guide to Cold Weather Concreting.
 - 9. ACI 308R Guide to External Curing of Concrete.
 - 10. ACI 309R Guide for Consolidation of Concrete.
 - 11. ACI 318 Building Code Requirements for Structural Concrete.
 - 12. ACI 347R Guide to Formwork for Concrete.
 - 13. ASTM C31 Standard Practice for Making and Curing Concrete Test Specimens in the Field.
 - 14. ASTM C33 Standard Specification for Concrete Aggregates.

- 15. ASTM C39 Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
- 16. ASTM C42 Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
- 17. ASTM C88 Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
- 18. ASTM C94 Standard Specification for Ready-Mixed Concrete.
- 19. ASTM C131 Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
- 20. ASTM C138 Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.
- 21. ASTM C143 Standard Test Method for Slump of Hydraulic Cement Concrete.
- 22. ASTM C150 Standard Specification for Portland Cement.
- 23. ASTM C157 Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete
- 24. ASTM C171 Standard Specification for Sheet Materials for Curing Concrete.
- 25. ASTM C172 Standard Practice for Sampling Freshly Mixed Concrete.
- 26. ASTM C173 Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
- 27. ASTM C231 Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
- 28. ASTM C260 Standard Specification for Air-Entraining Admixtures for Concrete.
- 29. ASTM C309 Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
- 30. ASTM C494 Standard Specification for Chemical Admixtures for Concrete.
- 31. ASTM C979 Standard Specification for Pigments for Integrally Colored Concrete.
- 32. ASTM C1017 Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
- 33. ASTM C1059 Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete.
- 34. ASTM C1064 Standard Test Method for Temperature of Freshly Mixed Hydraulic Cement Concrete.
- 35. ASTM C1077 Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation.
- 36. ASTM C1107 Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
- 37. ASTM D1751 Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
- 38. ASTM D2103 Standard Specification for Polyethylene Film and Sheeting.
- 39. ASTM E154 Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.
- 40. ASTM E329 Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.
- 41. ASTM E1155 Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers.
- 42. ASTM E1745 Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.
- 43. Concrete Reinforcing Steel Institute (CRSI) Manual of Standard Practice.

1.4 SAMPLING AND TESTING REQUIREMENTS

- A. Maintain records verifying materials used are of the specified and accepted types and sizes and are in conformance with the requirements of the Contract Documents.
- B. Use of testing services will not relieve the Contractor of the responsibility to furnish materials and construction in full compliance with the Contract Documents.
- C. Take samples of fresh concrete at the job site for each mix design placed each day. Sampling and testing shall be done after the final addition and proper mixing of any water or admixtures that are added on site.
 - 1. Personnel and testing equipment shall meet the requirements of ASTM E329.
 - 2. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
 - 3. Testing Frequency: Obtain at least one composite sample for each 150 cu. yd. or 5,000 sq. ft. of surface area, whichever is less or fraction thereof of each concrete mixture placed each day.
 - a. On a given project, if the total volume of concrete is such that the frequency of testing required above would provide less than five strength tests for a given class of concrete, tests shall be made from at least five randomly selected batches or from each batch if fewer than five batches are used.
 - 4. A strength test shall be the average of the strengths of two 6x12 inch or three 4x8 inch cylinders made from the same sample of concrete and tested at 28 days.
- D. For each sample of fresh concrete, perform the following duties:
 - 1. Measure and record slump in accordance with ASTM C143.
 - 2. Measure and record temperature in accordance with ASTM C1064.
 - a. Provide one test hourly when air temperature is 40°F and below and when 80°F and above, and one test for each composite sample.
 - 3. Measure and record air content by volume in accordance with either ASTM C231 or ASTM C173.
 - a. Wet cure specimens for a period of seven (7) days (including the period of time the specimens are in the mold). Wet cure may be achieved through storage in a moist cabinet or room in accordance with ASTM C511, or through storage in lime-saturated water.
 - b. Slump of concrete for testing shall match job requirements and need not be limited to the restrictions as stated in ASTM C157.
 - c. Report results in accordance with ASTM C157 at 0, 7, 14 and 28 days of drying.
 - 4. Mold three 6x12 inch or four 4x8 inch cylinders (laboratory cylinders) in accordance with ASTM C31 to be laboratory-cured. Protect from moisture loss and maintain at 60°F to 80°F for 24 to 48 hours before moving. Deliver cylinders to testing laboratory for curing and testing.

- 5. Mold one cylinder (field cylinder) in accordance with ASTM C31 to be field-cured. Field cylinder shall be placed as near as possible to the in-place concrete from which it was taken, protected, and cured in the same manner. Deliver field-cured cylinder to testing laboratory, and measure and record compressive strength in accordance with ASTM C39. Field cylinder shall be used to determine if concrete footings, walls, or piers have reached the required compressive strength for steel erection to begin.
- E. Measure and record compressive strength in accordance with ASTM C39 for laboratory cylinders. Test one laboratory cylinder at 7 days and all other cylinders at 28 days. Acceptance is based on the average of the two 6x12 inch or three 4x8 inch laboratory cured 28-day tests. Notify Architect in the event strength levels do not meet the acceptance requirements of ACI 318.
 - 1. Any additional cylinders molded for Contractor to have a compressive strength test done before seven days shall be at the Contractor's expense.
- F. Prepare and submit test reports to the [Architect] [Engineer][Contractor] [and] [Supplier]. Reports shall be completed and furnished within 48 hours of testing. Refer to description in Submittals.
- G. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
- H. Should the strength of any grade of concrete for any portion of work, as indicated by molded test cylinders, fall below the minimum 28-day compressive strength specified on the drawings, upon approval of the Structural Engineer, the concrete supplier shall adjust the concrete mix for remaining portion of construction so that the resulting concrete meets the minimum strength requirements.

1.5 SUBMITTALS

- A. Concrete Materials: Submit information on concrete materials as listed below.
 - 1. Cementitious materials: Submit type, class, producer name, and certification not more than 90 days old of compliance with applicable ASTM standard.
 - 2. Aggregates: Submit type, pit or quarry location, producer name, gradations, specific gravity, water content, and certification not more than 90 days old.
 - 3. Admixtures: Submit product data sheet. Product data shall include: dosages and performance data, brand names, producers, chloride ion concentrations, and certifications of compliance with applicable ASTM standard. Certifications shall not be more than 90 days old.
 - 4. Water: Submit name of source.
- B. Product Data: Prepare and submit product and performance data for materials and accessories, including patching compounds, joint systems, curing compounds, finish materials, and other concrete related items.
- C. Testing Agency Qualifications: When requested, the proposed testing agencies shall submit data on qualifications for acceptance.

- D. Concrete Mix Design:
 - 1. Concrete mix design submittals shall be submitted to the Structural Engineer [and HCAI] for review and approval at least 14 days prior to placing concrete.
 - 2. Obtain Structural Engineer [**and HCAI**] approval for each mix design prior to use, including new mix designs required to be prepared should there be a change in materials being used.
 - 3. Submit concrete mixture proportions and characteristics for each concrete mix. Include standard deviation analysis or trial batch data with mix design. Submit historical field test data to demonstrate the average compressive strength for approval. Concrete mix proportions, materials, and handling methods for field test data or trial batches shall be the same as used for the work. Include the following information for each mix design:
 - a. Water/cementitious materials ratio.
 - b. Slump per ASTM C143
 - c. Air content per ASTM C231 or ASTM C173
 - d. Unit weight of concrete per ASTM C138
 - e. Compressive strength at 28 days per ASTM C39
 - f. Shrinkage (length change) as measured in accordance with ASTM C157 with the modifications included in Section 1.3.
 - 4. If trial batches are used, submit representative samples of each proposed ingredient to independent testing laboratory for use in preparation of mix design.
 - 5. Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments. Indicate amounts of mix water to be withheld for later addition at Project site.
 - 6. Provide a record copy of the final mix designs and test results to the testing agency prior to commencement of the concrete work.
- E. Concrete Finish Shop Drawings: Submit drawings indicating type of finish to be used at each location.
- F. Slab-on-Grade Joint Layout: Submit drawings for proposed slab-on-grade control joint and construction joint layout for approval.
- G. Construction Sequence Submittal: Contractor shall submit an elevated slab construction sequence indicating construction joints and the pour sequence.
- H. Test Reports: Submit laboratory test reports for concrete materials, mix design, compressive strength, slump, air content, and temperature. Each report shall indicate date of sampling, date of test, mix design, and location of concrete in structure.
- I. Repair Methods: When stains, rust, efflorescence, and surface deposits must be removed, submit the proposed method of removal.
- J. Certificates: Submit written certification regarding the design mix from the ready-mix supplier and the admixture manufacturer stating all concrete and admixtures do not contain chloride ions in excess of concentrations specified herein.
- K. Placement Notification: Notify the Architect at least 24 hours in advance of concrete placement.

- L. Adjustments: Submit any adjustments to mixture proportions or changes in materials, suppliers, or sources, along with supporting documentation, during the course of the work.
- M. Cold Weather Procedure Submittal: Refer to Cold Weather Concreting article in Part 3 for more information.
- N. Record Documents: Accurately record actual locations of embedded utilities and components that are concealed from view.
- 1.6 DELIVERY, STORAGE, AND HANDLING
 - A. Cementitious materials: Store cementitious materials in dry weather tight buildings, bins, or silos that exclude contaminants.
 - B. Aggregates: Store and handle aggregate in a manner that will avoid segregation and prevent contamination with other materials or other sizes of aggregates. Store aggregates so as to drain freely.
 - C. Admixtures: Protect stored admixtures against contamination, evaporation, or damage. Protect liquid admixtures from freezing and temperature changes, which would adversely affect their performance. Handle chemical admixtures in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

- A. Portland Cement: Portland cement shall conform to ASTM C150, Type I Normal, and be a standard brand of Portland cement. Use one brand of cement throughout project, unless approved in writing by the Engineer. Cement, which conforms to ASTM C150 Type II, may be used if it also meets the requirements of ASTM C150 Type I. Cement used in concrete shall be of the same brand and type as the cement used in the concrete represented by the submitted field test data or used in the trial mixtures. Maintain consistent cement color throughout project unless directed otherwise by architectural requirements.
 - 1. Total replacement of Portland cement by supplementary cementitious materials in design mixture shall not exceed 50% (by weight).
- B. Supplementary Cementitious Materials
- C. Coarse Aggregate for Normal Weight Concrete: Comply with ASTM C33. Provide coarse aggregate from a single source for exposed concrete. Gradations shall be similar to that described in the following table:

COARSE AGGREGATE GRADATIONS								
SIEVE SIZE - PERCENT PASSING								
Grade No.	1-1/2"	1"	3/4"	1/2"	3/8"	No. 4	No. 16	
4	90-100 Note 1	20-55	0-15		0-5			

57	100	95-100		25-60	0-10	0-10	
67		100	90-100		20-55	0-10	
89				100	90-100	20-55	0-10

1. Shall be 100 percent passing the 2" sieve.

FINE AGGREGATE GRADATIONS								
SIEVE SIZE - PERCENT PASSING								
Grade No.	3/8	No. 4	No. 8	No. 16	No. 50	No. 80	No. 100	
FA	100	95-100	80-100	50-85	5-30		0-10	

- D. Do not use aggregates containing deleterious substances that could cause spalling on any exterior exposed surface. These include, but are not limited to the following:
 - 1. Organic impurities.
 - 2. Ferrous metals.
 - 3. Soluble salts.
 - 4. Coal, lignite, or other lightweight materials.
 - 5. Soft particles.
 - 6. Clay lumps and friable particles.
 - 7. Cherts of less than 2.40 specific gravity.
- E. Water: Mixing water for concrete shall meet the requirements of ASTM C94. Water shall be clean and free from injurious amounts of acids, alkalis, organic materials, chloride ions and oils deleterious to concrete or reinforcing steel.
- F. Testing agency shall be given access to plants and stockpiles to obtain samples for testing for compliance with the Contract Documents.

2.2 ADMIXTURES

- A. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures. Calcium chloride thiocyanates or admixtures containing intentionally added chlorides are not permitted.
- B. Water Reducing Admixture: Material shall comply with ASTM C494, Type A.
 - 1. Acceptable:
 - a. BASF Corporation MasterPozzolith Series or MasterPolyheed Series.
 - b. Chemical Company Eucon WR Series.
 - c. Sika Chemical Corp. Plastocrete 161.
 - d. GRT Polychem 400 NC.
 - e. Grace Construction Products WRDA 82.
 - f. <**Insert**>.

- C. Air Entraining Admixture: Air entraining admixture shall comply with ASTM C260, and be certified by the manufacturer to be compatible with other admixtures to be used.
 - 1. Acceptable:
 - a. BASF Corporation MasterAir Series.
 - b. Euclid Chemical Company Air-Mix or AEA Series.
 - c. Sika Chemical Corporation Sika-Aer.
 - d. GRT Polychem VR.
 - e. Grace Construction Products Darex II or Daravair 1000.
 - f. <**Insert**>.
- D. Water Reducing and Retarding Admixture: Material shall comply with ASTM C494, Types B and D.
 - 1. Acceptable:
 - a. BASF Corporation MasterSet R Series or MasterSet DELVO Series.
 - b. Euclid Chemical Company Eucon Retarder Series.
 - c. Sika Chemical Corporation Plastiment.
 - d. GRT Polychem R.
 - e. Grace Construction Products Daratard 17 or Recover.
 - f. <**Insert**>.
- E. Set Accelerating Corrosion-Inhibiting Admixture: Admixture shall contain at least 30% calcium nitrite, while meeting the requirements of ASTM C494 as a Type C admixture.
 - 1. Acceptable:
 - a. BASF Corporation MasterLife CI 30.
 - b. Euclid Chemical Company Eucon CIA.
 - c. Grace Construction Products DCI.
 - d. <Insert>.
- F. Shrinkage Reducing and/or Shrinkage Compensating Admixture: Admixture used for the compensation and reduction of shrinkage in Portland cement concrete.
 - 1. Acceptable:
 - a. Euclid Chemical Company Conex.
 - b. Grace Construction Products Eclipse Floor 200.
 - c. BASF Corporation MasterLife SRA Series or MasterLife CRA 007 MasterSure Z60 MasterLife 300D.
 - d. <Insert>.
- G. Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.
 - 1. Acceptable:

- a. Axim Concrete Technologies Catexol 1000CL
- b. BASF Corporation MasterLife CI 30 or MasterLife CI 222.
- c. Cortec Corporation MCI 2000 or MCI 2005
- d. W. R. Grace & Co DCI or DCI-S
- e. Sika Corporation FerroGard-901
- f. Euclid Chemical Company Eucon CIA
- g. <**Insert**>
- H. Admixtures used in concrete shall be the same brand, type, and dosage used in concrete represented by field test data or used in trial mixes.

2.3 CURING PRODUCTS

- A. Moisture Retaining Cover
 - 1. Plastic Film: Use [6 mil] polyethylene film sheet materials that meet the requirements of ASTM C171.
 - 2. White burlap-polyethylene sheet meeting ASTM C171.
 - 3. Reinforced curing paper complying with ASTM C171.
 - 4. Moisture Retaining Fabric: A naturally colored, non-woven, polypropylene fabric with a 4-mil, non-perforated reflective (white) polyethylene coating containing stabilizers to resist degradation from ultraviolet light. Fabric shall exhibit low permeability and high moisture retention. Acceptable manufacturers and products include:
 - a. PNA Construction Technologies, Inc.: Hydracure S16.
 - b. PNA Construction Technologies, Inc.: Hydracure M5.
 - c. Reef Industries Incorporated: Transguard 4000.
 - d. <Insert>.
- B. Dissipating Resin Curing Compound: Clear, waterborne, membrane-forming curing compound complying with ASTM C309, Type 1, Class B shall be composed of hydrocarbon resins and dissipating agents that begin to break down upon exposure to ultraviolet light and traffic approximately 4 to 6 weeks after application, providing a film that is removable with standard degreasing agents and mechanized scrubbing actions so as to not impair the later addition of applied finishes.
 - 1. Curing compounds used on interior enclosed environments shall be a water-borne product and VOC compliant as required by the U.S. EPA Architectural Coating Rule.
- C. Non-dissipating Curing Compound: Clear, membrane-forming curing compound complying with ASTM C309, Type 1, Class B.
 - 1. Curing compounds used on interior enclosed environments shall be a water-borne product and VOC compliant as required by the U.S. EPA Architectural Coating Rule.
- D. Curing and Sealing Compound: Clear, membrane-forming curing and sealing compound complying with ASTM C309, Type 1, and ASTM C1315, Type 1, Class A. Compound shall dry to a clear finish, resist yellowing due to ultraviolet degradation, and provide a long-lasting finish that has high resistance to chemicals, oil, grease, deicing salts, and abrasion.

1. Curing and sealing compounds used on interior enclosed environments shall be a water-borne product and VOC compliant as required by the U.S. EPA Architectural Coating Rule.

2.4 MISCELLANEOUS MATERIALS

- A. Cement Grout: Mix 1 part Portland cement, 2-1/2 to 3 parts fine aggregate, and enough water for required consistency. Depending on use, consistency may range from mortar consistency to a mixture that will flow under its own weight. Do not mix more than the amount that can be used within 30 minutes. Retempering is not permitted. Use for leveling, preparing setting pads, beds, construction joints (with liquid bonding admixture) and similar uses. Do not use for grouting under bearing plates or structural members in place.
- B. Expansion Joint Material: Preformed, resilient, non-extruding asphalt-impregnated fiber conforming to ASTM D1751. Thickness of expansion joint material shall be 1/2" unless noted otherwise on the drawings.
- C. Vapor Barrier: ASTM E 1745, Class A, not less than 15 mils thick.
 - 1. Acceptable:
 - a. Stego Industries, LLC Stego Wrap.
 - b. W.R. Meadows, Inc. Perminator.
 - c. Raven Industries Vapor Block.
 - d. Insulation Solutions Viper VaporCheck II.
 - e. <**Insert**>.
- D. Vapor Retarder: ASTM E 1745, Class A, not less than 10 mils thick.
 - 1. Acceptable:
 - a. Stego Industries, LLC Stego Wrap.
 - b. W.R. Meadows, Inc. Perminator.
 - c. Raven Industries Vapor Block
 - d. Insulation Solutions Viper VaporCheck II.
 - e. <**Insert**>.
- E. Vapor Retarder: not less than 10 mils thick, of one of the following materials:
 - 1. Polyethylene sheet, ASTM D 4397.
 - 2. Nonwoven, polyester-reinforced, polyethylene coated sheet.
 - 3. Furnish adhesive back polyethylene tape.
 - 4. **<Insert>**.
- F. Bonding Agent: ["Weld-Crete" manufactured by the Larsen Products Corporation, or "Nitobond Acrylic" manufactured by Fosroc Inc.] [or approved equivalent].
- G. Anti-Bonding Agent: ["Thompson's Water Seal" as manufactured by A. E. Thompson, Inc., California] [or approved equivalent].
- H. Epoxy-Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class and grade to suit requirements, and as follows:
 - 1. Type II, non-load bearing, for bonding freshly mixed concrete to hardened concrete.
 - 2. Types I and II, non-load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
 - 3. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- I. Control Joint Filler: Flexible, single-component polyurethane sealant with backer rod compliant with ASTM C 920, Type S, Grade P, Class 25. Apply sealant per manufacturers written recommendations.
 - 1. Acceptable:
 - a. Dayton Superior Perma 230 SL.
 - b. Euclid Chemical Company Eucolastic I.
 - c. BASF Corporation MasterSeal SL 1.
 - d. <Insert>.
- J. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, non-glazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery with emery aggregate containing not less than 50 percent aluminum oxide and not less than 25 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.

2.5 STRENGTH AND PROPERTIES

A. Concrete Mix Designs: Refer to the drawings for specified compressive strength. Proportion concrete mixes according to the properties in the following table. The concrete supplier may produce a mix at a lower water-cement ratio to allow for adjustment of slump at the site by adding water. The addition of site water shall be in accordance with ASTM C94, and the total water-cement ratio shall not exceed the value specified below.

Class	Coarse Aggregate Gradation	Fine Aggregate Gradation	Range of Slump	Max. w/c	Air Content	Other Requirements
А	57 or 67	FA	1" to 4"	0.40	5% to 8%	
В	57 or 67	FA	1" to 4"	0.45	5% to 8%	
С	57 or 67	FA	1" to 4"	0.50	n/a∙	
D	57 or 67	FA	4" to 6"	0.50	• n/a	Use water reducing admixture to achieve slump specified
Е	4 or 57	FA	1" to 4"	0.50	• n/a	
F	4 or 57	FA	5" to 8"	0.50	n/a∙	Use retarder
Н	89	FA	5" to 8"	0.50	n/a∙	

	Coarse	Fine				
	Aggregate	Aggregate	Range of	Max.		Other
Class	Gradation	Gradation	Slump	w/c	Air Content	Requirements
J	Light-weight	FA	5" max	0.5	4% to 7%	

- B. Compliance with Fire Assembly: All concrete supplied for slab on metal decks shall meet the requirements for a [**2-hour**] floor construction per UL assembly number [**D925**]. Specifically, the concrete must meet the following:
 - 1. Be [lightweight] [normal weight] with fresh bulk density of [107-116] pcf.
 - 2. Be vibrated during placement.
 - 3. Be air-entrained between 4 to 7 percent.
 - 4. Be constructed to maintain a minimum [**3-1/4-inch**] slab thickness above the metal flutes.
- C. Water Reducer: Add water reducing admixture or high range water reducing admixtures (superplasticizers) as follows:
 - 1. All pumped concrete.
 - 2. Fiber reinforced concrete.
 - 3. As required for placement or workability.
 - 4. As required by high temperatures, low humidity, or other adverse placement conditions.
 - 5. Concrete with water-cementitious materials ratio below 0.50.
- D. Use shrinkage reducing admixture or shrinkage compensating admixture were indicated on the drawings to keep shrinkage below 0.04% or demonstrate that the proposed mix design meets the same value without the shrinkage reducing or shrinkage compensating admixture.
- E. No other admixtures shall be used unless approved by Structural Engineer.
- F. Chlorides: Admixtures or other ingredients including aggregates containing calcium chloride or more than 0.05% chloride ions by weight shall not be used.
- G. Workability: Concrete shall have a workability such that it will fill the forms without voids, honeycombs, or rock pockets with proper vibration without permitting materials to separate or excess water to collect on the surface.
- H. Concrete Temperatures: Minimum concrete temperature of fresh concrete varies in relation to average air temperature over a 24-hour period as follows:
 - 1. Air temperature below 0° F
- Concrete temperature 70° F min.
- Air temperature 0°F to 30°F
 Air temperature 30°F to 50°F
- Concrete temperature 65°F min.
- 50°F Concrete temperature 50°F min.
- 4. Air temperature above 50°F
- No minimum temperature
- 5. The maximum temperature of concrete at the time of delivery shall be 90°F. When concrete temperature exceeds 90°F, concrete supplier shall attempt to reduce temperature by shading aggregates and cement and cooling mix water. When these methods fail to reduce the concrete temperature below 90°F, supplier shall use ice in the water to reduce the concrete temperature. Use set retarding admixtures only when approved in the mix design.

3.1 PREPARATION

- A. Verify requirements for concrete cover over reinforcement.
- B. Verify anchors, seats, plates, reinforcement, and other items to be cast into concrete are accurately placed, positioned securely, and will not cause hardship in placing concrete.
- C. Do not place concrete until data on materials and mix designs have been approved, Architect has been notified, and all other affected trades have coordinated their work.
- D. Remove snow, ice, frost, water, mud, and other foreign material from surfaces, reinforcing bars and embedded items against which concrete will be placed.
- E. Prepare previously placed concrete by cleaning with sandblasting, steel brush, or water blast to expose aggregate to minimum 1/4" amplitude.
- F. Sandblast all existing concrete surfaces older than 28 days against which concrete is to be placed, unless directed otherwise in writing by Architect/Engineer.
- 3.2 SLABS
 - A. Embedded Items:
 - 1. The outside diameter of embedded conduit or pipe shall not exceed one-third of the slab thickness in structural slabs, including at crossovers, and shall be placed between the top and bottom reinforcing with a minimum 3" clear cover. Conduit or pipe running parallel to each other shall be spaced at least 8" apart and no more than 2 runs stacked vertically in the slab. Conduit or pipe shall not be embedded in any supported slab less than 6" thick. No embedded conduit or pipe is allowed in any concrete slab-on-steel deck.

3.3 CONSTRUCTION JOINTS

- A. Beams: Locate construction joints for beams, joists, and girders in middle 1/3 of span, unless otherwise indicated on the drawings. When a beam intersects a girder at this point, the joint in the girder shall be offset a distance equal to or greater than twice the width of the beam. Make joints perpendicular to the main reinforcement.
- B. Slabs: Where slab pour is to receive a subsequent topping or additional concrete, expose aggregate in top surface by brooming in two directions at right angles to each other.
- C. Vertical: Locate vertical construction joints in [walls] [and] [grade beams] not farther than a maximum of 100 feet on center. Coordinate joint locations with architectural design.
- D. Horizontal: Locate horizontal joints in [walls,] [piers,] [and][columns] at underside of [slabs,][beams,][and][girders] and at the top of[slabs][and][footings] unless otherwise indicated. At least 24 hours shall elapse between placing concrete in a [wall,] [beam,][or][column] and placing concrete in an area supported by the[walls,][beams,][or][columns], unless approved in writing by the Structural Engineer.

- E. Reinforcing: Stop all welded wire reinforcement and/or reinforcing at construction joints in slabs on grade and provide dowel bars as detailed. Provide reinforcement at other construction joints as detailed. Roughen and thoroughly clean the surface of the concrete, remove all laitance, and wet the surface before placing new concrete against the joint. [Slush vertical joints with a neat cement grout before placing new concrete.][Roughen entire surface at construction joints to remove surface paste and expose aggregate.]
- F. Wall Control Joints: Locate vertical control joints in exposed walls at a minimum uniform spacing not to exceed 25'-0". Coordinate joint locations with architectural drawings.
- G. Exposed Surfaces: Locate construction joints only at predetermined locations approved by the Architect and the Structural Engineer.

3.4 CONCRETE PLACEMENT

- A. Place concrete as continuously as possible until placement is complete. Do not place against concrete that has attained initial set, except at authorized joints. If, for any reason, concrete pour is delayed for more than 45 minutes, bulkhead off pour at last acceptable construction joint. Immediately remove excess concrete and clean forms.
- B. Do not begin to place concrete during periods of rain, sleet, or snow unless adequate protection is provided.
- C. No concrete shall be cast onto or against sub-grades containing free water, frost, ice, or snow. If earth at bottom of forms has dried out, rewet so the soil is moist, but free of standing water and mud.
- D. Notify the Architect in advance if concrete is to be pumped.
- E. Do not place concrete until all reinforcement is in place, forms have been thoroughly cleaned and approval has been given.
- F. Do not accept concrete delivered to the job site more than 90 minutes after initial mixing.
- G. Concrete from its point of release to mixers, hoppers, or conveyances, shall not be permitted to drop more than 5 feet (10 feet for concrete containing high range water reducers). Deposit concrete directly into conveyances and directly from conveyances to final points of deposit. Sufficient transportation equipment in good working order shall be on hand before work begins. All conveying equipment must be clean and kept clean during concreting operations. Take every possible precaution to prevent segregation or loss of ingredients.
- H. Regulate rate of placement so concrete surface is kept level throughout; a minimum being permitted to flow from one area to another. Use tremie heads spaced at approximately 10-foot intervals for placing concrete in walls. Control rate of placement consistent with form design.
- I. Deposit concrete in one continuous operation until section being placed has been completed. For slab thicknesses greater than 12 inches, prevent excessive segregation of aggregate and high temperatures in accordance with ACI 304 and ACI 308. Place concrete in wall forms in layers not greater than 12 inches in depth, each layer being compacted by internal vibration before succeeding layer is placed.

- J. Place concrete as near as possible to its final position to prevent segregation or loss of materials. Do not use vibrators to transport concrete within forms. Consolidate concrete in walls, columns, beams, and slabs or joist construction thicker than 8" with internal vibrators (8,000 to 12,000 VPM). Slabs less than 8" thick may be consolidated with internal vibrators (9,000 to 13,500 VPM) or vibrating screeds supported on forms, boards, or rails, approved by the Structural Engineer, supplement vibration by forking or spading by hand along surfaces adjacent to forms and construction joints. Be sure an adequate number of operating vibrator units are on hand to properly consolidate quantity of concrete to be placed, including spares for emergency use.
 - 1. Vertically insert and remove handheld vibrators at constant intervals 18 to 30 inches apart. Vibrate concrete the maximum amount and time required for complete consolidation, without segregation, and release of entrapped air bubbles, but in no instance exceed 15 seconds per square foot of exposed surface.
- K. Place concrete during daylight hours, unless permitted otherwise by the Structural Engineer.
- L. Re-tempering of concrete shall not be permitted. Concrete that has stood more than 15 minutes after leaving the mixer shall be discarded.
- M. Exercise care in placing concrete over waterproof membranes, rigid insulation, and/or protection boards to avoid damaging those materials. Report damage immediately, and do not proceed until damage is repaired.
- N. Remove loose debris from hardened surfaces of previous pours by sandblasting surfaces and expose clean coarse aggregate firmly embedded in cement matrix.
- O. Remove loose debris from hardened surfaces of previous pours, thoroughly wet and slush with a neat cement grout immediately before placing new concrete or apply bonding compound to surface and let dry before placing new concrete.
- P. Protect existing concrete work to be exposed to view and other finished materials from damage and staining resulting from concreting operations. Handle concrete carefully to avoid dripping and spillage. Remove spilled concrete from existing surfaces immediately. Covering sills, ledges, and other surfaces with protective coverings may be necessary to protect the work.
- Q. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete Work.
- R. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on drawings. Set anchor rods for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.
- S. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on the drawings. Screed, tamp, and trowel-finish concrete surfaces.

3.5 CONCRETE FINISHES AND TOLERANCES

- A. Exposed Smooth Formed Surfaces: Remove forms and perform necessary repairs and patch to produce surface finish-3.0 as specified in ACI 301. Apply the following to smooth-formed finished concrete exposed to view in the finished work. Confirm finishes with the Architect prior to concrete placement by submitting shop drawings indicating locations of all types of finishes.
 - 1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
 - 2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part Portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white Portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
 - 3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part Portland cement and one-part fine sand with a 1:1 mixture of bonding agent and water. Add white Portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.
- B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.6 CONCRETE SLAB FINISHES AND TOLERANCES

- A. Trowel Finish:
 - 1. Screed concrete to an even plane, float, then power trowel the surface.
 - 2. Hand trowel the surface smooth and free of trowel marks. Continue hand troweling until a ringing sound is produced as the floor is troweled.
 - 3. Provide trowel finish as indicated on the drawings and at the following locations:
 - a. Concrete floors exposed in finished work unless otherwise indicated.
 - b. Slabs to receive curing compounds and sealers.
 - c. Slabs to receive resilient flooring or carpet.
 - d. <Insert>.
 - e. Slabs to receive waterproof membranes.
- B. Fine Broom Finish:
 - 1. Screed concrete to an even plane, float, then power trowel the surface. Provide fine hair broom finish perpendicular to slope, free of loose particles, ridges, projections, voids, and concrete droppings.
 - 2. Provide fine broom finish as indicated on the drawings and at the following locations:

- a. Stoop slabs.
- b. Raised curbs and walkway areas.
- c. Slabs to receive thin set ceramic tile.
- d. <Insert>.
- C. Broom Finish:
 - 1. Screed concrete to an even plane and then float. Immediately after concrete has received a floated finish, give the concrete surface a coarse transverse scored texture by drawing a coarse broom across the surface.
 - 2. Provide as indicated on the drawings and at the following locations:
 - a. ADA ramp slabs.
 - b. Exterior walkway slabs.
 - c. <**Insert**>.
- D. Float Finish:
 - 1. Screed concrete to an even plane then float.
 - 2. Provide as indicated on the drawings and at the following locations:
 - a. Slabs to directly receive concrete topping.
 - b. Roof slabs to receive loose laid roof insulation.
 - c. <Insert>.
- E. Floor Finish Tolerances: Floor finish tolerances as measured in accordance with ASTM E1155, Standard Test Method for Determining Floor Flatness and Levelness Using the F-Number System (Inch Pound Units), shall be as follows:

	Minimum Flatness Number Required				
Floor Profile Quality	Test Area		Minimum Local F-Number		
Classification	Flatness F _F Level F _L		Flatness F _F	Level F _L	
Slab on Grade (Office,					
School)	25	20	15	12	
Slab on Grade (General					
Warehouse)	35	25	21	15	
Slab on Grade					
(Very Flat)	45	35	27	21	
Slab on Grade					
(Super flat)	60	40	36	24	
Suspended Slab					
(Steel frame)	25	N/A	15	N/A	

- F. Floor Finish Tolerances: Floor finish tolerances shall be measured by placing a freestanding (unleveled) 10-foot straightedge anywhere on the slab and allowing it to rest upon two high spots within 72 hours after placement of slab and removal of shoring (if present). The gap at any point between the straightedge and the floor (and between the high spots) shall not exceed:
 - 1. Slab on Grade (Office, School): 1/4"

- 2. Slab on Grade (General Warehouse): 3/16"
- 3. Suspended Slabs (Steel frame): 1/4"
- G. Slab Drainage: Finish all concrete slabs to proper elevations to ensure that all surface moisture will drain freely to floor drains, and that no puddle areas exist. Contractor shall bear the cost of corrections to provide positive drainage.
- H. Special Tolerances for Concrete Slabs: No abrupt change in vertical elevation of 1/4" or more is acceptable at the interface between slabs and within areas where pedestrian traffic is expected.

3.7 CONCRETE CURING

- A. Freshly placed concrete shall be protected from premature drying and excessively hot temperatures.
- B. Concrete other than high-early strength shall be maintained above 50°F and in a moist condition for at least the first 7 days after placement, except when special curing is used. Special curing procedures shall not be used without written permission from the Structural Engineer.
- C. High-early strength concrete shall be maintained above 50°F and in a moist condition until it has reached 2/3 of the specified 28-day compressive strength, but not less than 3 days unless special curing is used with written permission from the Structural Engineer.
- D. Formed surfaces shall be cured by leaving the formwork in place during the curing period.
- E. Protect concrete from excessive changes in temperature during the curing period and at the termination of the curing process. Changes in the temperature of the concrete shall be as uniform as possible and shall not exceed 5°F in any one hour or 50°F in any 24-hour period.
- F. Protect concrete from injury from the elements until full strength is developed. Protect from mechanical injury.
- G. During cold weather construction, all [**footings**] shall be protected from frost penetration until the building is enclosed and temporary heat is provided.

3.8 SLAB CURING

- A. Begin curing after finishing concrete, but not before free water has disappeared from concrete surface. Use one of the methods described below.
- B. Moisture-Retaining-Cover Curing for Concrete Floors Not Exposed in Final Condition: Cover concrete surface with waterproof sheet material as soon as finishing operations are complete and the concrete is sufficiently hard to be undamaged by covering. The cover shall be placed flat on the concrete surface, avoiding wrinkles. Sprinkle concrete with water as necessary during application of covering. Place in widest practicable width, with sides and ends lapped at least 12 inches, and seal with waterproof tape or adhesive. Verify the concrete is continuously wet under the sheets; otherwise, add water through soaker hoses under the sheets. Weight down covering to prevent displacement. Immediately repair any holes or tears during the curing period using polyethylene sheet and waterproof tape. Curing process shall be maintained for a minimum of 7 days.

- C. Moisture-Retaining-Fabric Curing for Concrete Floors to Remain Exposed: Cover concrete surface with moisture retaining fabric as soon as finishing operations are complete and the concrete is sufficiently hard to be undamaged by covering. The cover shall be installed in accordance with the manufacturer's written recommendations, in largest practical widths. Wet the slab to rejection, then thoroughly wet fabric side of cover and install with poly side up. Lap over adjacent covers a minimum of 18". Wet all laps and outside edges to prevent displacement and to ensure intimate contact with concrete and adjacent covers. Rewet as necessary and protect covers from damage during curing process.
 - 1. After minimum 7-day cure, remove moisture retaining fabric in sections.
 - 2. A maximum of 3,500 square feet of concrete curing cover may be removed at any one time. At no time shall the exposed area be permitted to dry prior to completion of the floor scrubbing process.
 - 3. Using a high-powered floor scrubber capable of a minimum 80 pounds head pressure, and a mild citrus-based detergent that does not damage or mar the surface in any way, scrub the floor to remove any minerals or soluble salts that may have accumulated at the floor surface. Rinse area thoroughly with clean fresh water. Remove water and allow floor to dry. If whitening occurs during drying, repeat scrubbing process before floor dries until no whitening occurs during drying.
 - 4. All areas of the floor shall remain wet during floor scrubbing process. Expose only the amount of floor surface that can be cleaned before any drying occurs without exceeding the maximum allowable exposed area.
- D. Curing Compound: Apply uniformly in continuous operation by low pressure spray equipment or roller as soon as finishing operations are complete, free water on the surface has disappeared, and no water sheen can be seen. Follow the manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period. Verify compatibility of the curing compound with paint, finishes, or toppings that require positive bond to the concrete. If curing compound is not compatible with paint finishes or toppings, utilize a dissipating curing compound and remove in accordance with the manufacturer's recommendations.

3.9 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
- B. Do not fill joints until construction traffic has permanently ceased.
- C. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

3.10 APPLICATION OF FLOOR SEALER - FINISH COAT

- A. Give concrete floors, as indicated in the Room Finish Schedule and where exposed in finished Work, a second coat of curing and sealing compound immediately prior to Substantial Completion.
- B. Clean floors and apply sealer strictly according to manufacturer's instructions. Dilution and coverage shall be as recommended by the manufacturer. Apply sealer evenly.

3.11 COLD WEATHER CONCRETING

- A. Definition: Cold weather shall be defined as a period when for more than three successive days the average daily outdoor temperature drops below 40°F. The average daily temperature is the average of the highest and lowest temperature during the period from midnight to midnight. When temperatures above 50°F occur during more than half of any 24-hour duration, the period shall not be regarded as cold weather.
- B. All cast-in-place concrete work occurring during cold weather shall conform to all requirements of ACI 306.1, "Standard Specification for Cold Weather Concreting", published by the American Concrete Institute, Detroit, Michigan, except as modified by the contract documents or this specification.
- C. Planning: The [General Contractor,] [concrete contractor,] [concrete supplier,][and][Architect] shall have a pre-construction conference to outline the cold weather concreting operations concerning the placing, finishing, curing and protection of the concrete during cold weather. Pre-construction conference shall occur before cold weather is expected to occur.
- D. Detailed procedure submittal: Concrete contractor shall prepare and submit for review detailed procedures for the production, transportation placement, protection, curing and temperature monitoring of concrete during cold weather. Include procedures to be implemented upon abrupt changes in weather conditions. Do not begin cold weather concreting until these procedures have been reviewed and approved.
- E. Mixing: Concrete flatwork poured in cold weather shall be proportioned to obtain a lower slump to minimize the amount of bleed water during finishing. All bleed water should be skimmed off flatwork prior to troweling. Concrete that will be exposed to cycles of freezing and thawing while saturated should be properly air entrained as outlined in this specification.
- F. Protection of Concrete: Cure and protect concrete against damage from freezing for a minimum period of 72 hours, unless approved by the Structural Engineer. The protection period may be reduced according to ACI 306.1 requirements. Concrete contractor shall submit a letter of request to reduce the protection period, by outlining the method used to achieve the reduction per ACI 306.1.
 - 1. When practical for the construction schedule, formwork shall be insulated and remain in place for at least the required protection period.
- G. Concrete Temperatures: The minimum temperature of concrete immediately after placement shall be as specified in the following table.

			Mixing Te	emperatures	
Section Size	Minimum temperature of concrete as placed and maintained during the protection period	Maximum gradual decrease in surface temperature during any 24 hours after the end of the protection.	Above 30°F	0 to 30°F	Below 0°F
Less than 12 in	55°F	50°F	60°F	65°F	70°F
12-36 in	50°F	40°F	55°F	60°F	65°F

36-72 in	50°F	30°F	50°F	55°F	60°F
Greater	50°F	20°F	45°F	50°F	55°F
than 72 in					

- H. Mixing Temperatures: As the ambient air temperature decreases, the concrete mixing temperature shall be increased to compensate for the heat lost in the period between mixing and placement. The concrete supplier shall use one or both of the following methods for increasing the concrete temperature.
 - 1. Heating the mixing water to a temperature necessary to offset the temperature losses during transport. Supplier shall not heat water to temperatures in excess of 140°F, without taking special precautions as outlined in ACI 306.
 - 2. Heating the aggregate with a circulated steam piping system.
- I. Temperature measurements: The Contractor shall be responsible for monitoring and recording the concrete temperatures during placement and throughout the protection period.
 - 1. Inspection personnel shall keep a record of the date, time, outside air temperature, temperature of concrete as placed, and weather conditions.
 - 2. Temperature of the concrete and the outside air shall be recorded at regular intervals but not less than twice in a 24-hour period. The record shall include temperatures at several points within the enclosure and on the concrete surface of sufficient frequency to determine a range of temperatures.
 - 3. Inspection agency shall submit the temperature logs to the Architect for permanent job records.

3.12 HOT WEATHER PROTECTION

A. Definition: Hot weather shall be defined as any combination of high ambient temperature, low relative humidity, high winds, and intense solar radiation that leads to higher than usual evaporation. The table below defines low relative humidity based on air temperature. For a given air temperature, if the relative humidity is equal to or less than the specified minimum, provisions for hot weather concreting shall be as follows:

Air Temperature	Minimum Relative Humidity
105°F	90%
100°F	80%
95°F	70%
90°F	60%
85°F	50%
80°F	40%
75°F	30%

B. Scheduling: When hot weather is expected, adjust concrete placement schedules to avoid placing or finishing during the period from noon until 3:00 pm. When possible, slab pours should be delayed until the building is enclosed to protect the concrete from wind and direct sunlight. The construction schedule shall account for 7-day moist curing period.

- C. Mixing: Concrete supplier shall adjust mix designs and admixtures to minimize slump loss. Concrete shall be mixed at a water-cement ratio, which is lower than the specified maximum, to allow for the adjustment of slump by addition of water in the field. Water reduction shall be accomplished without reducing initial slump by increasing dosage of a water reducing admixture.
- D. Preparation: Do not order concrete earlier than is required to avoid delays. Cool forms, subgrades and reinforcing bars with water spray from fog nozzle prior to concrete placement.
- E. Delivery: Site traffic shall be coordinated, and delivery times scheduled to minimize waiting times for concrete trucks.
- F. Placement: Preparations shall be made to place and consolidate the concrete at the fastest possible rate. Maintain a continuous flow of concrete to the job site to avoid development of cold joints, during placement of slabs, apply fog spray to prevent moisture loss without causing surplus water to stand on concrete surface.
- G. Finishing: Finish concrete as fast as practical. Continue fogging concrete during finishing. Where fogging is not possible, apply sprayable moisture-retaining film between finishing passes.
- H. Curing: Formed concrete shall be covered with a waterproof material to retain moisture. Flat work shall be moisture cured as described in this specification. Moist curing shall continue for at least 7 days.

3.13 FIELD QUALITY ASSURANCE

- A. Independent Testing Agency and [**Special**] Inspector shall each perform their prescribed inspection, sampling, and testing services as described in Part 1 of this specification section.
- B. In cases where samples have not been taken or tests conducted as specified or strength of laboratory test cylinders for a particular portion of the structure fails to meet requirements of ACI 301, for evaluation of concrete strength, Structural Engineer shall have the right to order compressive or flexural test specimens or both be taken from the hardened concrete according to ASTM C42, load tests according to ACI 318, or such other tests as may be necessary to clearly establish the strength of the in situ concrete, and such tests shall be paid for by the Contractor. Where cores have been cut from the Work, Contractor shall fill voids with dry-pack and patch the finish to match the adjacent existing surfaces.

3.14 REPAIR OF DEFECTIVE AREAS

- A. All repair of defective areas shall be made, with prior approval of Architect and Structural Engineer as to method and procedure, in accordance with Section 5 of ACI 301, except specified bonding compound must be used. Cosmetic repairs of minor defects in exposed concrete surfaces shall be in a manner acceptable to the Architect. Defective areas shall be deemed when:
 - 1. Tests on core or prism specimens fail to show specified strengths.
 - 2. Not formed as indicated or detailed.
 - 3. Not plumb or level where so indicated or required to receive subsequent work.
 - 4. Not true to intended grades and levels.

- 5. Cut, filled, or resurfaced, unless under direction of the Structural Engineer.
- 6. Debris is embedded therein.
- 7. Not fully in conformance with provisions of the drawings.
- 8. Damaged by hot or cold weather conditions.
- 9. Mixing time exceeds 90 minutes from ready-mix plant to the time of deposit.
- B. Patch form tie holes at the following locations:
 - 1. Unfinished exposed concrete (not scheduled for painting, plus at board formed concrete finish).
 - 2. All other areas: Prime voids with bonding compound and fill with patching mortar. Strike flush without overlap, float to uniform texture to match adjacent surfaces.
 - 3. Exposed areas scheduled for spray texture:
 - a. Remove projections and protrusions: 1/16" or larger.
 - b. Remove continuous ridges 1/32" or larger.
 - c. Fill voids and pin holes.
 - 4. Exposed areas scheduled for paint or epoxy:
 - a. Remove projections, ridges, and other protrusions 1/32" or larger.
 - b. Fill voids and pin holes 1/16" or larger.
 - 5. Exposed areas not scheduled for paint or other finishes:
 - a. Remove projections, ridges and other protrusions not conforming to requirements specified under Section 03 10 00.
 - b. Fill voids and pin holes not conforming to requirements specified under Section 03 10 00.
- C. All structural repairs shall be made, with prior approval of the Architect/Engineer, as to method and procedure, using the specified epoxy adhesive and/or epoxy mortar.
- D. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension in solid concrete but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 - 2. Repair defects on surfaces exposed to view by blending white Portland cement and standard Portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 - 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

- E. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
 - 1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 - 2. After concrete has cured at least 14 days, correct high areas by grinding.
 - 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 - 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
 - 5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 - 6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mix as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 - 7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

3.15 CEMENT GROUT AND DRY-PACK

A. Cement Grout: Thoroughly mix sufficient quantities to avoid combining different batches of grout mix. Ensure that grout completely fills all spaces and voids. Level, screed, or cut flush excess grout to produce smooth, neat, even exposed surfaces.

3.16 CLEANING

A. Clean exposed concrete to remove laitance, efflorescence, and stains.

END OF SECTION

SECTION 04 05 13 - MORTAR

PART 1 - GENERAL

- 1.1 SECTION INCLUDES
 - A. Mortar for masonry.
 - B. Structural notes indicated on the drawings regarding mortar shall be considered part of this specification.
- 1.2 RELATED WORK
 - A. Section 04 20 00 Unit Masonry.
 - B. Section 04 22 00 Reinforced Unit Masonry.
- 1.3 REFERENCES
 - A. Codes and Standards: Comply with the provisions of the following codes, specifications, and standards, except where more stringent requirements are shown or specified. Where any provision of other pertinent codes and standards conflict with this specification, the more stringent provisions shall govern.
 - 1. ASTM C5 Standard Specification for Quicklime for Structural Purposes.
 - 2. ASTM C91 Standard Specification for Masonry Cement.
 - 3. ASTM C94 Standard Specification for Ready-Mixed Concrete.
 - 4. ASTM C144 Standard Specification for Aggregate for Masonry Mortar.
 - 5. ASTM C150 Standard Specification for Portland Cement.
 - 6. ASTM C207 Standard Specification for Hydrated Lime for Masonry Purposes.
 - 7. ASTM C270 Standard Specification for Mortar for Unit Masonry.
 - 8. ASTM C387 Standard Specification for Packaged, Dry, Combined Materials for Concrete and High Strength Mortar.
 - 9. ASTM C404 Standard Specification for Aggregates for Masonry Grout.
 - 10. ASTM C476 Standard Specification for Grout for Masonry.
 - 11. ASTM C595 Standard Specification for Blended Hydraulic Cements.
 - 12. ASTM C780 Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
 - 13. ASTM C1019 Standard Test Method for Sampling and Testing Grout.
 - 14. International Masonry Industry All-Weather Council (IMIAC) Recommended Practices and Guide Specifications for Cold Weather Masonry Construction.

1.4 SUBMITTALS

- A. Prepare and submit product data for Engineer's approval. Data should include color additives, and admixture products proposed for this project.
- B. Include design mix, indicate Proportion or Property method used, required environmental conditions, and admixture limitations.

- C. Samples: Submit two ribbons of mortar color, illustrating color and color ranges.
- D. Submit test reports on mortar and grout indicating conformance to ASTM C270 following ASTM C780 procedures.
- E. Submit test reports on grout indicating conformance to ASTM C476 following ASTM C1019 procedures.
- F. Submit manufacturer's certificate indicating all products supplied meet or exceed the specified requirements.
- G. Premix Mortar: Submit manufacturer's recommendations and installation instructions.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to Worksite stacked on pallets. Store products clear of the ground to prevent deterioration due to moisture.
- B. Store and protect in areas which are sheltered from weather. Cover products with waterproof coverings anchored to prevent displacement during high winds.
- C. Maintain packaged materials clean, dry, and protected against dampness, freezing, and foreign matter.

1.6 COLD WEATHER REQUIREMENTS

- A. Maintain materials and surrounding air temperatures to minimum 50°F prior to, during, and 48 hours after completion of masonry work.
- B. Cold Weather Requirements: IMIAC Recommended Practices and Guide Specifications for Cold Weather Masonry Construction.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - PREMIX MORTAR

A. Insert.

2.2 MATERIALS

- A. Portland Cement: ASTM C150, Type I or II, graywhite color.
- B. Blended Cement: ASTM C595, Type IP or I(PM) for Type I or II cement.
- C. Masonry Cement: ASTM C91, Type S.
- D. Mortar Aggregate: ASTM C144, standard masonry type.
- E. Hydrated Lime: ASTM C207, Type S or M
- F. Quicklime: ASTM C5, non-hydraulic type.

- G. Premix Mortar: ASTM C387, using gray white cement, Normal strength.
- H. Grout Aggregate: ASTM C404.
- I. Grout Fine Aggregate: Sand
- J. Water: Clean and potable.
- K. Do not use calcium chloride in mortar or grout.

2.3 MORTAR MIXES

- A. Mortar for Load Bearing Walls and Partitions: ASTM C270, Type M or S using the Property Method to achieve 2000 min. psi strength.
- B. Mortar for Reinforced Masonry: ASTM C270, Type S using the Property Method to achieve 2000 min. psi strength.
- C. Stain Resistant Pointing Mortar: One part Portland cement, 1/8 part hydrated lime, and two parts graded (80 mesh) aggregate, proportioned by volume. Add aluminum tristearate, calcium stearate, or ammonium stearate equal to 2 percent of Portland cement by weight.
- 2.4 MORTAR AND GROUT MIXING
 - A. Thoroughly mix mortar and grout ingredients in quantities needed for immediate use in accordance with ASTM C270 and ASTM C780, respectively.
 - B. Add mortar color and admixtures in accordance with the manufacturer's instructions. Provide uniformity of mix and coloration.
 - C. Do not use anti-freeze compounds to lower the freezing point of mortar.
 - D. If water is lost by evaporation, re-temper only within two hours of mixing.
 - E. Use mortar within two hours after mixing at temperatures of 80°F, or two-and-one-half hours at temperatures under 50°F.

2.5 GROUT MIXES

- A. Bond Beams and Lintels: Use concrete with 3000 psi strength at 28 days; 7–8-inch slump; ready-mixed type in accordance with ASTM C94.
- B. Engineered Masonry: Use concrete with 3000 psi strength at 28 days; 7–8-inch slump; ready-mixed type in accordance with ASTM C94.

2.6 GROUT MIXING

- A. Thoroughly mix grout ingredients in quantities needed for immediate use in accordance with ASTM C476 Fine grout.
- B. Add admixtures in accordance with the manufacturer's instructions. Provide uniformity of mix.

C. Do not use anti-freeze compounds to lower the freezing point of grout.

PART 3 - EXECUTION

- 3.1 EXAMINATION
 - A. Request inspection of spaces to be grouted.
- 3.2 PREPARATION
 - A. Apply bonding agent to all existing concrete and masonry surfaces.
 - B. Plug cleanout holes with similar masonry units to prevent leakage of grout materials. Brace masonry for wet grout pressure.
- 3.3 INSTALLATION
 - A. Install premix mortar and grout in accordance with manufacturer's instructions.
 - B. Install mortar in accordance with ASTM C270.
 - C. Install grout in accordance with ASTM C476
 - D. Work grout into masonry cores and cavities to eliminate voids.
 - E. Do not displace reinforcement while placing grout.
 - F. Remove grout spaces of excess mortar.

END OF SECTION

SECTION 04 20 00 - UNIT MASONRY

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Fabrication and installation of masonry units. Work shall include, but not be limited to, the following items:
 - 1. Concrete masonry units.
 - 2. Split faced masonry units.
 - 3. Acoustical concrete masonry units.
 - 4. Decorative stone masonry.
 - 5. All wall reinforcement, anchorage, insulation, lintels, and accessories.
 - 6. Mortar for masonry including admixtures.
 - 7. Grout for masonry.
 - 8. Form control joints.
 - 9. Built-in items supplied by other trades.
- B. Products furnished but not installed under this section.
 - 1. Dovetail anchors embedded in concrete work.
 - 2. Adjustable masonry anchors connecting to structural steel.
 - 3. Flashing reglets embedded in concrete work.
- C. Products installed but not furnished under this section.
 - 1. Placement of special anchorage for precast concrete installation.
 - 2. Placement of steel anchors for ledge angle installation.
 - 3. Placement of steel bearing pads for bar joist installation.
 - 4. Placement of loose steel lintels.
 - 5. Placement of fabricated steel items.
 - 6. Placement of reglets for flashing.
 - 7. Placement of window and door frame anchors.
- D. Structural notes indicated on the drawings regarding unit masonry shall be considered part of this specification.

1.2 RELATED WORK

- A. Section 03 30 00 Cast-in-Place Concrete.
- B. Section 04 22 00 Reinforced Unit Masonry.
- C. Section 05 12 23 Structural Steel.
- D. Section 05 21 00 Steel Joists.
- E. Section 31 23 00 Foundation Excavating and Backfilling.

1.3 REFERENCES

- A. Codes and Standards: Comply with the provisions of the following codes, specifications, and standards except where more stringent requirements are shown or specified. Where any provision of other pertinent codes and standards conflict with this specification, the more stringent provision shall govern.
 - 1. ASTM A123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 2. ASTM A153 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 3. ASTM A36 Standard Specification for Carbon Structural Steel.
 - 4. ASTM A615 Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - 5. ASTM A641 Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
 - 6. ASTM A653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 7. ASTM A924 Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
 - 8. ASTM A951 Standard Specification for Steel Wire for Masonry Joint Reinforcement.
 - 9. ASTM A1064 Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
 - 10. ASTM C5 Standard Specification for Quicklime for Structural Purposes.
 - 11. ASTM C90 Standard Specification for Loadbearing Concrete Masonry Units.
 - 12. ASTM C91 Standard Specification for Masonry Cement.
 - 13. ASTM C140 Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
 - 14. ASTM C144 Standard Specification for Aggregate for Masonry Mortar.
 - 15. ASTM C150 Standard Specification for Portland Cement.
 - 16. ASTM C207 Standard Specification for Hydrated Lime for Masonry Purposes.
 - 17. ASTM C270 Standard Specification for Mortar for Unit Masonry.
 - 18. ASTM C331 Standard Specification for Lightweight Aggregates for Concrete Masonry Units.
 - 19. ASTM C387 Standard Specification for Packaged, Dry, Combined Materials for Concrete and High Strength Mortar.
 - 20. ASTM C404 Standard Specification for Aggregates for Masonry Grout.
 - 21. ASTM C476 Standard Specification for Grout for Masonry.
 - 22. ASTM C494 Standard Specification for Chemical Admixtures for Concrete.
 - 23. ASTM C595 Standard Specification for Blended Hydraulic Cements.
 - 24. ASTM C780 Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
 - 25. ASTM C1019 Standard Test Method for Sampling and Testing Grout.
 - 26. BIA Brick Institute of America.
 - 27. International Masonry Industry All-Weather Council (IMIAC) Recommended Practices and Guide Specifications for Cold Weather Masonry Construction.
 - 28. NCMA National Concrete Masonry Association.
 - 29. TMS 402/602 Building Code Requirements and Specifications for Masonry Structures.
 - 30. UL Underwriters Laboratories.

- 1.4 QUALITY ASSURANCE
 - A. Installation Company: Company shall have not less than five (5) years of documented experience in the construction of masonry projects of similar scope and complexity.
 - B. For the actual cutting and placing of concrete masonry units, use only skilled masons who are thoroughly experienced with the material and methods specified and thoroughly familiar with the design requirements. Workers shall have not less than three (3) years of documented experience in the construction of masonry walls.
 - C. Fire Resistance: Whenever a fire-resistant classification is indicated for unit masonry construction, provide concrete block units as tested and listed for the particular fire-resistant construction.
 - D. The governing building department reserves the right to take samples and make material tests prior to or during construction, without expense to the Contractor. Materials found to be defective shall be removed and replaced.

1.5 SUBMITTALS

- A. Prepare and submit product data for the Architect/Engineer's approval. Data should include all horizontal reinforcement, anchoring devices, and all other embedded items herein specified.
- B. Prepare and submit shop drawings detailing the fabrication, bending, and placement of reinforcing bars. Provide wall elevations showing reinforcement layout.
- C. Submit manufacturer's recommendations and product data for the following items:
 - 1. Admixtures.
 - 2. Accessories.
 - 3. Flashing materials.
 - 4. Anchors and ties.
 - 5. Horizontal joint reinforcing.
 - 6. Waterproofing system and accessories.
- D. Samples: Submit not less than five individual brick and masonry unit samples for verification of the following:
 - 1. Full size units for each different exposed masonry unit required, showing the full range of exposed colors, textures, and dimensions to be expected during construction.
 - 2. Colored masonry mortar samples for each color required showing the full range of colors expected in the finished construction. Make samples using the same sand and mortar mix specified for this project.
 - 3. Weep hole/vent material. Color to match mortar color.
 - 4. Accessories embedded in the masonry.
- E. Certificates:
 - 1. Prior to delivery, submit to the Architect/Engineer a certificate or letter certifying products supplied for this project comply with the requirements of this specification.

- 2. Submit concrete unit masonry compressive strength test results demonstrating the units meet the specified strength. Test must be conducted by a qualified independent testing agency.
- F. Submit mortar mix design and test results as follows:
 - 1. Mix designs shall indicate type and proportions of ingredients in compliance with the proportion requirements of ASTM C270.
 - 2. For mix designs not in accordance with the proportion requirements of ASTM C270, the mortar test history must be performed in accordance with ASTM C780 to verify performance with property requirements of ASTM C270. Tests must meet the type of mortar specified on the drawings. Tests must be done by a qualified independent testing agency.
- G. Submit grout mix designs and test results as follows:
 - 1. Mix designs shall indicate type and proportions of the ingredients in compliance with the proportion requirements of ASTM C476.
 - 2. For mix designs not in accordance with the proportion requirements of ASTM C476, the grout test history must be performed in accordance with ASTM C1019 to verify performance with property requirements of ASTM C476. Tests must meet the type of grout specified on the drawings. Test must be done by a qualified independent testing agency.
 - a. Perform one test prior to construction and perform at least one test during construction for each 5000 square feet of wall.

1.6 MOCK-UP

- A. Prior to installation, Contractor shall erect a four-foot long by four-foot high sample wall panel to verify selection made under sample submittals and to demonstrate aesthetic effects of materials and quality of workmanship expected throughout construction.
- B. Erect panel in presence of Architect, Engineer, and Special Inspection Agency prior to installation of material.
- C. Provide a separate panel for each type of face material and mortar.
- D. Do not start work until the Architect/Engineer has given written acceptance of sample panels.
- E. Accepted mock-up will demonstrate minimum standard for workmanship required for the entire project's masonry construction.
- F. Construct mock-up panels for the following walls:
 - 1. Interior masonry wall construction.
 - 2. Exterior masonry wall construction.
 - 3. Insert.
- G. Demolish and remove mock-ups from site when directed by the Architect/Engineer.

- H. Mock-up may not remain as part of the project construction.
- 1.7 DELIVERY, STORAGE, AND HANDLING
 - A. Deliver all materials in sufficient quantity and time to maintain approved construction schedule.
 - B. Deliver all packaged materials in manufacturer's original containers, with labels and markings intact and legible.
 - C. Immediately remove all damaged materials or container from site and replace with new items.
 - D. Store all items in a secure, dry location, out of the way of construction operations. Store materials on pallets a minimum 4" off the ground to prevent deterioration from moisture and contaminants.
 - E. All items shall be transported, stored, and erected in a manner that will avoid any further damage or deformation. Bent or deformed items will be rejected and shall be replaced or repaired at the expense of the responsible party.
 - F. Masonry accessories, including reinforcing steel, shall be stored clear of the ground to prevent deterioration or damage due to moisture, temperature changes, contaminants, and corrosion.

PART 2 - PRODUCTS

2.1 MASONRY

- A. Hollow Load Bearing Concrete Masonry Units: ASTM C90 as follows:
 - 1. Weight: Normal weight or lightweight.
 - 2. Compressive Strength: As indicated on the drawings.
 - 3. Nominal Size: As indicated on the drawings.
 - 4. Actual Size: 3/8" less than nominal size.
 - 5. Aggregates: Conform to ASTM C33 for normal weight or ASTM C331 for lightweight.
 - 6. Exposed Face: Manufacturer's standard color and texture unless noted otherwise.
 - 7. Provide special units, including bull noses, for 90° corners, lintels, jambs, sash, control joints, headers, bond beams, and other conditions conforming to ASTM C90.
- B. Split Faced Dry-Block Concrete Masonry Units: ASTM C90 as follows:
 - 1. Weight: Normal weight or lightweight.
 - 2. Compressive Strength: As indicated on the drawings.
 - 3. Nominal Size: As indicated on the drawings.
 - 4. Actual Size: 3/8" less than nominal size.
 - 5. Aggregates: Conform to ASTM C33 for normal weight or ASTM C331 for lightweight.
 - 6. Exposed Face: As selected by Owner.
 - 7. Provide special units, including bull noses, for 90° corners, lintels, jambs, sash, control joints, headers, bond beams, and other conditions conforming to ASTM C90.

- 2.2 MORTAR AND GROUT
 - A. Mortar type for masonry construction shall be as designated in the General Notes of the drawings, conforming to ASTM C270, and grout shall conform to ASTM C476 and as follows:
 - 1. Compressive Strength: As indicated on the drawings.
 - 2. Portland Cement: ASTM C150, Type I non-staining, no air entrainment, natural color cement.
 - 3. Blend Cement: ASTM C595.
 - 4. Masonry Cement: ASTM C91.
 - 5. Hydrated Lime: ASTM C207.
 - 6. Quicklime: ASTM C5, non-hydraulic type.
 - 7. Premix Mortar: ASTM C387, using gray cement, normal strength.
 - 8. Water: Clean, free from injurious amounts of oil, alkali, organic matter, or other deleterious material.
 - 9. Cold Weather Admixtures: ASTM C494, non-chloride, non-corrosive, accelerating type recommended by the manufacturer for use in masonry mortar of composition indicated.
 - 10. Do not use calcium chloride in mortar or grout.
 - B. Pigmented Mortar: Select and portion pigments with other ingredients to produce the required color.
 - 1. Limit mineral oxide pigments to only 10 percent of the Portland cement-lime mortar mix.
 - 2. Manufacturers:
 - a. Davis Colors.
 - b. Lafarge Corporation.
 - c. L.M. Scofield.
 - d. Insert

2.3 STEEL REINFORCEMENT

- A. Reinforcing Steel: ASTM A615, Grade 60, deformed billet sizes as indicated on the drawings.
- B. Deformed Reinforcing Wire: ASTM A496, with ASTM A153, Class B-2 zinc coating.
- 2.4 JOINT REINFORCEMENT
 - A. Joint reinforcement shall be formed from galvanized carbon steel wire in accordance with ASTM A641, Class 1 for interior walls, and ASTM A153, Class B-2 for exterior walls.
 - B. Welded wire units shall have minimum 9 gauge deformed continuous side rods and minimum 9 gauge plain cross rods. The overall unit width shall be 1-1/2" to 2" less than the wall thickness. Prefabricate into small lengths not less than 10 feet with matching corners and tees.
 - C. For single wythe masonry, provide truss type reinforcement.
 - D. For multi-wythe construction, provide truss type reinforcement, which has one side rod for each face shell of hollow masonry units more than 4 inches in width, plus one side rod for each wythe of masonry 4 inches in width.

E. Adjustable Tab Design: Single pair of side rods and rectangular box-type cross ties spaced not more than 16 inches on center, with side rods spaced for embedment within each face shell of the back-up wythe and with separate adjustable ties engaging the cross ties and extending to engage the outer wythe by at least 1-1/2 inches and spaced not more than 16 inches on center. Use where horizontal joints of facing wythe do not align with the back-up wythe or where the facing wythe is of different material than back-up wythe.

2.5 WIRE TIES AND ANCHORS

- A. Provide wire ties and anchors as required for the wall construction indicated on the drawings which comply with the following:
 - 1. Exterior Walls: Galvanized carbon steel wire conforming to ASTM A153, Class B-2 coating.
 - 2. Interior Walls: Galvanized carbon steel wire conforming to ASTM A641, Class 1 coating.

2.6 STEEL PLATE

- A. Exterior Walls: ASTM A36 steel, hot-dip galvanized to comply with ASTM A123; temper as required to support loads imposed without exceeding allowable design stresses.
- B. Interior Walls: ASTM A36 steel, shop painted with one coat rust-inhibitive primer and two coats of finish paint. Refer to Section 09 90 00.
- C. Stainless Steel Plate and Bars: ASTM A167, TYPE 304 or TYPE 316; temper as required to support loads imposed without exceeding allowable design stresses.

2.7 ADJUSTABLE ANCHORS FOR CONNECTING TO STRUCTURAL FRAME

- A. Provide two-piece assemblies that allow vertical or horizontal movement between the masonry wall and the structural frame but resist the tension and compression forces applied perpendicular to it.
- B. Provide manufacturer's standard anchors with crimped 1/4-inch diameter wire anchor section for welding to steel and the triangular shaped 1/4-inch diameter wire tie section sized to extend within 1 inch of the masonry face.

2.8 WALL FLASHING COMPONENTS

A. Galvanized Metal Flashing (24 Gauge): Galvanized mill coated sheets conforming to ASTM A653, Structural Quality, and G90 finish.

2.9 MISCELLANEOUS MASONRY ACCESSORIES

- A. Pre-molded Control Joint Strips: Styrene-Butadiene rubber compound conforming to ASTM D2000, Designation M2AA-805. Designed to fit a standard sash block and to maintain lateral stability in masonry walls.
- B. Weep Holes: Provide cotton sash cord wick material in lengths required to produce a 2-inch exposure on the exterior and 18 inches in the cavity between wythes.

C. Compressible Filler: Pre-molded filler strips complying with ASTM D1056, Type 2, Class A, Grade 1; compressible up to 35 percent. Provide widths and thicknesses as indicated on the drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify field conditions are acceptable and are ready to receive work.
 - 1. Verify foundations are constructed with tolerances conforming to the requirements of ACI 117.
 - 2. Verify reinforcing dowels are positioned in accordance with the drawings.
- B. Verify items provided by other Sections of work are properly sized and located.
- C. Verify built-in items are properly located and ready for roughing into masonry work.
- D. Beginning of installation means Installer accepts existing conditions.

3.2 PREPARATION

- A. Lay out walls in advance for accurate spacing of bond patterns, with uniform joint widths and properly located openings, expansion joints, and offsets.
- B. Direct and coordinate placement of metal anchors supplied to other trades for their installation when required.
- C. Install metal anchors other than those required to be installed by other trades.
- D. The Contractor is responsible to design, provide, and install bracing that will ensure stability of masonry during construction. Maintain until building structure provides permanent bracing.
- E. Ensure items built-in by other trades for this work are properly located and sized.

3.3 COURSING

- A. Establish lines, levels, and coursing. Protect survey lines from displacement.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Lay concrete masonry units in running bond pattern. Course one unit and one mortar joint to equal 8 inches. Form [concave] [raked] [flush] [beveled] [match existing] mortar joints.
- D. Lay split faced block units in running bond pattern. Course one unit and one mortar joint to equal 8 inches vertically. Form [concave] [raked] [flush] [beveled] [match existing] mortar joints.

3.4 MORTAR MIX

- A. Thoroughly mix mortar ingredients in quantities needed for immediate use.
- B. Use mortar within two hours of mixing at temperatures over 80°F and 2-1/2 hours at temperatures under 50°F.
- C. If necessary, re-temper mortar within two hours of mixing to replace water lost by evaporation. Do not re-temper after two hours of mixing.
- 3.5 GROUT
 - A. Thoroughly mix grout ingredients in quantities needed for immediate use. Place grout within 1-1/2 hours from introducing water to the mixture and prior to the initial set. Retempered grout is not allowed.
 - B. Do not use anti-freeze compounds to lower the freezing point of grout.
 - C. Do not use admixtures in grout.
- 3.6 COLD-WEATHER CONSTRUCTION
 - A. When ambient temperature is below 40°F, implement cold weather procedures.
 - B. Special cold weather requirements for various temperature ranges are as follows:
 - 1. Air temperature 40°F to 32°F: Sand or mixing water shall be heated to produce mortar temperatures between 40°F to 120°F.
 - 2. Air temperature $32^{\circ}F$ to $25^{\circ}F$:
 - a. Sand and mixing water shall be heated to produce mortar temperatures between 40°F to 120°F. Maintain temperature of mortar on boards above freezing.
 - b. Grout aggregates and mixing water shall be heated to produce grout temperature between 70°F to 120°F.
 - 3. Air temperature 25°F to 20°F: Comply with requirements for air temperature between 32°F to 25°F and the following:
 - a. Provide heat sources on both sides of the wall under construction to heat masonry surfaces to 40°F. Windbreaks shall be used when wind is in excess of 15 miles per hour.
 - b. Heat masonry to a minimum temperature of 40°F prior to grouting.
 - 4. Air temperature 20°F and below. Comply with requirements for air temperature between 32° to 20°F and the following:
 - a. Enclosure and auxiliary heat shall be provided to maintain air temperature above freezing. Do not lay masonry units having a temperature below 20°F.

- C. Cold-Weather Protection:
 - 1. When the mean daily air temperature is 40°F to 25°F, masonry shall be completely covered for 24 hours with weather-resistive membrane.
 - 2. When the mean daily air temperature is 25°F to 20°F, masonry shall be completely covered for 24 hours with insulating blankets with a weather-resistive covering. Extend time period to 48 hours for grouted masonry.
 - 3. When the mean daily air temperature is 20°F or below, masonry temperature shall be maintained above freezing for 24 hours by enclosure and auxiliary heating. Extend time period to 48 hours for grouted masonry.
- D. Do not lay masonry units having either a temperature below 20°F or containing frozen moisture, visible ice, or snow on their surfaces.
- E. Remove visible ice and snow from the top surface of existing foundations and masonry to receive new construction. Heat these surfaces above freezing.
- F. Top of all walls not enclosed or sheltered shall be covered with strong weather-resistive material at the end of each day or shutdown.
- G. Partially completed walls shall be covered at all times when work is not in progress.
- H. Any section of masonry deemed frozen and damaged shall be removed before continuing construction of that section.
- I. Masonry units shall be dry at the time of placement. Wet or frozen units shall not be laid.
- J. All cold weather masonry construction shall conform to TMS 402/602 Building Code Requirements and Specifications for Masonry Structures.
- 3.7 HOT WEATHER CONSTRUCTION
 - A. Hot weather construction is defined when:
 - 1. The ambient air temperature exceeds 100°F or exceeds 90°F with a wind velocity greater than 8 mph.
 - B. Hot Weather Procedures:
 - 1. Maintain sand piles in a damp, loose condition.
 - 2. Provide necessary conditions and equipment to produce mortar having a temperature below 120°F.
 - 3. Flush mixer, mortar transport container, and mortar boards with cool water before they come in contact with mortar ingredients or mortar.
 - 4. Use mortar within two hours of initial mixing.
 - 5. Fog spray all newly constructed masonry until damp, at least three times a day until the masonry is three days old.
 - 6. Do not spread mortar beds more than 4 feet ahead of masonry. Set masonry within one minute of spreading mortar.

3.8 PLACING AND BONDING

- A. Unless otherwise noted, construct masonry in running bond pattern.
- B. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
- C. Lay hollow masonry units with face shell bedding on head and bed joints.
- D. Bed and Head Joints:
 - 1. Unless otherwise required, construct 3/8" thick bed and head joints.
 - 2. At foundation, construct bed joint of the starting course a thickness not less than 1/4" and not more than 3/4".
 - 3. Unless otherwise noted, tool joint with a round jointer when the mortar is thumbprint hard.
 - 4. Remove masonry protrusions extending 1/2" or more into cells or cavities to be grouted.
 - 5. Where masonry rests on concrete, the concrete shall be sandblasted or bushed.
- E. Collar Joints:
 - 1. Unless otherwise required, solidly fill collar joints less than 3/4 inch wide with mortar as the job progresses.
- F. Place hollow units as follows:
 - 1. With face shells of bed joints fully mortared.
 - 2. With webs fully mortared in:
 - a. All courses of piers, columns, and pilasters.
 - b. In the starting course on foundations.
 - c. When necessary to confine grout or loose fill.
 - d. When otherwise required.
 - 3. With head joints mortared, a minimum distance from each face equal to the face shell thickness of the unit.
 - 4. Vertical cells to be grouted are aligned and openings are unobstructed.
- G. Place solid units as follows:
 - 1. Unless otherwise required, solidly fill bed and head joints with mortar.
 - 2. Do not fill head joints by grouting with mortar.
 - 3. Construct head by shoving mortar tight against the adjoining unit.
 - 4. Do not deeply furrow bed joints.
- H. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
- I. Fully bond external and internal corners and intersections.
- J. Remove excess mortar as work progresses.
- K. Interlock intersections and external corners.

- L. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- M. Where built-in items are too embedded into hollow masonry units, place a layer of metal lath in the joint below and fill cavities with mortar or grout.
- N. Isolate masonry partitions from vertical structural framing members with a control joint and anchor as detailed on the drawings.
- O. Where non-load bearing masonry partitions extend to underside of structural system, terminate masonry 1/2 inch to 3/4 inch below structure to allow for live load deflection to occur. Fill gaps with compressible joint filler or compressible fire stop material as required.
- P. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry units at corners.

3.9 JOINTS

- A. Maintain joint width to match abutting existing masonry wall joints.
- B. Neatly tool exposed exterior and interior mortar joints.
- C. Rake out mortar joints flush where sealants are shown.
- D. Cut mortar joints flush where ceramic or quarry wall tile is scheduled, resilient and tile base is scheduled, and cavity insulation vapor barrier adhesive is applied.

3.10 WEEPS AND VENTS

- A. Install weep holes in veneer at 32 inches on center horizontally, above the through wall flashing at lintels and at the base of the wall.
- B. Install cavity vents at the top of each cavity space and below shelf-angles at 32 inches on center horizontally.

3.11 CAVITY WALL

- A. Do not permit mortar to drop or accumulate into the cavity air space or plug weep holes.
- B. Construct inner wythe ahead of outer wythe to receive cavity insulation and vapor barrier adhesive. Strike joints facing the cavity flush.
- C. Tie exterior wythe to backup with continuous horizontal joint reinforcing embedded in mortar joints at a maximum distance of 16 inches on center vertically.
- D. Place horizontal reinforcing with drip centered over cavity.
- E. Install cavity wall insulation and weeps as specified herein.

3.12 HORIZONTAL REINFORCEMENT AND ANCHORS

- A. Install horizontal joint reinforcement as follows:
 - 1. Interior non-load bearing walls 24 inches on center vertically.
 - 2. Exterior walls and interior load bearing walls 16 inches on center vertically.
 - 3. Parapet walls 8 inches on center vertically unless noted otherwise.
 - 4. Foundation walls 8 inches on center vertically unless noted otherwise.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
- C. Place joint reinforcement continuous in first and second joint below top of walls.
- D. Lap joint reinforcement ends minimum 6 inches. Extend minimum 16 inches each side of openings.
- E. Place joint reinforcement so longitudinal wires are embedded in mortar with a minimum cover of 1/2 inch when not exposed to weather or earth, and 5/8 inch when exposed to weather or earth.
- F. Anchor masonry to structural members where masonry abuts or faces such members.
- G. Wall Ties:
 - 1. Embed the ends of wall ties in mortar joints. Embed wall tie ends at least 1/2" into the outer face shell of hollow units. Embed wire wall ties at least 1-1/2" into the mortar bed of solid masonry units or solid grouted hollow units.
 - 2. Do not bend wall ties after embedded in grout or mortar.
 - 3. Unless otherwise required, install adjustable ties in accordance with the following requirements.
 - a. One tie for each 1.77 square feet of wall area.
 - b. Do not exceed 16 inches horizontal or vertical spacing.
 - c. The maximum misalignment of bed joints from one wythe to the other is 1-1/4".
 - d. The maximum clearance between connecting parts of the ties is 1/16".
 - e. When pintle legs are used, provide ties with at least two legs made of wire size W2.8.
 - f. Install wire ties perpendicular to a vertical line on the face of the wythe from which they protrude. Where one-piece ties or joint reinforcement are used, the bed joints of adjacent wythes shall align.
 - g. Unless otherwise required, provide additional unit ties around all openings larger than 16 inches in either dimension. Space ties around perimeter of opening at a maximum of 3 feet on center. Place ties within 12 inches of opening.
- H. Veneer Anchors:
 - 1. Embed veneer anchors in mortar joint and extend into the veneer a minimum of 1-1/2 inch at least 5/8-inch cover to the outside face.
 - 2. Install adjustable veneer anchors as follows:

- a. The maximum misalignment of bed joints from one wythe to the other is 1-1/4".
- b. The maximum clearance between connecting parts of the ties is 1/16".
- c. When pintle legs are used, provide anchors with at least two legs made of wire size W2.8.
- d. Provide at least one adjustable two-piece anchor of wire size W1.7- or 22-gauge corrugated sheet metal anchor for each 2.67 square feet of wall area.
- 3. Install non-adjustable veneer anchors for each 3.5 square feet of wall area.
- 4. Space anchors at a maximum of 32 inches horizontally and 16 inches vertically.
- I. Provide additional anchors around all openings larger than 16 inches in either dimension. Space anchors around the perimeter of an opening at a maximum of 3 feet on center. Place anchors within 12 inches of the opening.

3.13 VERTICAL REINFORCEMENT

- A. Support and secure reinforcing bars from displacement beyond the tolerances allowed by construction loads or by placement of grout or mortar. Maintain position within 1/2 inch of masonry unit or formed surface, but not less than 1/4 inch (only when fine grout is used).
- B. Dowels in footings shall be set to align with cores containing reinforcing steel.
- C. Place and consolidate grout fill without displacing reinforcing. Completely embed reinforcing bars in grout.
- D. All cells containing reinforcing in concrete blocks shall be filled solid with grout.
- E. Do not bend reinforcement after it is embedded in grout or mortar.
- F. Reinforce masonry unit cores and cavities with vertical reinforcement bars and grout as indicated on the drawings. Place reinforcement and ties in grout spaces prior to grouting.
- G. Retain vertical reinforcement in position at top and bottom of cells and at intervals not exceeding 192 bar diameters.
- H. Place steel in walls and flexural elements within 1/2 inch of required location.
- I. Place vertical bars within 2 inches of the required location along the length of the wall.

3.14 REINFORCED MASONRY

- A. Lay masonry units with core cells vertically aligned and clear of mortar dropping, debris, loose aggregates, and any material deleterious to masonry grout.
- B. Support and secure reinforcing bars from displacement before grouting. Maintain position within 1/2 inch of dimensioned position.
- C. Do not place grout until height of masonry to be grouted has attained sufficient strength to resist grout pressure.

- D. Grout spaces less than two inches in width with fine grout using low lift grouting techniques. Grout spaces two inches or greater in width with coarse grout using high lift or low lift grouting techniques.
- E. When grouting has stopped for more than one hour, terminate grout 1-1/2 inch below the top of the upper masonry unit to form a positive key for subsequent grout placement.
- F. Do not wet concrete masonry units before laying.

3.15 GROUTING

- A. Place grout in lifts not to exceed five feet. Consolidate grout at time of placement.
 - 1. Consolidate grout pours 12 inches or less in height by mechanical vibration or by puddling.
 - 2. Consolidate grout pours exceeding 12 inches in height by mechanical vibration and reconsolidate by mechanical vibration after initial water loss and settlement has occurred.
- B. When the grout pour height exceeds 5 feet 4 inches, provide a cleanout opening no less than 3 inches high at the bottom of each cell to be grouted by cutting one face shell of the masonry unit. Opening should be of sufficient size to permit removal of debris.
- C. Pump grout into spaces. Maintain water content in grout to intended slump without aggregate segregation.
- D. Limit grout lift to 60 inches and rod for grout consolidation. Wait 30 to 60 minutes before placing next lift.

3.16 GROUTING REINFORCED CONCRETE BLOCK WALLS

- A. Provide reinforcing bars at indicated spacing and fill cavities and voids solid with grout having a 28-day compressive strength as listed in the General Notes of the drawings.
- 3.17 GROUTING BLOCK CELLS BELOW LINTELS AND BEAMS
 - A. For lintel spans greater than 5'-0", grout block cells 24 inches beneath the lintel and 24 inches on each side of the opening.

3.18 LINTELS AND BOND BEAMS

- A. Steel Lintels: Install steel lintels supplied from Division 5 of this specification. Provide a minimum of 8 inches of end bearing on each side of the opening unless noted otherwise. All exterior exposed steel lintels shall be hot-dip galvanized in accordance with ASTM A123.
- B. Bond Beam Lintels:
 - 1. Use specially shaped lintel units at hollow masonry unit walls, with reinforcing bars as shown and filled with concrete grout.
 - 2. Provide minimum 8 inches of end bearing at each side of opening.
 - 3. Provide reinforced concrete block lintels over openings less than 3'-0" wide that are not scheduled.

- 4. Place and consolidate the grout without disturbing the reinforcing.
- 5. Allow lintels to reach 100 percent of their design strength before removing temporary supports.
- 6. Do not place vertical control joints through bond beams. Place the vertical control joints at each end the bond beam lintel.

3.19 CONTROL AND EXPANSION JOINTS

- A. Do not continue horizontal joint reinforcement through control and expansion joints except above wall openings.
- B. Provide vertical expansion, control, and isolation joints as indicated on the drawings. If joints are not indicated, provide control joints at a maximum spacing of 30'-0".
- C. Install all built-in masonry accessory items as work progresses.
- D. Exposed joints to be tooled slightly concave and concealed joints to be struck flush. Use a 3/4-inch diameter round tool for making 1/2-inch joints.
 - 1. Bed Joints: Not less than 3/8-inch and not more than 2-inch thick.
 - 2. Head Joints: To match bed joints.
- E. Rake out mortar where sealants are shown or required.

3.20 BASE FLASHING

- A. Place flashing in accordance with the manufacturer's recommendations.
- B. Install reglets and nailers for flashing and other related work where shown on the drawings.
- C. Extend flashing through veneer, turn up 8 inches, and bed into a mortar joint of the masonry. Seal to concrete and/or steel framing.
- D. Lap end joints minimum 6 inches and seal watertight.
- E. Use adhesives and sealant as recommended by the flashing manufacturer.

3.21 BUILT-IN WORK AND EMBEDDED ITEMS

- A. As work progresses, build in metal doorframes, window frames, wood nailers, steel angle lintels, anchor bolts, bearing plates, and other items supplied by other trades.
- B. Place pipes and conduits passing horizontally through masonry beams or masonry walls in steel sleeves or cored holes.
- C. Install pipes and conduits passing horizontally through non-bearing masonry partitions.
- D. Install and secure connectors, flashing, weep holes, weep vents, nailing blocks, and other accessories.

- E. Do not embed aluminum conduits, pipes, and accessories in masonry, grout, or mortar, unless effectively coated or covered to prevent aluminum-cement chemical reaction or electrolytic action between aluminum and steel.
- F. Build-in items plumb and true.
- G. Bed anchors of hollow metal frames in mortar joints. Fill frame voids solid with mortar. Fill masonry cores with grout minimum 12 inches from framed opening.
- H. Do not build-in organic materials that will be subjected to rot or deterioration.

3.22 TOLERANCES

- A. Comply with tolerances in the MSJC Code and the following:
 - 1. Maximum variation from masonry unit to adjacent masonry unit is 1/32 inch.
 - 2. Maximum variation from vertical and horizontal building lines shall be 1/4 inch in 10 feet and 3/8 inch in 20 feet or more.
 - 3. Maximum variation from alignment of columns and pilasters shall be 1/4 inch.
 - 4. Maximum variation from plumb shall be 1/4 inch per story, non-cumulative.
 - 5. Maximum variation from level coursing shall be 1/8 inch in 3 feet, 1/4 inch in 10 feet, and 1/2 inch in 30 feet.
 - 6. Maximum variation of joint thickness shall be 1/8 inch in 3 feet.
 - 7. Maintain flush face on exposed masonry surfaces.
 - 8. Masonry to receive thin set ceramic tile shall have flush mortar joints and a maximum surface variation or 1/8 inch.

3.23 CUTTING AND FITTING

- A. Cut and fit masonry for chases, pipes, conduit, sleeves, and grounds. Coordinate fully with other trades to ensure correct size, shape, and location.
- B. Obtain the Architect/Engineer's review prior to cutting or fitting any area not indicated on drawings or which may impair appearance or strength of masonry work.

3.24 PROTECTION OF EXISTING WORK

- A. Protect finished installation under the provisions of Division 1.
- B. Without damaging completed work, provide protective boards at exposed external corners that may be damaged by construction activities.
- C. Water Repellent Coating:
 - 1. Apply sufficient coats of the approved material to achieve a consistent and uniform appearance, free from runs and sags, and with a uniformly resistive surface that will prevent penetration of water through the walls for the required period of warranty.
 - 2. Twenty days after completion of the portion of work, and as a condition of its acceptance, demonstrate by running a water test showing it will successfully repel water.

- a. Notify the Architect/Engineer at least 72 hours in advance and conduct the test in the Architect/Engineer's presence.
- b. By means of an outrigger or similar acceptable equipment, place the nozzle of a 3/4" garden hose at a point approximately 10 feet away from the top of the wall, aiming the nozzle at a slight downward angle to direct the full stream of water onto the wall.
- c. Run the water onto the wall at full available force for not less than 4 hours.
- d. Upon completion of the 4-hour period, inspect the interior surfaces of the wall for evidence of moisture penetration.
- 3. If evidence of moisture penetration is discovered, apply an additional coat of the water repellent material to the exterior surface in areas directed by the Architect/Engineer, repeating the application and the testing, at no additional cost to the Owner, until no evidence of moisture penetration is found.

END OF SECTION
SECTION 04 22 00 - REINFORCED UNIT MASONRY

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Supply and installation of all reinforced concrete unit masonry work (concrete unit masonry, mortar, grout, reinforcement, anchors, and ties) and accessories as shown on the drawings and herein specified.
- B. Products installed but not furnished under this section:
 - 1. Loose fill insulation.
 - 2. Foam core insert insulation.
- C. Structural notes indicated on the drawings regarding reinforced unit masonry shall be considered part of this specification.

1.2 RELATED WORK

- A. Section 03 30 00 Cast-in-Place Concrete.
- B. Section 04 20 00 Unit Masonry.
- C. Section 05 12 23 Structural Steel.
- D. Section 05 21 00 Steel Joists.
- E. Section 31 23 00 Foundation Excavating and Backfilling.

1.3 REFERENCES

- A. Codes and Standards: Comply with the provisions of the following codes, specifications, and standards except where more stringent requirements are shown or specified. Where any provision of other pertinent codes and standards conflict with this specification, the more stringent provision shall govern.
 - 1. ASTM A153 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 2. ASTM C90 Standard Specification for Loadbearing Concrete Masonry Units.
 - 3. ASTM C270 Standard Specification for Mortar for Unit Masonry.
 - 4. ASTM C387 Specification for Packaged, Dry, Combined Materials for Concrete and High Strength Mortar.
 - 5. ASTM C476 Standard Specification for Grout for Masonry.
 - 6. ASTM C780 Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
 - 7. ASTM C1019 Standard Test Method for Sampling and Testing Grout.
 - 8. International Masonry Industry All-Weather Council (IMIAC) Recommended Practices and Guide Specifications for Cold Weather Masonry Construction.
 - 9. TMS 402/602 Building Code Requirements and Specifications for Masonry Structures.

10. UL - Underwriters Laboratories.

1.4 QUALITY ASSURANCE

- A. Installation Company: Company shall have not less than five (5) years of documented experience in the construction of masonry projects of similar scope and complexity.
- B. For the actual cutting and placing of concrete masonry units, use only skilled masons who are thoroughly experienced with the material and methods specified and thoroughly familiar with the design requirements. Workers shall have not less than three (3) years of documented experience in the construction of masonry walls.
- C. Fire Resistance: Whenever a fire-resistant classification is indicated for unit masonry construction, provide concrete block units as tested and listed for the particular fire-resistant construction.
- D. The governing building department reserves the right to take samples and make material tests prior to or during construction, without expense to the Contractor. Materials found to be defective shall be removed and replaced.

1.5 SUBMITTALS

- A. Prepare and submit product data for the Engineer's approval. Data should include all horizontal reinforcement, anchoring devices, and all other embedded items herein specified.
- B. Prepare and submit shop drawings detailing the fabrication, bending, and placement of reinforcing bars. Provide wall elevations showing reinforcement layout.
- C. Samples: When requested by the Architect and before any materials are delivered to the Worksite, submit for approval one sample of the proposed masonry materials, showing the full range of colors and textures available.
- D. Certificates:
 - 1. Submit a letter of certification from the manufacturer of the concrete masonry units certifying all concrete masonry units delivered to the worksite are in strict conformance with the provisions of this specification.
 - 2. Submit concrete unit masonry compressive strength test results demonstrating the units meet the specified strength. Test must be conducted by a qualified independent testing agency.
- E. Submit mortar mix design and test results as follows:
 - 1. Mix designs shall indicate type and proportions of ingredients in compliance with the proportion requirements of ASTM C270.
 - 2. For mix designs not in accordance with the proportion requirements of ASTM C270, the mortar test history must be performed in accordance with ASTM C780 to verify performance with property requirements of ASTM C270. Tests must meet the type of mortar specified on the drawings. Tests must be done by a qualified independent testing agency.

- F. Submit grout mix designs and test results as follows:
 - 1. Mix designs shall indicate type and proportions of the ingredients in compliance with the proportion requirements of ASTM C476.
 - 2. For mix designs not in accordance with the proportion requirements of ASTM C476, the grout test history must be performed in accordance with ASTM C1019 to verify performance with property requirements of ASTM C476. Tests must meet the type of grout specified on the drawings. Test must be done by a qualified independent testing agency.
 - a. Perform one test prior to construction and perform at least one test during construction for each 5000 square feet of wall.

1.6 MOCKUP

- A. Prior to installation of masonry work, erect sample wall panel to further verify color and texture characteristics of selected masonry units and mortar and to demonstrate the level of workmanship required for the unit masonry.
- B. Construct mockup at the site, where directed. Mockup shall be full thickness four-foot high by four-foot long, including face and back-up wythes, as well as all accessories. Mockup shall indicate the proposed range of color, texture, and quality of workmanship to be expected in the completed work.
- C. Obtain the Architect's acceptance of visual qualities of the mockup before start of masonry work.
- D. Retain mockup during construction as a standard for judging completed masonry work.
- E. Construct mockup panels for the following walls:
 - 1. Interior masonry wall construction.
 - 2. Exterior masonry wall construction.
 - 3. Insert.
- F. Demolish and remove mockups from site when directed by the Architect/Engineer.
- G. Mockups may remain as part of work when directed by the Architect/Engineer.
- 1.7 DELIVERY, STORAGE, AND HANDLING
 - A. All masonry units shall be delivered to the worksite and stacked on pallets to allow the circulation of air through all units. Cover with a waterproof covering anchored to prevent displacement during high winds.
 - B. Masonry accessories, including reinforcing steel, shall be stored clear of the ground to prevent deterioration or damage due to moisture, temperature changes, contaminants, and corrosion.
 - C. Deliver all materials in sufficient quantity and time to maintain approved construction schedule.
 - D. Deliver all packaged materials in manufacturer's original containers, with labels and markings intact and legible.

E. Immediately remove all damaged materials or containers from site and replace with new items.

PART 2 - PRODUCTS

- 2.1 MATERIALS
 - A. Mortar and Grout:
 - 1. Compressive Strength: As indicated on the drawings.
 - 2. Mortar type for masonry construction shall be as designated in the General Notes of the drawings, conforming to ASTM C270, and grout shall conform to ASTM C476.
 - 3. Portland Cement: ASTM C150, Type I, non-staining, no air entraining, natural color cement.
 - 4. Blended Cement: ASTM C595.
 - 5. Masonry Cement: ASTM C91.
 - 6. Mortar Aggregate: ASTM C144, standard masonry type sand .
 - 7. Hydrated Lime: ASTM C207.
 - 8. Quicklime: ASTM C5, non-hydraulic type.
 - 9. Premix Mortar: ASTM C387, using graywhite cement, normal strength.
 - 10. Grout Aggregate: ASTM C404 Pea gravel with not more than 5% passing the No. 8 sieve and 100% passing the 3/8-inch sieve .
 - 11. Grout Fine Aggregate: Sand.
 - 12. Water: Clean and potable.
 - 13. Do not use calcium chloride in mortar or grout.
 - B. Joint Reinforcement:
 - 1. Provide joint reinforcement formed from galvanized carbon-steel wire in accordance with ASTM A641, Class 1 for interior walls; and ASTM A153, Class B-2, for exterior walls.
 - 2. Provide welded wire units prefabricated with 9 gauge deformed continuous side rods and 9 gauge plain cross rods into straight lengths of not less than 10 feet with matching corner and tee units. Unit widths to be 1-1/2 to 2 inches less than the wall thickness.
 - C. Control and Expansion Joints:
 - 1. Control joint material for unit masonry shall consist of cross-shaped extruded polyvinyl gaskets sized to match wall thickness.
 - 2. Expansion or joint filler material, unless otherwise indicated, shall be 1/2 inch thick asphalt impregnated cellular board.
 - 3. Compressible filler shall be pre-molded filler strips complying with ASTM D1056, Type 2, Class A, Grade 1; compressible up to 35 percent of width and thickness indicated.
 - 4. Bond breaker strips shall be asphalt-saturated, organic roofing felt complying with ASTM D226, Type I (No. 15 asphalt felt).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify field conditions are acceptable and are ready to receive work.

- 1. Verify foundations are constructed with tolerances conforming to the requirements of ACI 117.
- 2. Verify reinforcing dowels are positioned in accordance with the drawings.
- B. Verify items provided by other Sections of work are properly sized and located.
- C. Verify built-in items are in proper location and ready for roughing into masonry work.
- D. Beginning of installation means Installer accepts existing conditions.

3.2 PREPARATION

- A. Layout walls in advance for accurate spacing of bond patterns, with uniform joint widths and to properly locate openings, expansion joints, and offsets.
- B. Direct and coordinate placement of metal anchors supplied to other Sections.
- C. The Contractor is responsible to design, provide, and install bracing that will ensure stability of masonry during construction. Maintain in place until building structure provides permanent bracing.
- D. Remove laitance, loose aggregate, and anything else that would prevent mortar from bonding to the foundation.
- E. Clean all reinforcement by removing mud, oil, or other materials that will adversely affect or reduce bond at the time mortar or grout is placed.
- 3.3 COLD WEATHER CONSTRUCTION
 - A. When ambient temperature is below 40°F, implement cold weather procedures.
 - B. Special cold weather requirements for various temperature ranges are as follows:
 - 1. Air temperature 40°F to 32°F: Sand or mixing water shall be heated to produce mortar temperatures between 40°F to 120°F.
 - 2. Air temperature $32^{\circ}F$ to $25^{\circ}F$:
 - a. Sand and mixing water shall be heated to produce mortar temperatures between 40°F to 120°F. Maintain temperature of mortar on boards above freezing.
 - b. Grout aggregates and mixing water shall be heated to produce grout temperature between 70°F to 120°F.
 - 3. Air temperature 25°F to 20°F: Comply with requirements for air temperature between 32°F to 25°F and the following:
 - a. Provide heat sources on both sides of the wall under construction to heat masonry surfaces to 40°F. Windbreaks shall be used when wind is in excess of 15 miles per hour.
 - b. Heat masonry to a minimum temperature of 40°F prior to grouting.
 - 4. Air temperature 20°F and below. Comply with requirements for air temperature between 32°F to 20°F and the following:

- a. Enclosure and auxiliary heat shall be provided to maintain air temperature above freezing. Do not lay masonry units having a temperature below 20°F.
- C. Cold-Weather Protection:
 - 1. When the mean daily air temperature is 40°F to 25°F, masonry shall be completely covered for 24 hours with weather-resistive membrane.
 - 2. When the mean daily air temperature is 25°F to 20°F, masonry shall be completely covered for 24 hours with insulating blankets with a weather-resistive covering. Extend time period to 48 hours for grouted masonry.
 - 3. When the mean daily air temperature is 20°F or below, masonry temperature shall be maintained above freezing for 24 hours by enclosure and auxiliary heating. Extend time period to 48 hours for grouted masonry.
- D. Do not lay masonry units having either a temperature below 20°F or containing frozen moisture, visible ice, or snow on their surfaces.
- E. Remove visible ice and snow from the top surface of existing foundations and masonry to receive new construction. Heat these surfaces above freezing.
- F. Top of all walls not enclosed or sheltered shall be covered with strong weather-resistive material at the end of each day or shutdown.
- G. Partially completed walls shall be covered at all times when work is not in progress.
- H. Any section of masonry deemed frozen and damaged shall be removed before continuing construction of that section.
- I. Masonry units shall be dry at the time of placement. Wet or frozen units shall not be laid.
- J. All cold weather masonry construction shall conform to TMS 402/602 Building Code Requirements and Specifications for Masonry Structures.
- 3.4 HOT WEATHER CONSTRUCTION
 - A. Hot weather construction is defined when:
 - 1. The ambient air temperature exceeds 100°F or exceeds 90°F with a wind velocity greater than 8 mph.
 - B. Hot Weather Procedures:
 - 1. Maintain sand piles in a damp, loose condition.
 - 2. Provide necessary conditions and equipment to produce mortar having a temperature below 120°F.
 - 3. Flush mixer, mortar transport container, and mortar boards with cool water before they come in contact with mortar ingredients or mortar.
 - 4. Use mortar within two hours of initial mixing.
 - 5. Fog spray all newly constructed masonry until damp, at least three times a day until the masonry is three days old.

6. Do not spread mortar beds more than 4 feet ahead of masonry. Set masonry within one minute of spreading mortar.

3.5 COURSING

- A. Establish lines, levels, and coursing indicated. Protect from displacement. Grouted cells shall be in vertical alignment.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Lay concrete masonry units in bond to match existing at all patch and infill locations.
- D. Unless noted otherwise, provide masonry control joints at 30'-0" on center maximum.
- E. Unless noted otherwise, build non-bearing interior partitions walls full height to underside of structure.

3.6 PLACING AND BONDING

- A. Unless noted otherwise, construct masonry in running bond pattern.
- B. Lay hollow masonry units with face shell bedding on head and bed joints.
- C. Bed and Head Joints:
 - 1. Unless otherwise required, construct 3/8 inch thick bed and head joints.
 - 2. At foundation, construct bed joint of the starting course a thickness not less than 1/4 inch, and not more than 3/4 inch.
 - 3. Unless otherwise noted, tool joint with a round jointer when the mortar is thumbprint hard.
 - 4. Remove masonry protrusions extending 1/2 inch or more into cells or cavities to be grouted.
 - 5. Where masonry rests on concrete, the concrete shall be sandblasted or bushed.
- D. Collar Joints:
 - 1. Unless otherwise required, solidly fill collar joints less than 3/4 inch wide with mortar as the job progresses.
- E. Place hollow units as follows:
 - 1. With face shells of bed joints fully mortared.
 - 2. With webs fully mortared in:
 - a. All courses of piers, columns, and pilasters.
 - b. In the starting course on foundations.
 - c. When necessary to confine grout or loose fill.
 - d. When otherwise required.
 - 3. With head joints mortared, a minimum distance from each face equal to the face shell thickness of the unit.

- 4. Vertical cells to be grouted are aligned and openings are unobstructed.
- F. Place solid units as follows:
 - 1. Unless otherwise required, solidly fill bed and head joints with mortar.
 - 2. Do not fill head joints by grouting with mortar.
 - 3. Construct head by shoving mortar tight against the adjoining unit.
 - 4. Do not deeply furrow bed joints.
- G. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
- H. Remove excess mortar as work progresses.
- I. Interlock intersections and external corners.
- J. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- K. Perform job site cutting of masonry units with proper tools to provide straight, clean, undamaged edges. Prevent broken masonry unit corners or edges.
- L. Isolate masonry partitions from vertical structural framing members with a control joint.
- M. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler and pin top of wall with prefabricated partition anchors that allow vertical movement.

3.7 HORIZONTAL REINFORCEMENT AND ANCHORS

- A. Install horizontal joint reinforcement as follows:
 - 1. Interior non-load bearing walls 24 inches on center vertically.
 - 2. Exterior walls and interior load bearing walls 16 inches on center vertically.
 - 3. Parapet walls 8 inches on center vertically unless noted otherwise.
 - 4. Foundation walls 8 inches on center vertically unless noted otherwise.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
- C. Place joint reinforcement continuous in first and second joint below top of walls.
- D. Lap joint reinforcement ends minimum 6 inches. Extend minimum 16 inches each side of openings.
- E. Place joint reinforcement so longitudinal wires are embedded in mortar with a minimum cover of 1/2 inch when not exposed to weather or earth, and 5/8 inch when exposed to weather or earth.
- F. Anchor masonry to structural members where masonry abuts or faces such members.

3.8 VERTICAL REINFORCEMENT

- A. Support and secure reinforcing bars from displacement beyond the tolerances allowed by construction loads or by placement of grout or mortar. Maintain position within 1/2 inch of masonry unit or formed surface, but not less than 1/4 inch (only when fine grout is used).
- B. Dowels in footings shall be set to align with cores containing reinforcing steel.
- C. Place and consolidate grout fill without displacing reinforcing. Completely embed reinforcing bars in grout.
- D. All cells containing reinforcing in concrete blocks shall be filled solid with grout.
- E. Do not bend reinforcement after it is embedded in grout or mortar.
- F. Reinforce masonry unit cores and cavities with vertical reinforcement bars and grout as indicated on the drawings. Place reinforcement and ties in grout spaces prior to grouting.
- G. Retain vertical reinforcement in position at top and bottom of cells and at intervals not exceeding 192 bar diameters.
- H. Place steel in walls and flexural elements within 1/2 inch of required location.
- I. Place vertical bars within 2 inches of the required location along the length of the wall.

3.9 CONCRETE UNIT MASONRY

- A. Lay masonry units with core cells vertically aligned and clear of mortar dropping, debris, loose aggregates, and any material deleterious to masonry grout.
- B. Do not place grout until height of masonry to be grouted has attained sufficient strength to resist grout pressure.
- C. Do not wet concrete masonry units before laying.
- D. Grout spaces less than two inches in width with fine grout using low lift grouting techniques. Grout spaces two inches or greater in width with course grout using high lift or low lift grouting techniques.
- E. When grouting is stopped for more than one hour, terminate grout 1-1/2 inch below top of upper masonry unit to form a positive key for subsequent grout placement.
- F. Grouting:
 - 1. Place grout in lifts not to exceed five feet. Consolidate grout at time of placement.
 - a. Consolidate grout pours 12 inches or less in height by mechanical vibration or by puddling.
 - b. Consolidate grout pours exceeding 12 inches in height by mechanical vibration and reconsolidate by mechanical vibration after initial water loss and settlement has occurred.

- 2. When the grout pour height exceeds 5 feet 4 inches, provide cleanout opening no less than 3 inches high at the bottom of each cell to be grouted by cutting one face shell of masonry unit. Opening should be of sufficient size to permit removal of debris.
- 3. Pump grout into spaces. Maintain water content in grout to intended slump without aggregate segregation.
- 4. Limit grout lift to 60 inches and rod for grout consolidation. Wait 30 to 60 minutes before placing next lift.

3.10 GROUTING REINFORCED CONCRETE BLOCK WALLS

A. Provide reinforcing bars at indicated spacing and grout bars and voids solid with grout having a 28-day compressive strength as listed in the General Notes of the drawings.

3.11 GROUTING BLOCK CELLS BELOW LINTELS AND BEAMS

A. For lintel spans greater than 5'-0": Grout block cells 24 inches beneath the lintel and 24 inches each side of lintel.

3.12 LINTELS AND BOND BEAMS

- A. Steel Lintels: Install steel lintels supplied from Division 5 of this specification. Provide a minimum of 8 inches of end bearing on each side of opening unless noted otherwise. All exterior exposed steel lintels shall be hot-dip galvanized in accordance with ASTM A123.
- B. Bond Beams:
 - 1. Use specially shaped lintel units at hollow masonry unit walls, with reinforcing bars as shown and filled with concrete grout.
 - 2. Provide minimum 8 inches of end bearing at each side of opening.
 - 3. Provide reinforced concrete block lintels over openings less than 3'-0" wide which are not scheduled.
 - 4. Place and consolidate concrete without disturbing the reinforcing.
 - 5. Allow lintels to reach 100 percent of their design strength before removing temporary supports.
 - 6. Do not place vertical control joints above bond beams or within 16 inches each side of bond beam.

3.13 CONTROL AND EXPANSION JOINTS

- A. Do not continue horizontal joint reinforcement through control and expansion joints except above wall openings.
- B. Provide vertical expansion, control, and isolation joints as indicated on the drawings. If joints are not indicated, then provide control joints at a maximum spacing of 30'-0".
- C. Install all built-in masonry accessory items as work progresses.

- D. Exposed joints to be tooled slightly concave and concealed joints to be struck flush. Use a 3/4-inch diameter round tool for making 1/2-inch joints.
 - 1. Bed Joints: Not less than 3/8-inch and not more than 2-inch thick.
 - 2. Head Joints: To match bed joints.

3.14 BUILT-IN WORK AND EMBEDDED ITEMS

- A. As work progresses, build in metal door and glazed frames, fabricated metal lintels, anchor bolts, plates, and other items furnished by other Sections.
- B. Place pipes and conduits passing horizontally through masonry beams or masonry walls in steel sleeves or cored holes.
- C. Install pipes and conduits passing horizontally through non-bearing masonry partitions.
- D. Install and secure connectors, flashing, weep holes, weep vents, nailing blocks, and other accessories.
- E. Do not embed aluminum conduits, pipes, and accessories in masonry, grout, or mortar, unless effectively coated or covered to prevent aluminum-cement chemical reaction or electrolytic action between aluminum and steel.
- F. Build in items plumb and level.
- G. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout.
- H. Do not build in organic materials subject to deterioration.
- 3.15 PREFABRICATED CONCRETE AND MASONRY ITEMS
 - A. Erect prefabricated concrete and masonry items in accordance with the requirements.

3.16 TOLERANCES

- A. Comply with tolerances in the MSJC Specification and the following:
 - 1. Maximum variation from alignment of columns and pilasters: 1/4 inch.
 - 2. Maximum variation from unit to adjacent unit: 1/32 inch.
 - 3. Maximum variation from plane of wall: 1/4 inch in 10 feet and 3/8 inch in 20 feet or more.
 - 4. Maximum variation from plumb: 1/4 inch per story non-cumulative.
 - 5. Maximum variation from level coursing: 1/8 inch in 3 feet and 1/4 inch in 10 feet; 1/2 inch in 30 feet.
 - 6. Maximum variation of bed joint thickness: 1/8 inch.

3.17 CUTTING AND FITTING

A. Cut and fit for chases, pipes, conduit, sleeves, and structural members. Coordinate with other Sections of work to provide correct size, shape, and location.

B. Obtain the Engineer's approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.18 PROTECTION OF FINISHED WORK

A. Without damaging completed work, provide protective boards at exposed external corners that may be damaged by construction activities.

END OF SECTION

SECTION 05 05 23 - WELDING

PART 1 - GENERAL

- 1.1 SECTION INCLUDES
 - A. Welding of structural steel, including both field and shop welding.
 - B. Structural notes indicated on the drawings regarding welding should be considered a part of this specification.
- 1.2 RELATED WORK
 - A. Pertinent Sections of Division 01.
 - B. Section 05 12 23 Structural Steel.
 - C. Section 05 31 00 Steel Deck.
 - D. Section 05 50 00 Metal Fabrications.
 - E. Section 05 51 00 Metal Stairs.

1.3 REFERENCES

- A. Codes and Standards: Comply with the provisions of the following codes, specifications, and standards except where more stringent requirements are shown or specified. Where any provisions of other pertinent codes and standards conflict with this specification, the more stringent provision shall govern.
 - 1. AISC Seismic Provisions for Structural Steel Buildings and Supplement No. 2.
 - 2. AISC 303 Code of Standard Practice for Buildings and Bridges.
 - 3. AISC 341-10 Seismic Provisions for Structural Steel Buildings, including any Supplements.
 - 4. AISC 358-10 Prequalified Connections for Special and Intermediate Steel Moment Frames for Seismic Applications.
 - 5. AISC 360-10 Specification for Structural Steel Buildings.
 - 6. ANSI/ASNT CP-189 Standard for Qualification and Certification of Nondestructive Testing Personnel.
 - 7. ANSI/ASNT SNT-TC-1A Personnel Qualification and Certification in Nondestructive Testing
 - 8. ASTM A435 Standard Specification for Straight-Beam Ultrasonic Examination of Steel Plates.
 - 9. ASTM A898 Standard Specification for Straight Beam Ultrasonic Examination of Rolled Steel Structural Shapes.
 - 10. ASTM E114 Standard Practice for Ultrasonic Pulse-Echo Straight-Beam Contact Testing.
 - 11. ASTM E164 Standard Practice for Contact Ultrasonic Testing of Weldments.

- 12. ASTM E329 Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.
- 13. ASTM E543 Standard Specification for Agencies Performing Nondestructive Testing.
- 14. ASTM E587 Standard Practice for Ultrasonic Angle-Beam Contact Testing.
- 15. ASTM E1212 Standard Practice for Establishing Quality Management Systems for Nondestructive Testing Agencies.
- 16. AWS A5.01 Welding Consumables Procurement of Filler Metals and Fluxes.
- 17. AWS C4.1 Criteria for Describing Oxygen-Cut Surfaces, and Oxygen Cutting Surface Roughness Gauge.
- 18. AWS D1.1 Structural Welding Code Steel.
 - a. Amendment to Chapter 4, Section 4.2.2: Aging: Replace this section with the following. "No thermal treatment of weldment or test specimens is permitted, except that machined tensile test specimens may be aged at 200°F to 220°F for up to 48 hours, then cooled to room temperature before testing."
- 19. AWS D1.8 Structural Welding Code Seismic Supplement.

1.4 QUALITY ASSURANCE

- A. Welder Qualifications:
 - 1. All welders, welding operators, and tack welders must have been qualified by test with the largest diameter electrodes to be used on the work and must hold a currently valid certificate, issued by an independent testing agency, to perform the type of welds required by the work, including the process, position, and thickness of materials used.
 - 2. In addition to meeting the requirements above, welders who will make welds with restricted access, such as, but not limited to, the beam bottom flange to column welds through a cope hole or access hole in the beam web, or where access to the bottom of a groove is restricted by the presence of a column flange, must have currently valid qualification certification performed per Annex C of AWS D1.8.
 - 3. All welders on the project shall be capable of understanding and following the requirements of the written WPS.
 - 4. Each welder employed on the project shall understand all the requirements of this welding specification before welding on the project.

PART 2 - PRODUCTS

2.1 WELDING PROCESS

- A. Welding Procedure Specifications (WPS) corresponding to SMAW, SAW, GMAW (except GMAW-S), and FCAW processes, which conform to all the provisions of AWS D1.1, Chapter 3 shall be deemed as prequalified and can be used without performing WPS qualification tests for the process. Any deviation from the prequalified WPS requirements shall necessitate qualification by test.
- B. FCAW and GMAW done with prequalified WPSs shall be performed using constant voltage (CV) power supplies.

C. Where ESW-NGI process is used, the joints must be positioned in vertical or near-vertical position.

2.2 MATERIALS

- A. Filler metals shall conform to the requirements of ANSI/AWS Specifications for electrodes and shall provide Charpy N-Notch (CVN) impact energy of 20 ft-lbs at -20°F and 40 ft-lbs at 70°F.
- B. Testing of each lot to be used in production shall be performed on each filler metal manufacturer's production lot (i.e., Production Lot Testing), as defined in AWS A5.01, as follows:
 - 1. Class C3 or C4 for SMAW electrodes
 - 2. Class S4 for solid GMAW and SAW electrodes
 - 3. Class T4 for FCAW and composite GMAW electrodes
 - 4. Class F2 for SAW fluxes
- C. Production Lot Testing of the filler metals is required for welding of the seismic force resisting system (SFRS) only.
- D. In order to remain exempt from the Production Lot Testing, the manufacturer shall perform WPS Heat Input Envelope Testing of Filler Metals as described in Annex A of AWS D1.8, on at least one lot of material, at a frequency not exceeding three (3) years, for each trade name and diameter of electrodes to be used in production. The WPS Heat Input Envelope Testing of filler metals may be performed by the filler metal manufacturer or by the Contractor. The Contractor, however, shall be responsible to ensure this testing has been performed for the filler metals to be used.
- E. Filler metals shall be provided in packaging that limits the ability of the electrode to absorb moisture. Electrodes from packaging that has been punctured or torn shall be dried in accordance with the manufacturer's recommendations or shall not be used. Modification or lubrication of the electrodes after manufacture is prohibited, except that drying is permitted in accordance with the manufacturer's recommendations.
- F. For FCAW electrodes, the permissible exposure time after removal from protective packaging shall not exceed the time recommended by the manufacturer. Overexposed FCAW electrodes shall be either dried in accordance with the electrode manufacturer's recommendations or shall not be used.

PART 3 - EXECUTION

3.1 WELDING PROCEDURE SPECIFICATIONS (WPS)

- A. All welding shall be performed in strict adherence to a written WPS, whether the WPS is prequalified or whether it has been qualified by test. All applicable parameters in AWS D1.1, Table 3.7 shall be complied with for prequalified WPSs.
- B. All WPSs shall be first submitted to the Structural Engineer for review.

- C. All WPSs shall be prepared by qualified individuals, and the same individual responsible for the suitability of the WPS shall be recorded on the WPS.
- D. The written WPS shall be available to the welder, welding supervisor, and inspector.
- E. All welding equipment shall be properly maintained and regularly checked to ensure compliance with manufacturer's stated accuracy.
- F. WPSs that are not prequalified shall be subject to qualification testing in accordance with AWS D1.1, Chapter 4. For WPSs that have been qualified by test, the supporting Procedure Qualification Record (PQR) shall be submitted along with the WPS.
- G. The written WPS shall contain all the necessary information required by AWS D1.1, this specification, and any other information necessary to produce welds that are in compliance with these requirements.
 - 1. The WPS shall list the applicable base metal types and thicknesses.
 - 2. The WPS shall contain a sketch of the joint and shall list the welding joint detail, including type, weld type, joint geometry, and applicable dimensions. Individual weld passes shall be identified in the sketch and numbered to identify the maximum layer thicknesses and bead widths.
 - 3. The WPS shall list the applicable welding process.
 - 4. The WPS shall list the filler metal specification, AWS classification, electrode manufacturer's designation, and details regarding the shielding material used, if any.
 - 5. The WPS shall indicate the minimum preheat and inter-pass temperature requirements. The inter-pass temperature shall, at least, be equal to the preheat temperature. Maximum inter-pass temperature shall not exceed 550°F. Additional preheat requirements are included in Section 3.2.F of this specification.
 - 6. The WPS shall list all applicable electrical characteristics for the process employed. The WPS shall clearly indicate the acceptable values required for each welding pass. These electrical characteristics shall include, at a minimum, the following:
 - a. Type of current and acceptable ranges of current measured in amperage. For wire feed process, both wire feed speed and amperage shall be listed.
 - b. Voltage
 - c. Travel speed (range)
 - d. Electrode extension for wire feed processes
 - e. Amperage, voltage, and electrode extension (as applicable) shall be within the filler metal manufacturer's recommendations.

3.2 FABRICATION AND ERECTION

A. Assembly:

- 1. Assembly tolerances shall not exceed those for the prequalified joint detail employed, or the limits of AWS D1.1, Figure 5.3, as applicable. The minimum root-opening dimension shall be maintained for the length of the joint. For joints where the minimum root opening dimensions are less than the minimum requirement, compensation may be made by increasing the root opening by gouging, chipping, or grinding. At Contractor's option, alternate approved written WPS suitable for the smaller root opening in the WPS may be corrected by welding to acceptable dimensions and performing ultrasonic testing of the built-up weld after minimum 24 hours prior to joining the parts by welding. The Structural Engineer shall be notified whenever the root opening exceeds the allowable tolerance range.
- 2. All CJP welds shall be ultrasonically tested a minimum of 24 hours after the welding is complete.
- 3. Bolts shall be fully torqued only after welds have been completed on both flanges.
- B. Tack Welds:
 - 1. All tack welds shall be of the same quality as the final welds. This includes the requirements for preheat. The requirements of AWS D1.1, Section 5.18 shall be adhered to.
- C. Weld Access Holes:
 - 1. Weld access holes shall be sized in accordance with the detail provided on the drawings.
- D. Weld Termination:
 - 1. Weld tabs shall be employed as shown on the drawings. Minimum length shall be 1 inch or thickness of the part, whichever is greater, but need not exceed 2 inches. Where there is inadequate access for weld tabs, such as with closely spaced pieces or pieces intersecting at acute angles, weld ends may be cascaded for approximately one weld size.
 - 2. End dams may be metallic or non-metallic. End dams shall not be placed at either end of the weld joint, except end dams may be placed at outboard ends of the weld tabs.
 - 3. Weld tabs shall be removed, and end of the weld finished. Removal of weld tabs could be by any of the following processes: air carbon arc cutting (CAC-A), grinding, chipping, or thermal cutting. The process shall be controlled to minimize errant gouging. The edges where weld tabs have been removed shall have a surface roughness of not more than 500 micro-inches. AWS C4.1, Sample 4, may be used as a guide for evaluating surface roughness of these surfaces. Grinding to a flush condition is not required. The contour of the weld shall provide a smooth transition, free of notches and sharp corners.
- E. Steel Backing:
 - 1. If backing bars are used on complete joint penetration (CJP) groove welds, the backing bar shall be removed at beam bottom flange to column connection. Removal shall be by air carbon arc cutting (CAC-A), plasma air gouging (PAC-G), grinding, chipping, or thermal cutting. The process shall be controlled to minimize errant gouging.
 - 2. Following removal of backing, the weld root shall be backgouged to sound metal and filled with weld metal, as necessary, to achieve at least a flush condition. The weld shall be deposited in accordance with an applicable and approved WPS. Gouges that remain after any back-welding or fillet welding is performed shall be repaired.

- 3. Where reinforcing fillet welds are required at locations where steel backing has been removed, the minimum size shall be 5/16 inch. The leg of the fillet weld adjacent to the beam flange shall be such that the fillet toe is located on the base metal, except that if the weld root and base metal is ground smooth after removal of backing, the fillet need not extend to the base metal.
- 4. The backup bars can be left in place at most of the other joints, for instance, beam top flange to column connection, at column continuity plates, etc. provided a reinforcing fillet weld, minimum 5/16 inch, is made under the backup bar to the column flange. The backing bars shall be removed only at locations specifically indicated on the drawings.
- F. Preheat and Inter-Pass Temperatures:
 - 1. The preheat temperature at the parts being welded (referred to as "weld location" hereon) shall be in accordance with the applicable WPS and shall be attained by heating full length of the joint gradually and uniformly. Local hot spots shall be avoided. The preheat temperature shall be measured at a distance from the axis of the weld equal to thickness of the thickest part being welded, but in no case less than 3 inches in all directions, including the through thickness dimension of the part being welded, for full length of the weld joint. The inter-pass temperature shall not be less than the preheat temperature. Preheat shall be maintained until all welding at the weld location is complete unless otherwise approved by the Structural Engineer.
 - 2. Special Inspection Agency shall measure and record, on a random daily basis, that proper preheat was applied and inter-pass temperatures were maintained and provide daily written reports documenting the areas observed and measured and recorded temperatures.
 - 3. Unless noted otherwise, preheat temperature shall be determined in accordance with AWS D1.1, Table 3.2.
 - 4. Preheating shall be by electric strip heaters, induction heating, radiant heating method, or fuel gases. If fuel gases are used for preheating, the fabricator shall submit a preheating procedure to the Structural Engineer for review. The acceptance of use of fuel gases for preheating shall be subjected to procedures approval by the Structural Engineer.
 - 5. The preheat temperature shall be measured either by using strip charts for each location, with capability of monitoring preheat and temperature of multiple welds, or by using handheld laser guns.
 - 6. For WPSs that have been qualified by testing, preheat temperature shall be based on the associated PQR within the limitations of AWS D1.1, Table 4.5.
- G. Intermix of Filler Metals:
 - 1. When FCAW-S filler metals are used in combination with filler metals for any other process, including FCAW-G, supplemental notch toughness testing shall be conducted. Such testing can be conducted using either of the following two methods: (a) in accordance with Annex B of AWS D1.8 or (b) by running PQRs that contain intermixed weld metal, corresponding to the welding process that would be used in combination with FCAW-S for production welding, wherein CVN test specimens have been taken from the intermixed zone. Regardless of the testing method used, compliance with the acceptance criteria of Annex B of AWS D1.8 shall be demonstrated.
- H. Peening:
 - 1. Peening shall not be allowed except if approved by the Structural Engineer.

- I. Cleaning:
 - 1. Surfaces to be welded and surfaces adjacent to a weld shall be free from loose or thick scale, slag, rust, moisture, grease, and other foreign materials that would prevent proper welding or create objectionable fumes. Mill scale that can withstand vigorous wire brushing, a thin rust-inhibitive coating, or anti-spatter compound may remain with the following exception: for girders of the seismic-load-resisting-system, all mill scale shall be removed from the surfaces on which flange-to-web welds are to be made.
- J. Technique for Making Welds Involving Weld Access Holes:
 - 1. After the joint has been assembled (bolts not fully torqued), the weld shall be completed as follows:
 - a. The root pass shall initiate near the center of the joint, in the area of the weld access hole. The welder shall extend the electrode through the weld access hole approximately 1" beyond the opposite side of the web. After the arc is initiated, travel shall progress toward the end of the joint, and the weld shall be terminated on the weld tab.
 - b. The half-length root pass shall be thoroughly cleaned.
 - c. The start of the weld in the weld access hole area shall be visually inspected to ensure fusion, soundness, freedom from slag inclusions, and excessive porosity. The resulting lead profile shall be suitable for obtaining good fusion by the subsequent pass to be initiated on the opposite side of the beam web. If the profile is not conducive to good fusion, the start of the first root pass shall be ground, gouged, chipped, or otherwise prepared to ensure adequate fusion.
 - d. The second half of the weld joint shall have the root pass applied before any other weld passes are performed. The arc shall be initiated in the area of the start of the first root pass, and travel shall progress to the end of the joint, terminating on the weld tab.
 - e. Each weld layer shall be completed on both sides of the joint before a new layer is deposited.
 - f. Deviation from the preceding procedure may be made, provided the Contractor submits, in writing, an alternate sequence that is approved by the Structural Engineer prior to fabrication.

3.3 QUALITY CONTROL AND QUALITY ASSURANCE

- A. Inspections for Quality Control (QC) and Quality Assurance (QA) shall comply with AWS D1.1, Chapter 6, and AWS D1.8, Chapter 7. Where there is a conflict with the preceding, the contract specifications and drawings shall prevail.
- B. Inspection points and frequencies of QC and QA tasks and associated documentation for the SLRS shall be in accordance with Appendix Q, Section Q5 of ANSI/AISC 341s1.
- C. Inspection:
 - 1. The Owner shall engage an independent testing and inspection agency (except for the fabrication/erection inspection and testing per AWS D1.1, Section 6.1.2.1) at no cost to the Contractor to perform the work listed in Sections 3.3,C.2 and 3.3,C.3 below.

- 2. Qualifications: All Inspectors shall meet the requirements of AWS D1.1, Section 6.1.4 and hold current CWI certification.
- 3. Special Inspection Agency Responsibility: The inspection agency shall perform all inspections required by AWS D1.1 including the requirements herein. The inspector shall be present before, during, and after welding on all complete joint penetration (CJP) welds and as necessary during all other welding operations. The inspector shall also be present during removal of steel backing and runoff tabs.
- D. Testing:
 - 1. All complete penetration groove welds shall be ultrasonically tested in accordance with AWS D1.1, Chapter 6, Part "F", Ultrasonic Testing (UT) of Groove Welds". The acceptance criteria for welds subjected to UT shall conform to the requirements of AWS D1.1, Table 6.2. All defective welds shall be repaired and retested with ultrasonic equipment at the Contractor's expense.
 - 2. Flanges: An area extending 6" above and below the point of attachment for CJP welds and flange edge shall be inspected visually, and entire area ultrasonically tested for lamination, plate discontinuities, and non-metallic inclusions.
 - 3. Ultrasonic inspections of all CJP welds shall be conducted from both the top and bottom sides of the flange, and from the back side of the column flange as necessary to determine potential rejectable welding defects.
 - 4. Base metal thicker than 1-1/2", when subjected to through thickness weld shrinkage strains, shall be ultrasonically inspected for discontinuities directly behind such weld before and after the joint completion. Repairs if needed, to parent material shall comply with ASTM A6, Section 9.
 - 5. All nondestructive testing (NDT) shall be performed after all welds are complete including, but not limited to, removal of runoff tabs and steel backing and grinding of the same; removal of reinforcement per AWS D1.1, Sections 5.24.4, 5.24.4.1, and 5.24.4.2; any post-weld heat treatment. This is not intended to exclude in-house intermittent NDT programs.
 - 6. Any NDT, except VT, shall not be started before a minimum of 24 hours after subject weldments have cooled down to the ambient temperature.
 - 7. NDT personnel, other than VT, shall also submit their experience and qualification on like-type weldments when required by the Structural Engineer.

END OF SECTION

SECTION 05 12 23 - STRUCTURAL STEEL

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Fabrication and erection of structural steel work, as shown on the drawings and specified herein. Work shall include, but not be limited to the following items:
 - 1. Structural steel.
 - 2. Base and bearing plates.
 - 3. Deck support angles and framing for roof openings.
 - 4. Steel lintel members for masonry openings.
 - 5. Edge angles and bent plates.
 - 6. Connection plates.
 - 7. Shear stud connectors.
 - 8. Architecturally Exposed Structural Steel (AESS).
 - 9. All other steel items as listed in AISC "Code of Standard Practice for Steel Buildings and Bridges" as shown on structural and architectural drawings.
- B. Work shall also include grouting of all structural steel members where indicated.
- C. Structural notes indicated on the drawings regarding structural steel framing should be considered a part of this specification.

1.2 RELATED WORK

- A. Pertinent Sections of Division 01.
- B. Section 03 30 00 Cast-in-Place Concrete.
- C. Section 05 05 23 Welding.
- D. Section 05 21 00 Steel Joists.
- E. Section 05 31 00 Steel Deck.
- F. Section 05 40 00 Cold-Formed Steel Framing Systems.
- G. Section 05 50 00 Metal Fabrications.
- H. Section 05 51 00 Metal Stairs.

1.3 REFERENCES

A. Codes and Standards: Comply with the provisions of the following codes, specifications, and standards except where more stringent requirements are shown or specified. Where any provisions of other pertinent codes and standards conflict with this specification, the more stringent provision shall govern.

2.

- 1. AISC Specification for Structural Joints Using ASTM A325 or A490 Bolts.
 - AISC Specification for Structural Joints Using High-Strength Bolts.
- 3. AISC 303 Code of Standard Practice for Buildings and Bridges.
- 4. AISC 341-10 Seismic Provisions for Structural Steel Buildings, including any Supplements.
- 5. AISC 358-10 Prequalified Connections for Special and Intermediate Steel Moment Frames for Seismic Applications.
- 6. AISC 360-10 Specification for Structural Steel Buildings.
- 7. ASTM A6 Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
- 8. ASTM A36 Standard Specification for Carbon Structural Steel.
- 9. ASTM A53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- 10. ASTM A108 Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
- 11. ASTM A123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- 12. ASTM A153 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- 13. ASTM A193 Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
- 14. ASTM A307 Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength.
- 15. ASTM A449 Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use.
- 16. ASTM A500 Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- 17. ASTM A563 Standard Specification for Carbon and Alloy Steel Nuts.
- 18. ASTM A572 Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
- 19. ASTM A992 Standard Specification for Steel for Structural Steel Shapes.
- 20. ASTM A1085 Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS).
- 21. ASTM B633 Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
- 22. ASTM E94 Standard Guide to Radiographic Examination Using Industrial Radiographic Film.
- 23. ASTM E165 Standard Practice for Liquid Penetrant Examination for General Industry.
- 24. ASTM E709 Standard Guide for Magnetic Particle Testing.
- 25. ASTM F436 Standard Specification for Hardened Steel Washers.
- 26. ASTM F959 Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners.
- 27. ASTM F1554 Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
- 28. ASTM F3125 Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi and 150 ksi Minimum Tensile Strength, Inch Dimensions.
- 29. AWS D1.1 Structural Welding Code Steel.
- 30. SSPC Steel Structures Painting Council.

1.4 QUALITY ASSURANCE

- A. Fabrication, Erection, and Welding Qualifications:
 - 1. Fabricate structural steel members in accordance with AISC Specification for the design, fabrication, and erection of structural steel for buildings.

1.5 SUBMITTALS

- A. Shop Drawings:
 - 1. Prepare and submit complete erection and detailed shop drawings for Engineer's approval, including framing plans indicating size, weight, and location of all structural members. Shop drawings shall indicate methods of connecting, anchoring, fastening, bracing, and attaching work of other trades.
 - a. Where contract documents indicate verify in field (VIF) dimensions, shop drawings shall indicate these dimensions and Contractor shall note the dimensions have been verified.
 - b. This specification modifies AISC Code of Standard Practice by deleting the following sentence from 4.4.1(c): "Release by the Owner's Designated Representatives for Design and Construction for the Fabricator to begin fabrication using the approved submittals." Review of the shop drawings by the Engineer shall not relieve the fabricator of this responsibility.
 - 2. Furnish both the Engineer and Architect with one copy of the following:
 - a. Final shop drawings containing all review notations.
 - b. Field Use/For Construction drawings.
 - 3. The steel fabricator shall submit a setting plan for all embedded items for Engineer's approval.
 - 4. Shop drawings shall identify and mark AESS members and items. Specific project requirements for AESS (required blast cleaning, SSPC designation, special handling, etc.) relating to shop fabrication and field erection practices shall be indicated on the shop drawings.
 - 5. Prepare and submit for approval structural calculations for all structural steel connections. Calculations shall be sealed by a Professional Engineer licensed in the State the project is located.
 - 6. Welder's Certification: Submit certifications for all welders employed on the project demonstrating they have been AWS qualified to perform the welding procedures required for this project.
 - 7. General Contractor/Construction Manager to provide copies of field concrete cylinder breaks indicating the concrete meets 75% of the design compressive strength to the steel erector.
- B. The General Contractor/Construction Manager shall conduct a field survey of as-built anchors and bearing plate locations and elevations prior to steel erection. Survey shall be furnished to the steel fabricator. Contractor shall identify deviations from approved shop drawings and submit proposed repairs and modifications to the Engineer and steel fabricator for approval.

- C. Product Data:
 - 1. Certified copies of material test reports, commonly called mill test reports, for all structural steel used on the project. Material test reports shall comply with the requirements of ASTM A6, shall cover chemical and physical properties, and shall be accompanied by a Certificate of Compliance from the fabricator.
 - 2. Manufacturer specifications, certifications, and installation recommendations for the following products, including laboratory test reports and other data required to prove compliance with these specifications:
 - a. High strength bolts, including nuts and washers.
 - b. Unfinished bolts and nuts
 - 3. The Contractor shall submit written procedures for the pre-installation testing, installation, snugging, pretensioning, and post-installation inspection of fasteners. The procedure(s) shall meet all requirements of the RCSC specification and the drawings. Procedures need to be submitted only for the method(s) of installation to be used by the Contractor, which may include the turn-of-nut, calibrated wrench, twist-off type tension control bolt, and direct tension indicator methods.
 - 4. Shear Stud Connectors: Contractor shall submit the following:
 - a. Certifications that the studs, as supplied, meet the requirements of AWS D1.1, Sections 7.2 and 7.3.
 - b. Certified copies of the stud manufacturer's test reports covering the last completed set of in-plant quality control mechanical tests for the diameter supplied.
 - c. Certified material test reports from the steel supplier indicating diameter, chemical properties, and grade on each heat number supplied.
 - d. Certificate of Compliance from the Contractor.
 - 5. Prepare and submit product data for Engineer's approval for shop applied primers, finished paint system, expansion and/or adhesive anchors, non-shrink grout and other miscellaneous materials.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Steel members shall be transported, stored, and erected in a manner that will avoid any damage or deformation. Materials should be stored to allow easy access for inspection and identification. Bent or deformed members will be rejected and shall be replaced or repaired at the expense of the responsible party. Store clear of the ground and in such a manner as to eliminate excessive handling.
- B. Store fasteners in a protected location. Clean and re-lubricate bolts and nuts before use.

PART 2 - PRODUCTS

- 2.1 MATERIALS
 - A. Structural Steel:

- 1. All structural steel shall be free from defects impairing strength, durability, or appearance. All structural steel shall meet the latest minimum requirements as follows:
 - a. Structural steel wide flange shapes shall:
 - 1) Conform to the ASTM designations listed in the General Notes of the drawings, unless noted otherwise.
 - 2) The following rolled sections and built-up sections shall be considered as "Heavy Sections", subject to special notch toughness, fabrication, welding, and inspection requirements:
 - a) ASTM A6 hot-rolled shape with a flange thickness exceeding 2 inches.
 - b) Built-up cross-sections consisting of plates with a thickness exceeding 2 inches.
 - 3) "Heavy Sections" (hot-rolled shapes) shall be supplied with Charpy V-Notch (CVN) testing in accordance with ASTM A6, Supplementary Requirement S30, Charpy V-Notch Impact Test for Structural Shapes -Alternate Core Location. "Heavy Sections" (plates for built-up sections) shall be supplied with Charpy V-North (CVN) testing in accordance with ASTM A6, Supplementary Requirement S5, Charpy V-Notch Impact Test. The test shall meet a minimum average value of 20 ft-lbs absorbed energy at +70°F. Testing shall be in accordance with the current AISC Specification. Steel shall be manufactured using fully killed fine grain practice yielding grain size numbers 5 or greater as determined by ASTM E112.
 - 4) All "Heavy Section" column flanges located at welded moment connections shall be ultrasonically examined, prior to welding, for evidence of laminations, inclusions, or other discontinuities in accordance with ASTM A435 or ASTM A898 as applicable and along beams, 6 inches past the end of the joint assembly. The area to be tested is a zone 6 inches above and below each beam flange connection. For plates, any discontinuity causing a total loss of back reflection that cannot be contained within a circle the diameter of which is 3 inches, or one-half the plate thickness, whichever is greater, shall be rejected.
 - 5) If beams in the Seismic-Force-Resisting-System (SFRS) are moment-connected to the weak axis of the column, the column web shall be similarly examined to the above criteria.
 - Shapes of ASTM A572, Grade 50, mill certified to AISC Technical Bulletin #3 requirements, may be substituted for A992 with approval from the Structural Engineer.
 - 7) Grade 50 steel shall have a minimum yield stress of 50 ksi and the yield stress, F_y, that is reported from tests shall be based on the yield strength definition in ASTM A370, using the offset method at 0.002 strain.

- b. Structural steel angles, channels, bars, plates and miscellaneous steel shall conform to the ASTM designations listed in the General Notes of the drawings.
- c. Square and rectangular structural tubing shall be cold formed conforming to the ASTM designations listed in the General Notes of the drawings.
- d. Round structural tubing shall be cold formed conforming to the ASTM designations listed in the General Notes of the drawings.
- e. Steel pipe shall conform to the ASTM designations listed in the General Notes of the drawings.
- B. High Strength Structural Bolts:
 - 1. High strength structural bolts shall conform to the ASTM designations listed in the General Notes of the drawings.
 - 2. High strength bolts shall be detailed and installed in accordance with AISC -"Specification for Structural Joints Using ASTM A325 or A490 Bolts."
 - 3. High strength bolts shall be detailed and installed in accordance with AISC -"Specification for Structural Joints Using High-Strength Bolts."
 - 4. Manufacturer's symbol and grade markings shall appear on all bolts and nuts.
- C. Anchoring Devices:
 - 1. Anchor Rods: Anchor rods used with structural steel members shall be plain threaded rods conforming to the ASTM designations listed in the General Notes of the drawings.
 - 2. Expansion Anchors: Expansion anchors shall consist of one-piece wedge type carbon steel anchors with heavy-duty nuts and washers. All components shall be zinc plated in accordance with ASTM B633. Refer to the drawing details and General Notes for the expansion anchors used as the basis of design and the acceptable alternates.
 - 3. Adhesive Anchoring System: Adhesive anchoring system shall consist of a threaded anchor rod complete with nut and washer and the adhesive cartridge. Refer to the drawing details and General Notes for the adhesive anchoring systems used as the basis of design and the acceptable alternates.
 - a. Nuts shall meet ASTM A563, Grade DH, and washers shall meet ASTM F436.
 - b. All components shall be zinc plated in accordance with ASTM B633 SC1.
 - c. Adhesive shall consist of a two-part acrylic based adhesive applied in a dual cartridge dispensing system that properly mixes the components at the point of application.
- D. Welding Materials:
 - 1. Type required for material being welded in conformance with AWS D1.1.
- E. Steel Stud Connectors:
 - 1. For threaded studs that are being used to connect steel beams to embed plates, use ASTM A108, Type A, Grades 1010 through 1020 forged steel, headed uncoated with a minimum tensile strength of 61,000 psi. Fabricated within the tolerances set forth in AWS D1.1.
 - 2. For shear connectors that are being used on steel beams in concrete slabs for composite shear transfer and embedded steel members, use ASTM A108, Type B, Grades 1010 through 1020 forged steel, headed uncoated with a minimum tensile strength of 65,000 psi. Fabricated within the tolerances set forth in AWS D1.1

- 3. Studs applied by means of the electric arc welding process and shall use an arc shield ferrules of heat resistant ceramic.
- F. Galvanizing: Where indicated on the drawings, steel shall be galvanized by the hot-dip process after fabrication conforming to ASTM A123. All exterior steel that will remain exposed shall be galvanized, unless otherwise indicated.
- G. Paints and Primers:
 - 1. Fabricator's standard lead- and chromate-free, non-asphaltic, rust-inhibiting primer.
 - 2. Galvanizing repair paint: SSPC Paint 20.
 - 3. Refer to Specification Section 09 90 00 for additional paint requirements.
- H. Non-Shrink Grout for Base and Bearing Plates: Non-shrink grout, conforming to ASTM C1107, shall be pre-mixed, non-metallic, non-corrosive, non-staining product containing selected silica sand, Portland cement, shrinkage compensating agents, plasticizing and water reducing agents. All constituents shall meet the requirements of these specifications. Minimum compressive strength at 28-days shall be 7,000 psi as determined by ASTM C109. Follow manufacturer's instructions for handling, mixing, placing, and curing. Acceptable products are:
 - 1. Euclid Chemical Company Euco N.S. Grout
 - 2. L&M Construction Chemical Crystex.
 - 3. Master Builders Masterflow 713.
 - 4. Sonneborn Sonnogrout.
 - 5. Five Star Products Inc. Five Star Grout.
 - 6. Dayton Superior Sure-Grip High Performance Grout.
 - 7. Dayton Superior 1107 Advantage Grout.
 - 8. Insert

2.2 FABRICATION AND MANUFACTURE

- A. Fabrication Procedures (non-AESS):
 - 1. Fabricate all structural steel items in accordance with AISC Specifications and as indicated on the approved shop drawings.
 - 2. Provide camber in structural members where indicated.
 - 3. Properly mark materials for field assembly and location for which intended. Fabricate for delivery sequence that will expedite erection and minimize handling of materials.
 - 4. Complete structural steel assemblies before shop priming or galvanizing.
- B. Shop Connections:
 - 1. All shop connections shall be welded, unless noted otherwise on drawings. Connections shall develop the full strength of the adjoining members unless detailed otherwise.
 - 2. All holes shall be either drilled or punched, as no burning of holes will be permitted, including the enlargement of holes. Provide all holes required for connections and for attaching the work of other trades where such holes are shown if furnished prior to fabrication.

- 3. Connections shall be detailed as standard framed beam connections (bearing type) in accordance with the AISC Manual of Steel Construction. Connections which require oversized holes or slotted holes in which the force is other than normal to the axis of the slot shall be detailed as "Slip-Critical Connections" and noted as such on the erection drawings. Provide bearing plates and end anchorage for beams resting on masonry.
- 4. All full and partial penetration welds shall be fully detailed on the shop drawings. Use backing for all full penetration welds.
- 5. Weld access holes shall be fabricated in accordance with the recommendations of AWS D1.1 and AISC Specification.
- C. Steel Stud Connectors:
 - 1. Steel stud shear connectors shall be securely welded in the field to structural steel beams as detailed on the drawings. Welds shall be such that the stud connector will deform before weld failure occurs. Welding shall be done in accordance with AWS D1.1.
 - 2. Steel stud connectors for embedded plates and angles shall be welded in the fabrication shop in accordance with AWS D1.1.
- D. Deck support framing and seats: Furnish all miscellaneous framing necessary to fully support the roof and floor steel decking.
- E. Shop Priming:
 - 1. Unless noted otherwise below, structural steel shall not be shop primed.
 - 2. The following are steel surfaces to receive shop priming:
 - a. Surfaces outside the building envelope that are not galvanized, including the following:
 - 1) Insert.
 - b. Surfaces to be painted per Architect's drawings.
 - 3. If the steel pieces are to be shop primed, the following surfaces are exceptions to shop priming:
 - a. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
 - b. Surfaces to be field welded.
 - c. Surfaces to be high-strength bolted with slip-critical connections.
 - d. Top flanges of beams supporting composite steel decking.
 - e. Surfaces to receive sprayed fire-resistive materials.
 - f. Galvanized surfaces.
 - 4. 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:
 - a. SSPC-SP 3, "Power Tool Cleaning."
 - b. SSPC-SP 5/NACE No. 1 "White Metal Blast Cleaning"
 - c. SSPC-SP 6/NACE No. 3 "Commercial Blast Cleaning"

- d. SSPC-SP 7/NACE No. 4 "Brush-off Blast Cleaning"
- e. SSPC-SP 10/NACE No. 2 "Near-White Blast Cleaning"
- f. SSPC-SP 11 "Power Tool Cleaning to Bare Metal"
- g. SSPC-SP 14/NACE No. 8 "Industrial Blast Cleaning"
- 5. Priming: Apply primer in accordance with paint manufacturer's recommendations, and at a rate recommended by SSPC to provide a dry film thickness of not less than 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
- F. Finished Paint System:
 - 1. Finished paint coats shall be in accordance with paint manufacturer's recommendations and Division 9.
 - 2. Paint shall be free of sags, runs, drips or other defects. Allow ample drying time before handling to prevent damage to coatings.
 - 3. Strip paint corners, crevices, bolts, welds, and sharp edges.
 - 4. Apply two coats of shop paint to surfaces that will be inaccessible after assembly or erection. Change color of the second coat to distinguish it from the first.
- G. Finished Paint System for Exposed Structural Steel: Structural steel exposed to the elements of weather shall be painted as follows:
 - 1. Apply one coat of steel primer in shop as specified above.
 - 2. Apply two coats of alkyd enamel paint to a minimum dry film thickness of 1.5 mils for each coat. Paint shall be applied according to the manufacturer's recommendations.
 - 3. Paint shall be free of sags, runs, drips or other defects. Allow ample drying time before handling to prevent damage to coatings.
- H. Galvanizing:
 - 1. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A123.
 - a. Fill vent holes and grind smooth after galvanizing.
 - b. Unless otherwise noted on drawings or in Division 9, all exterior steel components exposed to the elements shall be galvanized, including, but not limited to, lintels.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions have been corrected.

3.2 ERECTION

A. Erection Procedures:

- 1. The erector and not the Structural Engineer shall be responsible for the means, methods, and safety of erection of the structural steel framing.
- 2. Erection of all structural steel items shall meet the requirements of AISC "Specification and Code of Standard Practice."
- 3. All work shall be erected square, plumb, straight and true, accurately fitted and with tight joints and intersections, by mechanics experienced in the erection of structural steel. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- 4. Clean the bearing surface and other surfaces that will be in permanent contact before assembly.
- 5. All base plates shall be supported on steel wedges, steel shims or heavy-duty leveling nuts until the supported members have been leveled and plumbed.
 - a. Snug tighten anchor rods after supported members have been positioned and plumb. Do not remove wedges or shims but, if protruding, cut off flush with edge of base plate before packing with grout.
 - b. Promptly place non-shrink grout between bearing surfaces and base plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturers written installation instructions for shrinkage-resistant grouts.
- 6. Field connections of structural work shall be made with either high strength bolts (bearing type) or by welding. Proper precaution shall be taken to ensure anchored items will not be distorted or overstressed due to improperly fabricated items.
- 7. Splice members only where indicated unless, with the Structural Engineer's approval, splices not indicated would result in lower costs due to reduced shipping expense. For splices not indicated, submit structural calculations prepared under direct supervision of and signed by a Professional Engineer licensed in the state where the project is located.
- 8. Do not use thermal cutting during erection unless approved by the Engineer/Architect in writing.
- 9. Steel erection shall not proceed without concrete in footings, piers, and walls attaining 75% of the intended minimum compressive design strength. Documentation must be provided indicating compliance with this requirement.
- B. Surveys:
 - 1. Establish permanent benchmarks necessary for accurate erection of structural steel.
 - 2. Check elevations of concrete surfaces, and locations of anchor bolts and similar items, before erection proceeds.
- C. Bracing and Protection:
 - 1. Steel shall be well plumbed, leveled and braced to prevent any movement.
 - a. Contractor shall provide and maintain all necessary temporary guying of steel frame to safely resist all wind and construction loads during erection and to assure proper alignment of all parts of the steel frame.
 - 2. Provide all temporary flooring, bracing, shoring and guards necessary to prevent damage or injury. All partially erected steel shall be secured in an approved manner during interruptions of work.

- D. Anchor and Foundation Rods:
 - 1. All anchor or foundation rods and similar steel items to be built into concrete or masonry are to be set by the concrete or masonry contractors and shall be furnished promptly so they may be built in as the work progresses because cutting of structural steel members to accommodate errors pertaining to embedded items will not be permitted.

3.3 FIELD WELDING

- A. Welding Procedures:
 - 1. All field welding shall be in accordance with AISC Specifications and conform to AWS D1.1 "Structural Welding Code Steel".
 - a. Comply with AISC's "Code of Standard Practice for Steel Buildings and Bridges" for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
 - b. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC's "Code of Standard Practice" for Steel Buildings and Bridges" for mill material.
 - 2. Contractor shall remove ceramic ferrules from shear stud connectors in sufficient time to allow for inspection of welds prior to placement of the concrete.

3.4 REPAIRS, PROTECTION, AND TOUCH UP

- A. Repair damaged galvanized coatings and on galvanized items with galvanized repair paint according to ASTM A780 and manufacturer's written instructions.
- B. Touch up Painting: After installation, promptly clean, prepare, and prime or reprime field welds, final connections, rust spots, and abraded surfaces of prime-painted joists, bearing plates and abutting structural steel.
 - 1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
 - 2. Apply a compatible primer of the same type as shop primer used on adjacent surfaces.
 - 3. Secure approval by the Architect prior to field painting.

3.5 GROUTING

- A. Grouting under structural framing members shall be completed after all members have been plumbed and braced and before imposed loads are placed thereon.
- B. Remove all defective concrete, dirt, oil, grease, and other foreign matter from surfaces to which grout will be placed.

3.6 MISCELLANEOUS STEEL AND STEEL LINTELS

A. Furnish and install all miscellaneous steel as detailed in architectural and structural drawings.

- B. The steel fabricator shall furnish all steel lintels required for masonry wall construction indicated in the architectural and structural drawings and schedules.
- C. Provide additional steel framing for continuous support of steel deck edges at openings and column interruptions.
- D. All exterior exposed steel shall be hot-dip galvanized in accordance with ASTM A123.

END OF SECTION

SECTION 05 31 00 - STEEL DECK

PART 1 - GENERAL

- 1.1 SECTION INCLUDES
 - A. Fabrication and erection of steel deck. The Work shall include, but not be limited to the following:
 - 1. Roof deck, roof deck accessories, and roof deck fasteners.
 - 2. Shear studs.
 - B. Structural notes indicated on the drawings regarding steel decking shall be considered a part of this specification.

1.2 RELATED WORK

- A. Pertinent Sections of Division 01.
- B. Section 03 30 00 Cast-in-Place Concrete.
- C. Section 05 12 23 Structural Steel.
- D. Section 05 05 23 Welding.

1.3 REFERENCES

- A. Codes and Standards: Comply with the provisions of the following codes, specifications, and standards, except where more stringent requirements are shown or specified. Where any provisions of other pertinent codes and standards conflict with this specification, the more stringent provision shall govern.
 - 1. AISI S100 North American Specification for the Design of Cold-Formed Steel Structural Members.
 - 2. ASTM A36 Standard Specification for Carbon Structural Steel.
 - 3. ASTM A108 Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
 - 4. ASTM A653 Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 5. ASTM A924 Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
 - 6. ASTM A1008 Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
 - 7. AWS D1.1 Structural Welding Code Steel.
 - 8. AWS D1.3 Structural Welding Code Sheet Steel.
 - 9. SDI Roof Deck Design Manual.
 - 10. SDI Diaphragm Design Manual.

- 1.4 QUALITY ASSURANCE
 - A. Fabricator: Company specializing in performing the work of this section with minimum five (5) years documented experience at manufacturing steel deck. Fabrication Company shall be a current member of the Steel Deck Institute (SDI).
 - B. Erector: Company specializing in performing the work of this section with minimum five (5) years documented experience at erecting steel deck.
 - C. Welding: Qualify Welding Procedure Specifications (WPS) and welding operator in accordance with AWS D1.3. Provide certifications that welders to be employed in the construction have satisfactorily passed AWS qualifications tests. If recertification of welders is required, retesting will be the contractor's responsibility.
 - D. Contractor to verify the manufacturer's steel deck type selected is listed on the UL fire rated roof assembly specified by the Architect for this project.
 - E. Furnish and install steel deck in accordance with the manufacturer's current ICC Research Committee Report to obtain diaphragm values indicated.
 - F. Contractor to have pre-installation meeting where installer demonstrates workmanship by conducting representative fastenings at pre-installation meeting, subject to guidance from mechanical fastener manufacturer representative.

1.5 SUBMITTALS

- A. Prepare and submit shop drawings for Engineer's approval. Shop drawings shall indicate deck layout, depth, uncoated metal thickness, framing and supports with unit dimensions and sections, shear stud layout and complete end jointing. Contractor to verify measurements, lines, elevations, and details of field conditions to conform with actual conditions.
 - 1. Provide details of all accessories.
 - 2. Shop drawings shall also indicate typical welding or mechanical anchoring pattern for steel deck and accessories.
- B. Prepare and submit allowable construction span tables and allowable total load tables for Engineer's approval. Tables shall be accompanied with a letter of certification from the manufacturer stating the tabulated design values were determined in accordance with the Steel Deck Institute's Design Manuals for Roof Deck, Floor Deck and Diaphragm Design.
 - 1. The gauges and section moduli indicated on the drawings or specified herein are minimum and the gauge and section modulus of the deck furnished shall meet or exceed these minimum requirements. All gauges are United States standard, measured prior to coating.
- C. Provide manufacturer's latest recommendations and installation instructions.
- D. Prepare and submit product data of proposed materials.

1.6 DELIVERY, STORAGE AND HANDLING

- A. All decking materials shall be transported, stored, and erected in a manner that will prevent damage or deformation of sheets. Damaged material shall not be erected or repaired without Structural Engineer's approval.
- B. Deck panels shall be stored clear of the ground, elevated on one end, and protected from weather with waterproof covering.

1.7 COORDINATION

A. Portions of decking to receive spray applied fireproofing shall be a galvanized finish. Contractor shall certify compatibility of any shop primer with field applied finishes or fireproofing required for this project.

PART 2 - PRODUCTS

2.1 STEEL ROOF DECK

- A. Fabricate panels to comply with the "SDI Roof Deck Design Manual," and the following:
 - 1. Steel decking sheet material, minimum yield strength, depth, gauge, profile, and finish are indicated on the drawings, as classified by the Steel Deck Institute (SDI). Panels shall be formed with integral ribs and overlapping side flanges.
 - 2. Prime Painted Steel Sheet: ASTM A1008. Shop primed with manufacturer's standard gray white baked on acrylic primer.
 - 3. Galvanized Steel Sheet: ASTM A653 Structural Steel (SS), Grade 33, with a G90 zinc coating conforming to ASTM A924 for galvanized deck.
 - 4. Galvanized and Shop-Primed Steel Sheet: ASTM A653, Structural Steel (SS) Grade 33 with a G90 zinc coating; cleaned, pretreated, and primed with manufacturer's baked-on acrylic primer.

2.2 ACOUSTICAL STEEL ROOF DECK

- A. Acoustical Steel Roof Deck: Fabricate panels to comply with the "SDI Roof Deck Design Manual," and the following:
 - 1. Galvanized Steel Sheet: ASTM A653 Structural Steel (SS), Grade 33, with a G90 zinc coating conforming to ASTM A924 for galvanized deck.

2.3 COMPOSITE STEEL FLOOR DECK

- A. Composite Steel Floor Deck: Fabricate panels with integrally embossed or raised pattern ribs to comply with the "SDI Floor Deck Design Manual," and the following:
 - 1. Steel decking sheet material, minimum yield strength, depth, gauge, profile, and finish are indicated on the drawings, as classified by the Steel Deck Institute (SDI). Panels shall be formed with integral ribs and overlapping side flanges.

2.4 FASTENERS

- A. Support Fasteners:
 - 1. Welded: Refer to the drawings for weld size and spacing requirements.
 - a. Welding rods shall comply with all applicable requirements of the AWS Codes.
 - b. Shear studs may replace support fasteners. Refer to the drawings for requirements.
 - Provide headed stud type of cold finished carbon steel per Section 05 12 23
 - 2) Use ferrules suitable for use with galvanized steel deck.
 - c. Weld washers are required for material less than 0.028" thick. Weld washers shall be a minimum thickness of 0.0598" and be applicable to AWS D1.3 type welding and of type as recommended by the deck manufacturer.
 - d. Weld metal shall penetrate all layers of deck material and shall have good fusion to the supporting steel. Fasten ribbed deck to steel support members at ends and intermediate supports.
 - All welding shall be in conformance with previously cited AWS recommendations in appearance and quality of welds, and the methods used in correcting welding work.
 - 2. Screws: Zinc-coated, self-drilling, self-tapping (minimum No. 12) steel screws. Refer to the drawings for fastener spacing requirements.
- B. Side Lap Fasteners:
 - 1. Mechanical: Zinc coated self-drilling, self-tapping type (minimum No. 10) steel screws. Refer to the drawings for fastener spacing requirements.

PART 3 - EXECUTION

- 3.1 ROOF DECK
 - A. Fasten roof deck panels to steel supporting members using welds, mechanical fasteners, as specified herein and on the drawings.
 - B. Deck shall be fastened through the bottom of the deck rib to all structural supports for the specific deck sections.
 - C. End bearing of roof decking shall have a minimum of 1-1/2 inches of bearing occurring over structural supports.
 - D. Place deck panels on structural supports and adjust to final position with ends aligned. Attach to supports immediately after placement.
 - E. Install all roof deck accessories in accordance with the roof deck manufacturer's written instructions.
3.2 FIELD TOUCH UP

A. After erection, all weld burn marks and abraded spots shall be cleaned and field painted with a rust-inhibiting metal primer matching formulations and color of shop coat or a zinc-rich rust inhibiting paint for galvanized deck surfaces.

END OF SECTION

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SECTION 05 53 00 - STEEL GRATING AND STEEL FLOOR PLATES

PART 1 - GENERAL

- 1.1 SECTION INCLUDES
 - A. Fabrication and installation of all steel grating, floor plating, fasteners, and accessories.
 - B. Structural notes indicated on the drawings regarding shall be considered part of this specification.
- 1.2 RELATED WORK
 - A. Pertinent Sections of Division 01.
 - B. Section 03 30 00 Cast-in-Place Concrete.
 - C. Section 05 12 23 Structural Steel.
 - D. Section 05 50 00 Metal Fabrications.
 - E. Section 05 51 00 Metal Stairs.

1.3 REFERENCES

- A. Codes and Standards: Comply with the provisions of the following codes, specifications, and standards except where more stringent requirements are shown or specified. Where any provision of other pertinent codes and standards conflict with this specification, the more stringent provision will govern.
 - 1. AISC 360-10 Specification for Structural Steel Buildings.
 - 2. ASTM A36 Standard Specification for Carbon Structural Steel.
 - 3. ASTM A510 Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel, and Alloy Steel.
 - 4. ASTM A653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 5. ASTM A1011 Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.

1.4 DELIVERY, STORAGE AND HANDLING

- A. shall be transported, stored, and erected in a manner that will avoid any damage or deformation.
- B. Bent or deformed pieces will be rejected and shall be replaced or repaired at the expense of the responsible party.
- C. Store clear of the ground and in such a manner so as to eliminate excessive handling and protect from weather with a waterproof covering.

2.1 FABRICATION

- A. Fabricate to sizes indicated on the drawings.
- B. Weld or mechanically fasten joints of intersecting grating sections.
- C. Provide support framing for openings as indicated on the drawings.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Verify opening sizes and dimensional variations are acceptable to suit grating tolerances.
- B. Verify support anchors are correctly positioned.
- C. Beginning of installation means acceptance of existing conditions.
- 3.2 INSTALLATION
 - A. Mechanically cut galvanized finished surfaces. Do not use flame cutting tools.

END OF SECTION

SECTION 06 10 00 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Rooftop equipment bases and support curbs.
 - 2. Wood blocking and nailers.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product.
 - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements
 - 2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements.

1.3 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.
- B. Evaluation Reports: For the following, from ICC-ES:
 - 1. Wood-preservative-treated wood.
 - 2. Power-driven fasteners.
 - 3. Expansion anchors.
 - 4. Metal framing anchors.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
 - 2. Provide dressed lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content of Lumber: 15 percent for 2-inch nominal (38-mm actual) thickness or less, 19 percent for more than 2-inch nominal (38-mm actual) thickness.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2[for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground].
 - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. Application: Treat all items indicated on Drawings, and the following:
 - 1. Wood nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 - 2. Wood sills, sleepers, blocking, and similar concealed members in contact with masonry or concrete.
 - 3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
 - 4. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 - 1. Blocking.
 - 2. Nailers.
 - 3. Rooftop equipment bases and support curbs.
- B. For items of dimension lumber size, provide Construction or No. 2 grade lumber of any species.
- C. For concealed boards, provide lumber with 19 percent maximum moisture content and any of the following species and grades:
 - 1. Mixed southern pine; No. 2 grade; SPIB.
 - 2. Eastern softwoods; No. 2 Common grade; NeLMA.
 - 3. Northern species; No. 2 Common grade; NLGA.
 - 4. Western woods; Construction or No. 2 Commongrade; WCLIB or WWPA.

2.4 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 - 1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Power-Driven Fasteners: NES NER-272.
- C. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.

PART 3 - EXECUTION

- 3.1 INSTALLATION, GENERAL
 - A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.
 - B. Install fire-retardant treated plywood backing panels with classification marking of testing agency exposed to view.

- C. Metal Framing Anchors: Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- D. Do not splice structural members between supports unless otherwise indicated.
- E. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
- F. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- G. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. NES NER-272 for power-driven fasteners.
 - 2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.

END OF SECTION 06 10 00

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SECTION 07 01 51 - ROOF REPAIRS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes cutting and patching existing roofing at new and old penetrations to match existing:
- B. Related Requirements:
 - 1. Div. 06 Section "MISCELLANEOUS ROUGH CARPENTRY" for wood blocking, curbs, cants, and nailers.
 - 2. Div. 0 7 Section "SHEET METAL FLASHING AND TRIM" for metal roof penetration flashings, flashings and counterflashings.
 - 3. Div. 07 Section "JOINT SEALANTS."

1.2 REFERENCES

- A. Reference Standards: Perform Work according to standards specified and as follows unless modified by requirements in the Contract Documents.
 - 1. Make available via internet access or maintain on site a copy of each standard affecting the work of this section.
 - 2. National Roofing Contractors Association (NRCA):
 - a. NRCA Roofing Manual: Membrane Roof Systems latest edition.
 - b. NRCA Roofing Manual: Architectural Metal Flashing, Condensation and Air Leakage Control, and Reroofing latest edition.

B. Definitions:

- 1. Roofing Terminology: Definitions in the following apply to work of this section:
 - a. ASTM D 1079
 - b. Glossary in NRCA's "The NRCA Roofing and Waterproofing Manual."
 - c. Existing Roofing System: Includes roofing membranes, auxiliary roofing materials and accessories, substrate boards, vapor retarders, roof insulation, accessories, cover board, metal edging and flashing integral to the roof, metal copings protecting edges of roof and other roofing components.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. For insulation and roof system component fasteners, include copy of FM Approvals' RoofNav listing.
- B. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:
 - 1. Layout and thickness of insulation.
 - 2. Base flashings and membrane terminations.

- 3. Flashing details at penetrations.
- 4. Tapered insulation thickness and slopes.
- C. Samples: For the following products:
 - 1. Roof membrane and flashing, of color required.
- D. Wind Uplift Resistance Submittal: For roofing system, indicating compliance with wind uplift performance requirements.

1.5 INFORMATIONAL SUBMITTALS

- A. Manufacturer Certificates:
 - 1. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.
 - 2. Certificate that the installer is approved by the warrantor of the existing roofing system.
- B. Product Test Reports: For roof membrane and insulation, tests performed by independent qualified testing agency indicating compliance with specified requirements.
- C. Photographs or video showing existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as having been damaged by repair operations. Submit before Work begins.
- D. Field Test Reports: 1. Fastener-pullout test results.
- E. Field quality-control reports.
- F. Sample warranties.
- 1.6 CLOSEOUT SUBMITTALS
 - A. Maintenance data.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Provide a watertight, roofing system with compatible components that will not permit the passage of liquid water and will withstand wind loads, thermally induced movement, and continued exposure to weather without failure.
- B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning roofing removal. Comply with hauling and disposal regulation
- C. Material Compatibility: Provide roofing materials that are compatible with each other and with existing materials under conditions of service and application required, as demonstrated by roofing system manufacturer based on testing and field experience.
- D. Accelerated Weathering: Roof membrane shall withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.
- E. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D3746, ASTM D4272/D4272M, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.
- F. Material Compatibility: Roofing materials shall be compatible with one another and existing adjacent roof systems under conditions of service and application required, as demonstrated by roof membrane manufacturer based on testing and field experience.
- G. Wind Uplift Resistance: Design roofing system to resist the following wind uplift pressures when tested according to FM Approvals 4474, UL 580, or UL 1897:
 - 1. Zone 1 (Roof Area Field): -34 lbf/sq. ft..
 - 2. Zone 2 (Roof Area Perimeter): -55 lbf/sq. ft..
 - a. Location: From roof edge to 10 feet inside roof edge.
 - 3. Zone 3 (Roof Area Corners): -82 lbf/sq. ft..
 - a. Location: 10 feet in each direction from building corner.
- H. FM Approvals' RoofNav Listing: Roof membrane, base flashings, and component materials shall comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system and shall be listed in FM Approvals' RoofNav for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals Certification markings.
 - 1. Fire/Windstorm Classification: Class 1A-90.
 - 2. Hail-Resistance Rating: FM Global Property Loss Prevention Data Sheet 1-34.
 - 3. Wind Uplift Load Capacity: 60 psf.
- I. Energy Performance: Roofing system shall have an initial solar reflectance of not less than 0.80 and an emissivity of not less than 0.85 when tested according to CRRC-1.
- J. Exterior Fire-Test Exposure: ASTM E108 or UL 790, Class A; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

2.2 BUILT-UP ROOFING – Match existing Roofing System

- A. Built-up Roof System: Match existing roofing. Verify the existing roofing manufacturer and any current warranties.
- B. Source Limitations: Obtain components for roofing system from same manufacturer as roofing membrane.

2.3 ROOFING MEMBRANE SHEET MATERIALS

A. VERIFY TO MATCH EXISTING - Asphalt-Coated, Glass-Fiber-Mat Base Sheet: ASTM D4601/D4601M, Type I, nonperforated, asphalt-impregnated and -coated, glass-fiber sheet, dusted with fine mineral surfacing on both sides.

2.4 BASE FLASHING SHEET MATERIALS

- A. Asphalt-Impregnated, Glass-Fiber-Mat Backer Sheet: ASTM D2178/D2178M, Type IV, asphaltimpregnated, glass-fiber felt.
- B. Polyester Flashing Sheet: Roofing manufacturer's standard asphalt-coated, polyester-reinforced fabric, base flashing, suitable for application method specified.
- C. Fabric Termination: Roofing manufacturer's standard polyester cloth, suitable for application and for reinforcing top seal of base flashing.

2.5 BITUMEN MATERIALS

- A. Asphalt Primer: ASTM D41/D41M.
- B. Coal Tar Primer: ASTM D43/D43M.
- C. Coal Tar Pitch: ASTM D450/D450M, Type I.
- D. Roofing Asphalt: ASTM D312/D312M, Type III or IV as recommended by roofing system manufacturer for application.

2.6 ACCESSORY ROOFING MATERIALS

- A. General: Accessory materials recommended by built-up roofing manufacturer for intended use and compatible with roofing components.
- B. Sheathing Paper: Red-rosin type, minimum 3 lb/100 sq. ft. (0.16 kg/sq. m).
- C. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.
- D. Provide one of the following Adhesives as required for to match the existing system.

- 1 Cold-Applied Trichloroethylene Asphalt Adhesive: ASTM D3019, Type III, roof system manufacturer's standard asphalt-based, one- or two-part, asbestos-free, cold-applied adhesive, specially formulated for compatibility and use with roofing system and base flashings.
- 2 Cold-Applied Asphalt Adhesive: ASTM D4479/D4479M, Type I or Type II, roof system manufacturer's standard asphalt-based, one- or two-part, asbestos-free, cold-applied adhesive, specially formulated for compatibility and use with roofing system and base flashings.
- 3 Cold-Applied Polymer-Modified Asphalt Adhesive: Roof membrane manufacturer's standard solvent-and asbestos-free, cold-applied adhesive, specially formulated for compatibility and use with roofing system, base flashings, and aggregate surfacing adhesive.
- E. Asphalt Roofing Cement: ASTM D4586/D4586M, asbestos free, of consistency required by roofing manufacturer for application.
- F. SBS-Modified Asphalt Flashing Cement: Roofing manufacturer's standard, asbestos free, of consistency required for application.
- G. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosionresistance provisions in FM Approvals 4470, designed for fastening built-up roofing components to substrate; tested by manufacturer for required pullout strength, and acceptable to roofing manufacturer.
- H. Aggregate Surfacing: ASTM D1863/D1863M, No. 6 or No. 67, clean, dry, opaque, water-worn gravel or crushed stone, free of sharp edges match existing or reuse existing.
- I. Miscellaneous Accessories: Provide those recommended by roofing system manufacturer.

2.7 SUBSTRATE BOARDS

- A. Substrate Board to match existing: ASTM C1396/C1396M, Type X gypsum board (field verify to match existing).
 - 1. Thickness: 5/8 inch (16 mm).
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate board to roof deck.

2.8 ROOF INSULATION

- A. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces. (Field verify to match existing)
 - 1. Size: cut to fit, maximum 48 by 48 inches (1219 by 1219 mm)
 - 2. Thickness:
 - a. Base Layer: match existing.
 - b. Upper Layer: match existing.
- B. Tapered Insulation: Provide factory-tapered insulation boards.
 - 1. Material: Match roof insulation.
 - 2. Minimum Thickness: 1/4 inch (6.35 mm).

- 3. Slope:
 - a. Roof Field: Not applicable
 - b. Saddles and Crickets: 1/2 inch per foot (1:24) unless otherwise indicated on Drawings.

2.9 INSULATION ACCESSORIES

- A. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.
- B. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another layer of insulation:
- C. Cover Board: ASTM C208, Type II, Grade 2, cellulosic-fiber insulation board, 1/2 inch (13 mm) thick (field verify to match existing).

PART 3 - EXECUTION

3.1 FIELD CONDITIONS

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
 - 1. Verify type, thickness and attachment of underlying substrate, insulation and cover board to match.
- B. Proceed with roof repair preparation only when existing and forecasted weather conditions permit work to proceed without water entering existing roofing system or building.
- C. Protect building to be repaired, adjacent buildings, walkways, site improvements, exterior plantings and landscaping from damage or soiling from repair operations.
- D. Owner may occupy portions of the building immediately below repair area. Conduct repairs so Owner's operations will not be disrupted. Provide Owner with not less than 72 hours' notice of activities that may affect Owner's operations.
- E. Schedule work to coincide with commencement of installation of new rooftop equipment or support grillage.
- F. Coordinate roof repair work with mechanical and electrical and other work requiring roof penetrations and subsequent repairs.
- G. Remove no more existing roofing materials than can be replaced with new materials the same day.
- H. Protect existing roofing system that is not indicated to be replaced.
- I. Coordinate with Owner to shut down air-intake equipment in the vicinity of the work. Cover air-intake louvers before proceeding with repair work that could affect indoor air quality or activate smoke detectors in ductwork.
- J. Maintain roof drains in functioning condition to ensure proper roof drainage at the end of each workday. Prevent debirs from entering or blocking roof drains and conductors. Remove roof-drain protection at the end of each workday, when no work is taking place and/or when precipitation is forecast.

3.2 REMOVAL OF EXISTING ROOFING

- A. Notify the Owner each day of extent of roof tear-off proposed for that day and obtain authorization to proceed.
- B. Remove existing roofing and flashing as required to provide access for new deck penetrations. Remove membranes, flashings, insulation, vapor retarders, and any other roof elements to expose structural deck to the extent required for the work.
- C. Clean substrates of contaminants such as asphalt, sheet materials, dirt and debris
- D. Inspect and repair existing deck surface to provide acceptable working surface for replacement roof system.
- E. Provide temporary protective sheeting over exposed deck surfaces and to protect existing roofing materials from water infiltration. Retain sheeting in position with weights or temporary fasteners and provide for surface drainage from sheeting to existing drainage facilities.

3.3 ROOF REPAIRS

- A. Clean and prepare roof deck and adjacent roofing materials according to roofing system manufacturer's written instructions. Remove sharp projections.
- B. Patch roofing system according to roofing system manufacturer's written instructions, and applicable recommendations of NRCA quality control guidelines applicable to the type of roofing used.
- C. Install roof membrane and auxiliary materials to tie in with existing roofing to maintain weathertightness of transition.
- D. As soon as possible after penetrations or openings are completed, fill in the tear-off areas to match existing roofing system construction. Install new roofing the same day tear-off is made where possible.
- E. Apply urethane roof coating over EPDM patches, overlapping existing coated membrane to remain.
 - 1. Allow appropriate time as recommended by both coating and membrane manufacturers for membrane adhesives and seams to cure and achieve stability before applying coating.
 - 2. Provide coating reinforcement over seams and flashings as recommended by coating manufacturer.
 - 3. Apply coating in two separate coats to achieve total specified thickness.

3.4 PROTECTING AND CLEANING

- A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 07 01 51

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SECTION 071616 - CRYSTALLINE WATERPROOFING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Crystalline waterproofing.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, and installation instructions.

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each product formulation, for tests performed by manufacturer and witnessed by a qualified testing agency.

1.4 QUALITY ASSURANCE

A. Applicator Qualifications: A firm experienced in applying crystalline waterproofing similar in material, design, and extent to that indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

1.5 FIELD CONDITIONS

- A. Proceed with waterproofing work only after pipe sleeves, vents, curbs, inserts, drains, and other projections through the substrate to be waterproofed have been completed. Proceed only after substrate defects, including honeycombs, voids, and cracks, have been repaired to provide a sound substrate free of forming materials, including reveal inserts.
- B. Ambient Conditions: Proceed with waterproofing work only if temperature is maintained at 40 deg F (4.4 deg C) or above during work and cure period, and space is well ventilated and kept free of water.

PART 2 - PRODUCTS

2.1 WATERPROOFING MATERIALS

A. Crystalline Waterproofing: Prepackaged, gray-colored proprietary blend of portland cement, specially treated sand, and active chemicals that, when mixed with water and applied, penetrates into concrete and concrete unit masonry and reacts chemically with the byproducts

of cement hydration in the presence of water to develop crystalline growth within substrate capillaries to produce an impervious, dense, waterproof substrate; with properties complying with or exceeding the criteria specified below.

- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Anti-Hydro International, Inc.; A-H Hydrocap.
 - b. BASF Building Systems; Tegraproof.
 - c. Euclid Tamms; HEY'DI K-11.
 - d. Vandex USA LLC; Vandex Super/Super White.
 - e. Xypex Chemical Corporation; Xypex.
 - f. Comparable products by other manufacturers will be considered.
- 2. Water Permeability: Maximum zero for water at 30 feet (9 m) when tested in accordance with COE CRD-C 48.
- 3. Compressive Strength: Minimum 4000 psi (27.6 MPa) at 28 days when tested in accordance with ASTM C109/C109M.

2.2 ACCESSORY MATERIALS

- A. Patching Compound: Factory-premixed cementitious repair mortar, crack filler, or sealant recommended by waterproofing manufacturer for filling and patching tie holes, honeycombs, reveals, and other imperfections; and compatible with substrate and other materials indicated.
- B. Plugging Compound: Factory-premixed cementitious compound with hydrophobic properties and recommended by waterproofing manufacturer; resistant to water and moisture but vapor permeable for all standard applications (vertical, overhead, and horizontal surfaces not exposed to vehicular traffic); and compatible with substrate and other materials indicated.
- C. Water: Potable.
- D. Portland Cement: ASTM C 150, Type I.
- E. Sand: ASTM C 144.
- F. Polymer Admixture for Protective Topping: Polymer bonding agent and admixture designed to improve adhesion to prepared substrates and not to create a vapor barrier.

2.3 MIXES

A. Crystalline Waterproofing: Add prepackaged dry ingredients to water according to manufacturer's written instructions. Mix with mechanical mixer or by hand to required consistency.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for suitable conditions where waterproofing is to be applied.
- B. Proceed with application only after unsatisfactory conditions have been corrected.

C. Notify Architect in writing of active leaks or defects that would affect system performance.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions.
- B. Protect other work from damage caused by cleaning, preparation, and application of waterproofing. Provide temporary enclosure to ensure adequate ambient temperatures and ventilation conditions for application.
- C. Do not allow waterproofing, patching, and plugging materials to enter reveals or annular spaces intended for resilient sealants or gaskets, such as joint spaces between pipes and pipe sleeves.
- D. Stop active water leaks with plugging compound.
- E. Repair damaged or unsatisfactory substrate with patching compound.
 - 1. At holes and cracks 1/16 inch (1.6 mm) wide or larger in substrate, remove loosened chips and cut reveal with sides perpendicular to surface, not tapered, and minimum 1 inch (25 mm) deep. Fill reveal with patching compound flush with surface.
- F. Surface Preparation: Remove efflorescence, chalk, dust, dirt, mortar spatter, grease, oils, paint, curing compounds, and form-release agents to ensure that waterproofing bonds to surfaces.
 - 1. Clean concrete surfaces in accordance with ASTM D4258.
 - a. Scratch- and Float-Finished Concrete: Etch with 10 percent muriatic acid solution in accordance with ASTM D4260.
 - b. Smooth-Formed and Trowel-Finished Concrete: Prepare by mechanical abrading or abrasive-blast cleaning in accordance with ASTM D4259.

3.3 INSTALLATION

- A. Comply with waterproofing manufacturer's written instructions for application and curing.
 - 1. Saturate surface with water for several hours and maintain damp condition until applying waterproofing. Remove standing water.
 - 2. Apply waterproofing to surfaces and extend waterproofing onto adjacent surfaces as indicated on drawings.
 - 3. Number of Coats: Two.
 - 4. Application Method: Apply to ensure that each coat fills voids and is in full contact with substrate or previous coat.
 - 5. Dampen surface between coats.
- B. Final Coat Finish: Brushed or Spray textured.
- C. Curing: Moist-cure waterproofing for three days immediately after final coat has set, followed by air drying, unless otherwise recommended in writing by manufacturer.

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3.4 FIELD QUALITY CONTROL

A. Prepare test and inspection reports.

END OF SECTION 071616

SECTION 074213.19 - INSULATED METAL WALL PANELS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Foamed-insulation-core metal wall panels.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Meet with Owner, Architect, Owner's insurer if applicable, metal panel Installer, metal panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal panels, including installers of doors, windows, and louvers.
 - 2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 3. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.
 - 4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
 - 5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affect metal panels.
 - 6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
 - 7. Review temporary protection requirements for metal panel assembly during and after installation.
 - 8. Review procedures for repair of metal panels damaged after installation.
 - 9. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. Foamed-insulation-core metal wall panels.
- B. Product Data Submittals: For each product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
- C. Shop Drawings:

- 1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
- 2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches (1:10).
- D. Samples for Verification: For each type of exposed finish, prepared on Samples of size indicated below.
 - 1. Metal Panels: 12 inches (305 mm) long by actual panel width. Include fasteners, closures, and other metal panel accessories.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each product, tests performed by a qualified testing agency.
- C. Field quality-control reports.
- D. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panels to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on metal panels during installation.

1.8 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed in accordance with manufacturers' written instructions and warranty requirements.

1.9 COORDINATION

A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including rupturing, cracking, or puncturing.
 - b. Deterioration of metals and other materials beyond normal weathering.
 - 2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested in accordance with ASTM D2244.
 - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing in accordance with ASTM E72:
 - 1. Wind Loads: As indicated on Drawings.
 - 2. Deflection Limits: For wind loads, no greater than 1/240 of the span.
- B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) when tested in accordance with ASTM E283 at the following test-pressure difference:

- 1. Test-Pressure Difference: 6.24 lbf/sq. ft. (300 Pa).
- C. Water Penetration under Static Pressure: No water penetration when tested in accordance with ASTM E331 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 6.24 lbf/sq. ft. (300 Pa).
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- E. Fire-Test-Response Characteristics: Provide metal wall panels and system components with the following fire-test-response characteristics, as determined by testing identical panels and system components per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing agency.
 - 1. Fire-Resistance Characteristics: Provide materials and construction tested for fire resistance per ASTM E119.
 - 2. Radiant Heat Exposure: No ignition when tested in accordance with NFPA 268.
 - 3. Potential Heat: Acceptable level when tested in accordance with NFPA 259.
 - 4. Surface-Burning Characteristics: Provide wall panels with a flame-spread index of 25 or less and a smoke-developed index of 450 or less, per ASTM E84.

2.2 FOAMED-INSULATION-CORE METAL WALL PANELS

- A. General: Provide factory-formed and -assembled metal wall panels fabricated from two metal facing sheets and insulation core foamed in place during fabrication, and with joints between panels designed to form weathertight seals. Include accessories required for weathertight installation.
 - 1. Insulation Core: Polyisocyanurate foam using a non-CFC blowing agent, with maximum flame-spread and smoke-developed indexes of 25 and 450, respectively.
 - a. Closed-Cell Content: 90 percent when tested in accordance with ASTM D6226.
 - b. Density: 2.0 to 2.6 lb/cu. ft. (32 to 42 kg/cu. m) when tested in accordance with ASTM D1622.
 - c. Compressive Strength: Minimum 20 psi (140 kPa) when tested in accordance with ASTM D1621.
 - d. Shear Strength: 26 psi (179 kPa) when tested in accordance with ASTM C273/C273M.
- B. Concealed-Fastener, Foamed-Insulation-Core Metal Wall Panels: Formed with tongue-andgroove panel edges; designed for sequential installation by interlocking panel edges and mechanically attaching panels to supports using concealed clips or fasteners.
 - 1. Basis of Design: Centria (A Nucor Company)"Versawall V" or comparable product.
 - 2. Metallic-Coated Steel Sheet: Facings of zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 (Class AZM150) coating

designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

- a. Nominal Thickness: 26 ga. Exterior and Interior face
- b. Exterior Finish: Striated, Embossed, Two-coat fluoropolymer.
 - 1) Color: As selected by Architect from manufacturer's full range.
- c. Interior Finish: Planked, Embossed
 - 1) Color: As selected by Architect from manufacturer's full range.
- 3. Panel Coverage: 30 inches (762 mm) nominal.
- 4. Panel Thickness: 2 3/4 (70 mm)
- 5. Thermal-Resistance Value (R-Value): 23.0 in accordance with ASTM C1363.

2.3 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 (Z275 hot-dip galvanized) coating designation or ASTM A792/A792M, Class AZ50 (Class AZM150) aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
 - 1. Sub-girts: C or Z shapes sections, 0.054-inch (1.37 mm) minimum nominal thickness.
 - 2. Sill Channels: 0.06-inch (1.52) mm minimum
 - 3. Hat Channels: 0.06-inch (1.52) mm minimum nominal thickness.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
 - 1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal panels.
 - 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 - 3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- (25-mm-) thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.
- D. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

2.4 FABRICATION

- A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- C. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
 - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 - 2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
 - 3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flatlock seams. Tin edges to be seamed, form seams, and solder.
 - 4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
 - 5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
 - 6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
 - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.5 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Steel Panels and Accessories:
 - 1. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
 - 1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer.
 - a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages in accordance with ASTM C754 and metal panel manufacturer's written recommendations.

3.3 INSTALLATION OF METAL PANELS

- A. General: Install metal panels in accordance with manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 1. Shim or otherwise plumb substrates receiving metal panels.
 - 2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
 - 3. Install screw fasteners in predrilled holes.
 - 4. Locate and space fastenings in uniform vertical and horizontal alignment.
 - 5. Install flashing and trim as metal panel work proceeds.
 - 6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
 - 7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
 - 8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- B. Fasteners:
 - 1. Steel Panels: Use stainless steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.

- C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.
- D. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weathertight performance of metal wall panel assemblies. Provide types of gaskets, fillers, and sealants indicated by metal panel manufacturer; or, if not indicated, provide types recommended by metal wall panel manufacturer.
 - 1. Seal metal wall panel end laps with double beads of tape or sealant, full width of panel. Seal side joints where recommended by metal wall panel manufacturer.
 - 2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

3.4 INSTALLATION OF INSULATION-CORE METAL WALL PANELS

- A. General: Apply continuous ribbon of sealant to panel joint on concealed side of insulated metal wall panels as vapor seal; apply sealant to panel joint on exposed side of panels for weather seal.
 - 1. Fasten foamed-insulation-core metal wall panels to supports with fasteners at each lapped joint at location and spacing and with fasteners recommended by manufacturer.
 - 2. Apply panels and associated items true to line for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.
 - 3. Provide metal-backed washers under heads of exposed fasteners on weather side of insulated metal wall panels.
 - 4. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
 - 5. Provide sealant tape at lapped joints of insulated metal wall panels and between panels and protruding equipment, vents, and accessories.
 - 6. Apply a continuous ribbon of sealant tape to panel side laps and elsewhere as needed to make panels weathertight.
- B. Foamed-Insulation-Core Metal Wall Panels: Fasten metal wall panels to supports with concealed clips at each joint at location and spacing and with fasteners recommended by manufacturer. Fully engage tongue and groove of adjacent panels.
 - 1. Install clips to supports with self-tapping fasteners.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Water-Spray Test: After installation, test area of assembly as directed by Architect for water penetration in accordance with AAMA 501.2.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed metal wall panel installation, including accessories.
- D. Metal wall panels will be considered defective if they do not pass test and inspections.

- E. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.
- F. Prepare test and inspection reports.

3.6 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
- B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074213.19

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SECTION 075423 - THERMOPLASTIC-POLYOLEFIN (TPO) ROOFING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Thermoplastic polyolefin (TPO) roofing system.
 - 2. Accessory roofing materials.
 - 3. Substrate board.
 - 4. Vapor retarder.
 - 5. Roof insulation.
 - 6. Insulation accessories and cover board.
- B. Section includes installation of sound-absorbing insulation strips in ribs of roof deck. Soundabsorbing insulation strips are furnished under Section 053100 "Steel Decking."
- C. Related Requirements:
 - 1. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking; and for woodbased, structural-use roof deck panels.
 - 2. Section 076200 "Sheet Metal Flashing and Trim" for metal roof flashings and counterflashings.
 - 3. Section 077100 "Roof Specialties" for roof edge flashings.
 - 4. Section 079200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.

1.2 DEFINITIONS

A. Roofing Terminology: Definitions in ASTM D1079 and glossary in NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" apply to Work of this Section.

1.3 PREINSTALLATION MEETINGS

- A. Preliminary Roofing Conference: Before starting roof deck construction, conduct conference at Project site.
 - 1. Meet with Owner, Architect, Construction Manager, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, air barrier Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
 - 2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
 - 3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Review deck substrate requirements for conditions and finishes, including flatness and fastening.
 - 5. Review structural loading limitations of roof deck during and after roofing.

- 6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
- 7. Review governing regulations and requirements for insurance and certificates if applicable.
- 8. Review temporary protection requirements for roofing system during and after installation.
- 9. Review roof observation and repair procedures after roofing installation.
- B. Preinstallation Roofing Conference: Conduct conference at Project site.
 - 1. Meet with Owner, Architect, Construction Manager, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, air barrier Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
 - 2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
 - 3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
 - 5. Review structural loading limitations of roof deck during and after roofing.
 - 6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
 - 7. Review governing regulations and requirements for insurance and certificates if applicable.
 - 8. Review temporary protection requirements for roofing system during and after installation.
 - 9. Review roof observation and repair procedures after roofing installation.

1.4 ACTION SUBMITTALS

- A. Product Data:
 - 1. Thermoplastic polyolefin (TPO) roofing system.
 - 2. Accessory roofing materials.
 - 3. Substrate board.
 - 4. Vapor retarder.
 - 5. Roof insulation.
 - 6. Insulation accessories and cover board.
- B. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:
 - 1. Layout and thickness of insulation.
 - 2. Base flashings and membrane termination details.
 - 3. Flashing details at penetrations.
 - 4. Tapered insulation layout, thickness, and slopes.
 - 5. Roof plan showing orientation of steel roof deck and orientation of roof membrane, fastening spacings, and patterns for mechanically fastened roofing system.
 - 6. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
- C. Samples for Verification: For the following products:

D. Wind Uplift Resistance Submittal: For roofing system, indicating compliance with wind uplift performance requirements.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and manufacturer.
- B. Manufacturer Certificates:
 - 1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
 - a. Submit evidence of compliance with performance requirements.
 - 2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.
- C. Product Test Reports: For roof membrane and insulation, for tests performed by a qualified testing agency, indicating compliance with specified requirements.
- D. Evaluation Reports: For components of roofing system, from ICC-ES.
- E. Field Test Reports:
 - 1. Fastener-pullout test results and manufacturer's revised requirements for fastener patterns.
- F. Field quality-control reports.
- G. Sample Warranties: For manufacturer's special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For roofing system to include in maintenance manuals.
- B. Certified statement from existing roof membrane manufacturer stating that existing roof warranty has not been affected by Work performed under this Section.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is UL listed or listed in FM Approvals' RoofNav for roofing system identical to that used for this Project.
- B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
 - 1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.9 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.
 - 1. Special warranty includes roof membrane, base flashings, roof insulation, fasteners, cover boards, vapor retarder, substrate board, and other components of roofing system.
 - 2. Warranty Period: 20 years from date of Substantial Completion.
- B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of roofing system such as roof membrane, base flashing, roof insulation, fasteners, cover boards, substrate boards and vapor retarders, for the following warranty period:
 - 1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Installed roofing system and flashings to withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roof system and flashings to remain watertight.

- 1. Accelerated Weathering: Roof to withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.
- 2. Impact Resistance: Roof membrane to resist impact damage when tested according to ASTM D3746, ASTM D4272, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.
- B. Material Compatibility: Roofing materials to be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roof membrane manufacturer based on testing and field experience.
- C. Wind Uplift Resistance: Design roofing system to resist the following wind uplift pressures when tested according to FM Approvals 4474, UL 580, or UL 1897:
 - 1. Zone 1 (Roof Area Field): 34 lbf/sq. ft. (kPa).
 - 2. Zone 2 (Roof Area Perimeter): 55 lbf/sq. ft. (kPa).
 - a. Location: From roof edge to 10 inside roof edge.
 - 3. Zone 3 (Roof Area Corners): 82 lbf/sq. ft. (kPa).
 - a. Location: 10 in each direction from each building corner.
- D. FM Approvals' RoofNav Listing: Roof membrane, base flashings, and component materials comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system, and are listed in FM Approvals' RoofNav for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals Certification markings.
 - 1. Fire/Windstorm Classification: Class 1A-60
 - 2. Hail-Resistance Rating: FM Global Property Loss Prevention Data Sheet 1-34.
 - 3. Wind Uplift Load Capacity: 60 psf.
- E. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated. Identify products with appropriate markings of applicable testing agency.

2.2 THERMOPLASTIC POLYOLEFIN (TPO) ROOFING SYSTEM

- A. TPO Sheet: ASTM D6878/D6878M, internally fabric- or scrim-reinforced, fabric-backed TPO sheet.
 - 1. Manufactures: Subject to compliance with requirements. Provide a product by one of the following.
 - a. GAF
 - b. Carlise SynTec Incorporated
 - c. Firestone Building Products
 - d. Johns Manville; a Berkshire Hathaway company.
 - e. Versico Incorporated
 - f. Mule-Hide Products Co., Inc.
 - g. Or comparable product
 - 2. Source Limitations: Obtain components for roofing system from roof membrane manufacturer or manufacturers approved by roof membrane manufacturer.
 - 3. Thickness: 60 mils (1.5 mm), nominal.
 - 4. Exposed Face Color: White.

2.3 ACCESSORY ROOFING MATERIALS

- A. General: Accessory materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.
 - 1. Adhesive and Sealants: Comply with VOC limits of authorities having jurisdiction.
- B. Sheet Flashing: Manufacturer's standard unreinforced TPO sheet flashing, 55 mils (1.4 mm) thick, minimum, of same color as TPO sheet.
- C. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.
- D. Roof Vents: As recommended by roof membrane manufacturer.
 - 1. Size: Not less than 4-inch (100-mm) diameter.
- E. Bonding Adhesive: Manufacturer's standard.
- F. Slip Sheet: Manufacturer's standard, of thickness required for application.
- G. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.
- H. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosionresistance provisions in FM Approvals 4470, designed for fastening roofing components to substrate, and acceptable to roofing system manufacturer.
- I. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.4 SUBSTRATE BOARD

- A. Glass-Mat Gypsum Roof Substrate Board: ASTM C1177/C1177M, water-resistant gypsum board.
 - 1. Thickness: 1/2 inch (13 mm) thick.
 - 2. Surface Finish: Factory primed.
- B. Fiber-Reinforced Gypsum Roof Board: ASTM C1278/C1278M, cellulosic-fiber reinforced, waterresistant gypsum board.
 - 1. Thickness: 1/2 inch (13 mm).
- C. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosionresistance provisions in FM Approvals 4470, designed for fastening substrate board to roof deck.

2.5 VAPOR RETARDER

A. Polyethylene Film: ASTM D4397, 10 mils (0.25 mm) thick, minimum, with maximum permeance rating of 0.076 perm (0.050 metric perm).
- 1. Tape: Pressure-sensitive tape of type recommended by vapor retarder manufacturer for sealing joints and penetrations in vapor retarder.
- 2. Adhesive: Manufacturer's standard lap adhesive, listed by FM Approvals for vapor retarder application.

2.6 ROOF INSULATION

- A. General: Preformed roof insulation boards manufactured by TPO roof membrane manufacturer.
- B. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.
 - 1. Compressive Strength: 20 psi (138 kPa).
 - 2. Size: 48 by 96 inches (1219 by 2438 mm).
 - 3. Thickness:
 - a. Base Layer: 2 inches (50.8 mm).
 - b. Upper Layer: 2 inches (50.8 mm).

2.7 INSULATION ACCESSORIES AND COVER BOARD

- A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with other roofing system components.
- B. Fasteners: Factory-coated steel fasteners with metal or plastic plates complying with corrosionresistance provisions in FM Approvals 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.
- C. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:
 - 1. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.
- D. Glass-Mat Gypsum Cover Board: ASTM C1177/C1177M, water-resistant gypsum board.
 - 1. Thickness: 1/2 inch (13 mm).
 - 2. Surface Finish: Factory primed.
- E. Fiber-Reinforced Gypsum Roof Board: ASTM C1278/C1278M, cellulosic-fiber reinforced, waterresistant gypsum board.
 - 1. Thickness: 1/2 inch (13 mm).
- F. Fiber-Reinforced Cementitious Cover Board: ASTM C1325, fiber-mat-reinforced cementitious board.
 - 1. Thickness: 1/2 inch (13 mm).
- G. Polyisocyanurate Insulation Cover Board: ASTM C1289 Type II, Class 4, Grade 1, 1/2 inch (13 mm) thick, with a minimum compressive strength of 80 psi (551 kPa).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
 - 1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
 - 2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
 - 3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 053100 "Steel Decking."
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing system installation according to roofing system manufacturer's written instructions. Remove sharp projections.

3.3 INSTALLATION OF ROOFING, GENERAL

A. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning Work on adjoining roofing.

3.4 INSTALLATION OF SUBSTRATE BOARD

- A. Install substrate board with long joints in continuous straight lines, with end joints staggered not less than 24 inches (610 mm) in adjacent rows.
 - 1. At steel roof decks, install substrate board at right angle to flutes of deck.
 - a. Locate end joints over crests of steel roof deck.
 - 2. Tightly butt substrate boards together.
 - 3. Cut substrate board to fit tight around penetrations and projections, and to fit tight to intersecting sloping roof decks.
 - 4. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to roofing system manufacturers' written instructions.

3.5 INSTALLATION OF VAPOR RETARDER

A. Self-Adhering-Sheet Vapor Retarder: Prime substrate if required by manufacturer. Install selfadhering-sheet vapor retarder over area to receive vapor retarder, side and end lapping each sheet a minimum of 3-1/2 and 6 inches (90 and 150 mm), respectively.

- 1. Extend vertically up parapet walls and projections to a minimum height equal to height of insulation and cover board.
- 2. Seal laps by rolling.

3.6 INSTALLATION OF INSULATION

- A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at end of workday.
- B. Comply with roofing system and roof insulation manufacturer's written instructions for installing roof insulation.
- C. Installation Over Metal Decking:
 - 1. Install base layer of insulation with joints staggered not less than 24 inches (610 mm) in adjacent rows, end joints staggered not less than 12 inches (305 mm) in adjacent rows and with long joints continuous at right angle to flutes of decking.
 - a. Locate end joints over crests of decking.
 - b. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
 - c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
 - d. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
 - e. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
 - f. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
 - g. Mechanically attach base layer of insulation and substrate board using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to metal decks.
 - 1) Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.
 - 2. Install upper layers of insulation with joints of each layer offset not less than 12 inches (305 mm) from previous layer of insulation.
 - a. Staggered end joints within each layer not less than 24 inches (610 mm) in adjacent rows.
 - b. Install with long joints continuous and with end joints staggered not less than 12 inches (305 mm) in adjacent rows.
 - c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
 - d. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
 - e. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).
 - 1) Trim insulation so that water flow is unrestricted.
 - f. Fill gaps exceeding 1/4 inch (6 mm) with insulation.

g. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.

3.7 INSTALLATION OF COVER BOARDS

- A. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches (150 mm) in each direction.
 - 1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
 - 2. Cut and fit cover board tight to nailers, projections, and penetrations.

3.8 INSTALLATION OF ADHERED ROOF MEMBRANE

- A. Adhere roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.
- B. Unroll roof membrane and allow to relax before installing.
- C. Accurately align roof membrane, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- D. Bonding Adhesive: Apply to substrate and underside of roof membrane at rate required by manufacturer and allow to partially dry before installing roof membrane. Do not apply to splice area of roof membrane.
- E. Fabric-Backed Roof Membrane Adhesive: Apply to substrate at rate required by manufacturer, and install fabric-backed roof membrane.
- F. In addition to adhering, mechanically fasten roof membrane securely at terminations, penetrations, and perimeter of roofing.
- G. Apply roof membrane with side laps shingled with slope of roof deck where possible.

3.9 INSTALLATION OF BASE FLASHING

- A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to roofing system manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
- D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and to inspect substrate conditions, surface preparation, roof membrane application, sheet flashings, protection, and drainage components, and to furnish reports to Architect.

3.11 PROTECTING AND CLEANING

- A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing system, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

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SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Roof-drainage sheet metal fabrications.
 - 2. Miscellaneous sheet metal fabrications.

B. Related Requirements:

- 1. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking.
- 2. Section 074213.13 "Formed Metal Wall Panels" for sheet metal flashing and trim integral with metal wall panels.
- 3. Section 077100 "Roof Specialties" for manufactured copings, roof-edge specialties, roof-edge drainage systems, reglets, and counterflashings.

1.2 COORDINATION

- A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.
- B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 2. Review special roof details, roof drainage, roof-penetration flashing, equipment curbs, and condition of other construction that affect sheet metal flashing and trim.
 - 3. Review sheet metal flashing observation and repair procedures after flashing installation.

1.4 ACTION SUBMITTALS

- A. Shop Drawings: For sheet metal flashing and trim.
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled Work.
 - 3. Include identification of material, thickness, weight, and finish for each item and location in Project.
 - 4. Include details for forming, including profiles, shapes, seams, and dimensions.

- 5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
- 6. Include details of termination points and assemblies.
- 7. Include details of connections to adjoining work.
- B. Samples for Verification: For each type of exposed finish.
 - 1. Sheet Metal Flashing: 12 inches (300 mm) long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.
- B. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- C. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.
- B. Special warranty.

1.7 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 ANSI/SPRI/FM 4435/ES-1 tested, shop is to be listed as able to fabricate required details as tested and approved.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.
 - 1. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
 - 2. Protect stored sheet metal flashing and trim from contact with water.
- B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.9 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.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, are to 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 are not to rattle, leak, or loosen, and are to remain watertight.
- B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual: Architectural Metal Flashing, Condensation and Air Leakage Control, and Reroofing" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 SHEET METALS

- A. Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- B. Aluminum Sheet: ASTM B209 (ASTM B209M), alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface.
 - 1. As-Milled Finish: Mill.
 - 2. Factory Prime Coating: Where painting after installation is required, pretreat metal with white or light-colored, factory-applied, baked-on epoxy primer coat; minimum dry film thickness of 0.2 mil (0.005 mm).
 - 3. Clear Anodic Finish, Coil Coated: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.
- C. Stainless Steel Sheet: ASTM A240/A240M, Type 304, dead soft, fully annealed; with smooth, flat surface.
 - 1. Finish: ASTM A480/A480M, No. 2D (dull, cold rolled).
 - a. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

2.3 UNDERLAYMENT MATERIALS

- A. Felt: ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felt; nonperforated.
- B. Synthetic Underlayment: Laminated or reinforced, woven polyethylene or polypropylene, synthetic roofing underlayment; bitumen free; slip resistant; suitable for high temperatures over 220 deg F (111 deg C); and complying with physical requirements of ASTM D226/D226M for Type I and Type II felts.
 - 1. Source Limitations: Obtain underlayment from single source from single manufacturer.
- C. Self-Adhering, High-Temperature Sheet Underlayment: Minimum 30 mils (0.76 mm) thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer in accordance with underlayment manufacturer's written instructions.
 - 1. Source Limitations: Obtain underlayment from single source from single manufacturer.
 - 2. Low-Temperature Flexibility: ASTM D1970/D1970M; passes after testing at minus 20 deg F (29 deg C) or lower.

2.4 MISCELLANEOUS MATERIALS

- A. Provide materials and types of fasteners, 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. Blind Fasteners: High-strength aluminum or stainless steel rivets suitable for metal being fastened.
 - 2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
 - 3. Fasteners for Stainless Steel Sheet: Series 300 stainless steel.
- C. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
- D. Bituminous Coating: Cold-applied asphalt emulsion in accordance with ASTM D1187/D1187M.
- E. Asphalt Roofing Cement: ASTM D4586, asbestos free, of consistency required for application.
- F. 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 factorymitered and -welded corners and junctions and with interlocking counterflashing on exterior face, of same metal as reglet.
 - 1. Source Limitations: Obtain reglets from single source from single manufacturer.
 - 2. Material: Stainless steel, 0.0188 inch (0.477 mm) thick
 - 3. Masonry Type: Provide with offset top flange for embedment in masonry mortar joint.

- 4. Accessories:
 - a. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where Drawings show reglet without metal counterflashing.
 - b. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing's lower edge.
- 5. Finish: With manufacturer's standard color coating.

2.5 FABRICATION, GENERAL

- A. Custom fabricate sheet metal flashing and trim to comply with details indicated and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required.
 - 1. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
 - 2. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
 - 3. Verify shapes and dimensions of surfaces to be covered and obtain field measurements for accurate fit before shop fabrication.
 - 4. 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.
 - 5. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
- B. Fabrication Tolerances:
 - 1. Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.
 - 2. Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified.
- C. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal in accordance with cited sheet metal standard to provide for proper installation of elastomeric sealant.
- 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:
 - 1. Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.
- G. Do not use graphite pencils to mark metal surfaces.

2.6 WALL SHEET METAL FABRICATIONS

- A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch- (2400-mm-) long, but not exceeding 12-foot- (3.6-m-) long, sections, under copings, and at shelf angles. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches (150 mm) beyond each side of wall openings; and form with 2-inch- (50-mm-) high, end dams. Fabricate from the following materials:
 - 1. Stainless Steel: 0.0156 inch (0.396 mm) thick.
- B. Opening Flashings in Frame Construction: Fabricate head, sill, jamb, and similar flashings to extend 4 inches (100 mm) beyond wall openings. Form head and sill flashing with 2-inch- (50-mm-) high, end dams. Fabricate from the following materials:
 - 1. Aluminum: 0.032 inch (0.81 mm) thick.
 - 2. Stainless Steel: 0.0156 inch (0.396 mm) thick.

2.7 MISCELLANEOUS SHEET METAL FABRICATIONS

A. Equipment Support Flashing: Fabricate from the following materials:
1. Stainless Steel: 0.0188 inch (0.477 mm) thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.
 - 1. Verify compliance with requirements for installation tolerances of substrates.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF UNDERLAYMENT

- A. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal flashing and trim.
 - 1. Install in shingle fashion to shed water.
 - 2. Lap joints not less than 2 inches (50 mm).
- B. Synthetic Underlayment: Install synthetic underlayment, wrinkle free, in accordance with manufacturers' written instructions, and using adhesive where possible to minimize use of mechanical fasteners under sheet metal.
 - 1. Lap horizontal joints not less than 4 inches (100 mm).
 - 2. Lap end joints not less than 12 inches (300 mm).

- C. Self-Adhering, High-Temperature Sheet Underlayment:
 - 1. Install self-adhering, high-temperature sheet underlayment; wrinkle free.
 - 2. Prime substrate if recommended by underlayment manufacturer.
 - 3. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures.
 - 4. Apply in shingle fashion to shed water, with end laps of not less than 6 inches (150 mm) staggered 24 inches (600 mm) between courses.
 - 5. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps and edges with roller.
 - 6. Roll laps and edges with roller.
 - 7. Cover underlayment within 14 days.

3.3 INSTALLATION, GENERAL

- A. Install sheet metal flashing and trim to comply with details indicated and recommendations of cited sheet metal standard that apply to installation characteristics required unless otherwise indicated on Drawings.
 - 1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of sealant.
 - 2. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 3. Install sheet metal flashing and trim to fit substrates and to result in watertight performance.
 - 4. Install continuous cleats with fasteners spaced not more than 12 inches (300 mm) o.c.
 - 5. Space individual cleats not more than 12 inches (300 mm) apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
 - 6. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.
 - 7. Do not field cut sheet metal flashing and trim by torch.
 - 8. Do not use graphite pencils to mark metal surfaces.
- 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. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches (32 mm) for nails and not less than 3/4 inch (19 mm) for wood screws.
- D. 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.
- E. Seal joints as required for watertight construction.
 - 1. Use sealant-filled joints unless otherwise indicated.

- a. Embed hooked flanges of joint members not less than 1 inch (25 mm) into sealant.
- b. Form joints to completely conceal sealant.
- c. When ambient temperature at time of installation is between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way.
- d. Adjust setting proportionately for installation at higher ambient temperatures.
 - 1) Do not install sealant-type joints at temperatures below 40 deg F (4 deg C).
- 2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."
- F. Rivets: Rivet joints in uncoated aluminum where necessary for strength.

3.4 INSTALLATION OF ROOF-DRAINAGE SYSTEM

- A. Install sheet metal roof-drainage items to produce complete roof-drainage system in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.
- B. Parapet Scuppers:
 - 1. Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.
 - 2. Anchor scupper closure trim flange to exterior wall and seal with elastomeric sealant to scupper.
 - 3. Loosely lock front edge of scupper with conductor head.
 - 4. Seal with elastomeric sealant exterior wall scupper flanges into back of conductor head.

3.5 INSTALLATION OF ROOF FLASHINGS

- A. Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard.
 - 1. Provide concealed fasteners where possible, and set units true to line, levels, and slopes.
 - 2. Install work with laps, joints, and seams that are permanently watertight and weather resistant.
- B. Copings:
 - 1. Refer to Section 077100 "Roof Specialties".
- C. Counterflashing: Coordinate installation of counterflashing with installation of base flashing.
 - 1. Insert counterflashing in reglets or receivers and fit tightly to base flashing.
 - 2. Extend counterflashing 4 inches (100 mm) over base flashing.
 - 3. Lap counterflashing joints minimum of 4 inches (100 mm).
 - 4. Secure in waterproof manner by means of interlocking folded seam or blind rivets and sealant or anchor and washer spaced at 12 inches (300 mm) o.c. along perimeter and 6 inches (150 mm) o.c. at corners areas unless otherwise indicated.

3.6 INSTALLATION OF WALL FLASHINGS

- A. Install sheet metal wall flashing to intercept and exclude penetrating moisture in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.
- B. Opening Flashings in Frame Construction: Install continuous head, sill,[jamb,] and similar flashings to extend [4 inches (100 mm)] <Insert dimension> beyond wall openings.
- C. Reglets: Installation of reglets is specified in Section 042000 "Unit Masonry."

3.7 INSTALLATION OF MISCELLANEOUS FLASHING

- A. Equipment Support Flashing:
 - 1. Coordinate installation of equipment support flashing with installation of roofing and equipment.
 - 2. Weld or seal flashing with elastomeric sealant to equipment support member.

3.8 INSTALLATION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

3.9 CLEANING

- A. Clean and neutralize flux materials. Clean off excess solder.
- B. Clean off excess sealants.

3.10 PROTECTION

- A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended in writing by sheet metal flashing and trim manufacturer.
- C. Maintain sheet metal flashing and trim in clean condition during construction.
- D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures, as determined by Architect.

END OF SECTION 076200

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SECTION 077100 - ROOF SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Roof-edge specialties
- B. Related Requirements:
 - 1. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking.
 - 2. Section 076200 "Sheet Metal Flashing and Trim" for custom- and site-fabricated sheet metal flashing and trim.
 - 3. Section 079200 "Joint Sealants" for field-applied sealants between roof specialties and adjacent materials.
- C. Preinstallation Conference: Conduct conference at Project site.
 - 1. Meet with Owner, Architect, Owner's insurer if applicable, roofing-system testing and inspecting agency representative, roofing Installer, roofing-system manufacturer's representative, Installer, structural-support Installer, and installers whose work interfaces with or affects roof specialties, including installers of roofing materials and accessories.
 - 2. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
 - 3. Review special roof details, roof drainage, and condition of other construction that will affect roof specialties.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For roof specialties.
 - 1. Include plans, elevations, expansion-joint locations, keyed details, and attachments to other work. Distinguish between plant- and field-assembled work.
 - 2. Include details for expansion and contraction; locations of expansion joints, including direction of expansion and contraction.
 - 3. Indicate profile and pattern of seams and layout of fasteners, cleats, clips, and other attachments.
 - 4. Detail termination points and assemblies, including fixed points.
 - 5. Include details of special conditions.
- C. Samples for Verification:
 - 1. Include Samples of each type of roof specialty to verify finish and color selection, in manufacturer's standard sizes.

2. Include copings made from 12-inch (300-mm) lengths of full-size components in specified material, and including fasteners, cover joints, accessories, and attachments.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer.
- B. Product Certificates: For each type of roof specialty.
- C. Product Test Reports: For roof edge flashings, for tests performed by a qualified testing agency.
- D. Sample Warranty: For manufacturer's special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing specialties to include in maintenance manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not store roof specialties in contact with other materials that might cause staining, denting, or other surface damage. Store roof specialties away from uncured concrete and masonry.
- B. Protect strippable protective covering on roof specialties from exposure to sunlight and high humidity, except to extent necessary for the period of roof-specialty installation.

1.6 FIELD CONDITIONS

- A. Field Measurements: Verify profiles and tolerances of roof-specialty substrates by field measurements before fabrication and indicate measurements on Shop Drawings.
- B. Coordination: Coordinate roof specialties with flashing, trim, and construction of parapets, roof deck, roof and wall panels, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.7 WARRANTY

- A. Special Warranty on Painted Finishes: Manufacturer agrees to repair finish or replace roof specialties that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Delta E units when tested according to ASTM D2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Roof specialties to withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Wind Design Standard: Manufacture and install copings to match roofing requirements.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 ROOF-EDGE SPECIALTIES

- A. Manufactured, one-piece, metal gravel stop in section lengths not exceeding 12 feet (3.6 m), with a horizontal flange and vertical leg terminating in a drip edge, and concealed splice plates of same material, finish, and shape as gravel stop. Provide matching corner units.
 - 1. Metallic-Coated Steel Sheet Gravel Stops: Zinc-coated (galvanized) steel, nominal thickness as required to meet performance requirements.
 - a. Surface: Embossed finish.
 - b. Finish: Two-coat fluoropolymer.
 - c. Color: As selected by Architect from manufacturer's full range to match metal panels

2.3 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils (0.76 to 1.0 mm) thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
 - 1. Thermal Stability: ASTM D1970/D1970M; stable after testing at 240 deg F (116 deg C).
 - 2. Low-Temperature Flexibility: ASTM D1970/D1970M; passes after testing at minus 20 deg F (29 deg C).
- B. Felt: ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felt, nonperforated.

2.4 MISCELLANEOUS MATERIALS

A. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements. Furnish the following unless otherwise indicated:

- 1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal on roof side of coping only. NO EXPOSED FASTENERS visible on metal panel side.
- B. Elastomeric Sealant: ASTM C920, elastomeric silicone polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.
- C. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
- D. Asphalt Roofing Cement: ASTM D4586, asbestos free, of consistency required for application.

2.5 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Coil-Coated Galvanized-Steel Sheet Finishes:
 - 1. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with ASTM A755/A755M and coating and resin manufacturers' written instructions.
 - a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.
- B. Examine walls, roof edges, and parapets for suitable conditions for roof specialties.
- C. Verify that substrate is sound, dry, smooth, clean, sloped for drainage where applicable, and securely anchored.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF UNDERLAYMENT

- A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches (152 mm) staggered 24 inches (610 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps with roller. Cover underlayment within 14 days.
 - 1. Apply continuously under roof-edge specialities.
 - 2. Coordinate application of self-adhering sheet underlayment under roof specialties with requirements for continuity with adjacent air barrier materials.

3.3 INSTALLATION, GENERAL

- A. Install roof specialties according to manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, underlayments, sealants, and other miscellaneous items as required to complete roof-specialty systems.
 - 1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
 - 2. Provide uniform, neat seams with minimum exposure of solder and sealant.
 - 3. Install roof specialties to fit substrates and to result in weathertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
 - 4. Torch cutting of roof specialties is not permitted.
 - 5. Do not use graphite pencils to mark metal surfaces.
- B. Expansion Provisions: Allow for thermal expansion of exposed roof specialties.
 - 1. Space movement joints at a maximum of 12 feet (3.6 m) with no joints within 18 inches (450 mm) of corners or intersections unless otherwise indicated on Drawings.
 - 2. When ambient temperature at time of installation is between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.
- C. Fastener Sizes: Use fasteners of sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches (32 mm) for nails and not less than 3/4 inch (19 mm) for wood screws.
- D. Seal concealed joints with butyl sealant as required by roofing-specialty manufacturer.
- E. Seal joints as required for weathertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F (4 deg C).

3.4 INSTALLATION OF ROOF-EDGE SPECIALITIES

- A. Install cleats, anchor plates, and other anchoring and attachment accessories and devices with concealed fasteners.
- B. Anchor roof edgings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.

1. Interlock face-leg drip edge into continuous cleat anchored to substrate at manufacturer's required spacing that meets performance requirements. Anchor back leg of coping with screw fasteners and elastomeric washers at 24-inch (610-mm) centers.

3.5 INSTALLATION OF ROOF-EDGE SPECIALITIES

A. Install cleats, cants, and other anchoring and attachment accessories and devices with concealed fasteners.

3.6 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 and sealants.
- C. Remove temporary protective coverings and strippable films as roof specialties are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain roof specialties in a clean condition during construction.
- D. Replace roof specialties that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 077100

SECTION 077200 - ROOF 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. Pipe Portals.
 - 2. ACU Rails
 - 3. Roofing / flashing of roof curbs supplied by Mechanical Trades.

1.3 RELATED REQUIREMENTS

A. Section 23 74 16 Packaged Commercial Rooftop Unit for Roof Curb.

1.4 COORDINATION

- A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.
- B. Coordinate locations and dimensions with rough-in information from mechanical trades.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

2.2 PIPE PORTALS

A. Curb-Mounted Pipe Portal: Insulated roof-curb units with welded or mechanically fastened and sealed corner joints, stepped integral metal cant raised the thickness of roof insulation, and integrally formed deck-mounting flange at perimeter bottom; with weathertight curb cover with single or multiple collared openings and pressure-sealed conically shaped EPDM protective rubber caps sized for piping indicated, with stainless steel snaplock swivel clamps.

B. Flashing Pipe Portal: Formed aluminum membrane-mounting flashing flange and sleeve with collared opening and pressure-sealed conically shaped EPDM protective rubber cap sized for piping indicated, with stainless steel snaplock swivel clamps.

2.3 ACU RAIL EQUIPMENT SUPPORTS

- A. Equipment Supports: Rail-type metal equipment supports capable of supporting superimposed live and dead loads and other construction indicated on Drawings, spanning between structural supports; capable of meeting performance requirements; with welded or mechanically fastened and sealed corner joints, integral metal cant and integrally formed structure-mounting flange at bottom.
- B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.
- C. Supported Load Capacity: Coordinate load capacity with information on Shop Drawings of equipment to be supported.
- D. Construction:
 - 1. Curb Profile: Profile as indicated on Drawings compatible with roofing system.
 - 2. Insulation: Factory insulated with 1-1/2-inch (38-mm) thick glass-fiber board insulation.
 - 3. Liner: Same material as equipment support, of manufacturer's standard thickness and finish.
 - 4. Nailer: Factory-installed continuous wood nailers 3-1/2-inch (90-mm) wide on top of equipment supports, continuous for entire length of rail.
 - 5. Metal Counterflashing: Manufacturer's standard, removable, fabricated of the same metal and finish as equipment support.
 - 6. Fabricate equipment supports to minimum height of 12-inches (305-mm) above roofing surface unless otherwise indicated.

2.4 MISCELLANEOUS MATERIALS

- A. Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation on the existing roofing material.
- B. Elastomeric Sealant: ASTM C920, elastomeric polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.
- C. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for expansion joints with limited movement.
- D. Asphalt Roofing Cement: ASTM D4586/D4586M, asbestos free, of consistency required for application.

2.5 GENERAL FINISH REQUIREMENTS

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

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.
- B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- C. Verify dimensions of roof openings for roof accessories.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install roof accessories according to manufacturer's written instructions.
 - 1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
 - 2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
 - 3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
 - 4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.
- B. Preformed Flashing-Sleeve and Flashing Pipe Portal Installation: Secure flashing sleeve to roof membrane according to flashing-sleeve manufacturer's written instructions; flash sleeve flange to surrounding roof membrane according to roof membrane manufacturer's instructions.
- C. Seal joints with sealant as required by roof accessory manufacturer and compliant with existing roofing material.

3.3 REPAIR AND CLEANING

- A. Clean exposed surfaces according to manufacturer's written instructions.
- B. Clean off excess sealants.
- C. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 07 7200

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SECTION 078123 - INTUMESCENT FIRE PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Mastic and intumescent fire-resistive coatings.

1.2 ACTION SUBMITTALS

- A. Product Data:
 - 1. Mastic and intumescent fire-resistive coatings.
 - 2. Substrate primers.
 - 3. Topcoat.
- B. Shop Drawings: Framing plans or schedules, or both, indicating the following:
 - 1. Extent of fire protection for each construction and fire-resistance rating.
 - 2. Applicable fire-resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
 - 3. Minimum mastic and intumescent fire-resistive coating thicknesses needed to achieve required fire-resistance rating of each structural component and assembly.
 - 4. Treatment of mastic and intumescent fire-resistive coating after application.
- C. Samples: For each exposed product and for each color and texture specified, in manufacturer's standard dimensions in size.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and testing agency.
- B. Product Certificates: For each type of mastic and intumescent fire-resistive coating.
- C. Evaluation Reports: For mastic and intumescent fire-resistive coating, from ICC-ES.
- D. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by mastic and intumescent fire-resistive coating manufacturer as experienced and with sufficient trained staff to install manufacturer's products in accordance with specified requirements.

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Do not apply fire protection when ambient or substrate temperature is 50 deg F (10 deg C) or lower unless temporary protection and heat are provided to maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application.
- B. Ventilation: Ventilate building spaces during and after application of fire protection, providing complete air exchanges in accordance with manufacturer's written instructions. Use natural means or, if they are inadequate, forced-air circulation until fire protection dries thoroughly.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Assemblies: Provide fire protection, including auxiliary materials, in accordance with requirements of each fire-resistance design and manufacturer's written instructions.
- B. Source Limitations: Obtain fire protection for each fire-resistance design from single source.
- C. Fire-Resistance Design: Indicated on Drawings, tested in accordance with ASTM E119 or UL 263; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Steel members are to be considered unrestrained unless specifically noted otherwise.
- D. Asbestos: Provide products containing no detectable asbestos.

2.2 MASTIC AND INTUMESCENT FIRE-RESISTIVE COATINGS

- A. Mastic and Intumescent Fire-Resistive Coating: Manufacturer's standard, factory-mixed, multicomponent system consisting of intumescent base coat and topcoat, and complying with indicated fire-resistance design. Rating noted on the drawings.
 - 1. Application: Designated for "conditioned interior space purpose" use by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Thickness: As required for fire-resistance design indicated, measured in accordance with requirements of fire-resistance design.
 - 3. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.
 - 4. Hardness: Not less than 65, Type D durometer, in accordance with ASTM D2240.
 - 5. Finish: As selected by Architect from manufacturer's standard finishes.
 - a. Color and Gloss: As selected by Architect from manufacturer's full range.

2.3 AUXILIARY MATERIALS

- A. Provide auxiliary materials that are compatible with mastic and intumescent fire-resistive coating and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance designs indicated.
- B. Substrate Primers: Primers approved by mastic and intumescent fire-resistive coating manufacturer and complying with required fire-resistance design by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
- C. Topcoat: Suitable for application over mastic and intumescent fire-resistive coating; of type recommended in writing by mastic and intumescent fire-resistive coating manufacturer for each fire-resistance design.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of the Work and in accordance with each fire-resistance design.
 - 1. Verify that substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, paints, and encapsulants, or other foreign substances capable of impairing bond of fire protection with substrates under conditions of normal use or fire exposure.
 - 2. Verify that objects penetrating fire protection, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
 - 3. Verify that substrates receiving fire protection are not obstructed by ducts, piping, equipment, or other suspended construction that will interfere with fire protection application.
- B. Conduct tests in accordance with mastic and intumescent fire-resistive coating manufacturer's written instructions to verify that substrates are free of substances capable of interfering with bond.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Cover other work subject to damage from fallout or overspray of fire protection materials during application.
- B. Clean substrates of substances that could impair bond of fire protection.
- C. Prime substrates where included in fire-resistance design and where recommended in writing by mastic and intumescent fire-resistive coating manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive fire protection.

D. For applications visible on completion of Project, repair substrates to remove surface imperfections that could affect uniformity of texture and thickness in finished surface of fire protection. Remove minor projections and fill voids that would telegraph through fire-resistive products after application.

3.3 APPLICATION

- A. Construct fire protection assemblies that are identical to fire-resistance design indicated and products as specified, tested, and substantiated by test reports; for thickness, primers, topcoats, finishing, and other materials and procedures affecting fire protection Work.
- B. Comply with mastic and intumescent fire-resistive coating manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and apply fire protection; as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.
- C. Coordinate application of fire protection with other construction to minimize need to cut or remove fire protection.
 - 1. Do not begin applying fire protection until clips, hangers, supports, sleeves, and other items penetrating fire protection are in place.
 - 2. Defer installing ducts, piping, and other items that would interfere with applying fire protection until application of fire protection is completed.
- D. Install auxiliary materials as required, as detailed, and in accordance with fire-resistance design and mastic and intumescent fire-resistive coating manufacturer's written instructions for conditions of exposure and intended use. For auxiliary materials, use attachment and anchorage devices of type recommended in writing by mastic and intumescent fire-resistive coating manufacturer.
- E. Spray apply fire protection to maximum extent possible. After the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by mastic and intumescent fire-resistive coating manufacturer.
- F. Extend fire protection in full thickness over entire area of each substrate to be protected.
- G. Install body of fire protection in a single course unless otherwise recommended in writing by mastic and intumescent fire-resistive coating manufacturer.
- H. Provide a uniform finish complying with description indicated for each type of fire protection material and matching finish approved for required mockups.
- I. Cure fire protection in accordance with mastic and intumescent fire-resistive coating manufacturer's written instructions.
- J. Do not install enclosing or concealing construction until after fire protection has been applied, inspected, and tested and corrections have been made to deficient applications.
- K. Finishes: Where indicated, apply fire protection to produce the following finishes:
 - 1. Rolled, Spray-Textured Finish: Even finish produced by rolling spray-applied finish with a damp paint roller to remove drippings and excessive roughness.

3.4 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
 - 1. Test and inspect as required by the MBC.
- B. Perform the tests and inspections of completed Work in successive stages. Do not proceed with application of fire protection for the next area until test results for previously completed applications of fire protection show compliance with requirements. Tested values must equal or exceed values as specified and as indicated and required for approved fire-resistance design.
- C. Fire protection will be considered defective if it does not pass tests and inspections.
 - 1. Remove and replace fire protection that does not pass tests and inspections, and retest.
 - 2. Apply additional fire protection, per manufacturer's written instructions, where test results indicate insufficient thickness, and retest.
- D. Prepare test and inspection reports.

3.5 CLEANING

A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.

3.6 PROTECTION

A. Protect fire protection, in accordance with advice of manufacturer and Installer, from damage resulting from construction operations or other causes, so fire protection is without damage or deterioration at time of Substantial Completion.

3.7 REPAIRS

- A. As installation of other construction proceeds, inspect fire protection and repair damaged areas and fire protection removed due to work of other trades.
- B. Repair fire protection damaged by other work before concealing it with other construction.
- C. Repair fire protection by reapplying it using same method as original installation or using manufacturer's recommended trowel-applied product.

END OF SECTION 078123

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SECTION 07 8400 - FIRESTOPPING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. Firestopping systems, materials, and accessories.
- B. Perimeter fire/smoke barriers.
- C. Fire-resistive joint systems.
- D. Firestopping at electrical junction boxes in fire-rated walls.
- E. Firestopping of all penetrations and interruptions to fire rated assemblies, whether indicated on Drawings or not, and other openings indicated.
- F. Construction Manager's responsibility for determining required scope of firestopping system work, and for determining applicable tested/listed systems for the entire project, and for securing jurisdictional authority approval of firestopping systems.

1.3 DEFINITIONS

- A. Firestopping: A material or combination of materials used to retain the integrity of fire- and smoke-rated construction by maintaining an effective barrier against the spread of flame, and to impede the passage of smoke, gases, and moisture through penetrations, blank openings, construction joints, and perimeter fire/smoke containment in or adjacent to fire-and smoke-rated wall, floor, ceiling, and other rated construction assemblies.
- B. Assembly: Particular arrangement of materials specific to type of construction described or detailed in referenced UL or other approved design.
- C. Barrier: Time-rated fire walls, smoke barrier walls, time-rated floor/ceiling assemblies, and structural floors.
- D. Penetration: Opening or foreign material passing through or into barrier or structural floor such that full thickness of rated materials is interrupted.
- E. Membrane Penetration: An opening made through one side of an assembly without passing completely through the assembly.

- F. Construction Gaps: Gaps between adjacent sections of walls, exterior walls, top of wall and ceiling, structural floors or roof decks, and adjacent sections of structural floors.
- G. System: Specific products and applications, classified and numbered by UL or other approved testing agency to close specific barrier penetrations.
- H. Sleeve: Metal fabrication or pipe section extending through thickness of barrier used to permanently guard penetration.
- I. VOC: Volatile organic compound(s).

1.4 REFERENCE STANDARDS

- A. ASTM C612 Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
- B. ASTM E1996 Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes.
- C. ASTM E814 Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
- D. ASTM E1399 Standard Test Method for Cyclic Movement and Measuring the Minimum and Maximum Joint Widths of Architectural Joint Systems.
- E. ASTM E1966 Standard Test Method for Fire Resistive Joint Systems.
- F. ASTM E2174 Standard Practice for On-Site Inspection of Installed Firestops.
- G. ASTM E2393 Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers.
- H. ASTM E2307 Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-story Test Apparatus.
- I. ASTM E2837 Standard Test Method for Determining the Fire Resistance of Continuity Headof-Wall Joint Systems Installed Between Rated Wall Assemblies and Nonrated Horizontal Assemblies.
- J. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
- K. ASTM G21 Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- L. IFC International Firestop Council Recommended Guidelines for Evaluating Firestop Systems Engineering Judgements.
- M. ITS (DIR) Directory of Listed Products.
- N. FCIA Firestop Contractors International Association Manual of Practice.
- O. FM (AG) FM Approval Guide.
- P. UL 1479 Standard for Fire Tests of Penetration Firestops.

- Q. UL 2079 Standard for Tests for Fire Resistance of Building Joint Systems.
- R. UL (DIR) Online Certifications Directory.
- S. UL 723 Standard for Test for Surface Burning Characteristics of Building Materials.
- T. UL 1479 Standard for Fire Tests of Through-Penetration Firestops.

1.5 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate installation of firestopping systems with affected trades and adjacent work.
- B. Sequencing: Sequence work to permit firestopping materials to be installed after adjacent and surrounding work is complete.
 - 1. Do not cover or conceal firestopping installations until Owner's inspection agency and jurisdictional authority have inspected each installation.

1.6 SUBMITTALS

- A. See Section 01 3300 Submittal Procedures, for submittal procedures.
- B. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.
- C. Product Data: Provide data on product characteristics, performance ratings, and limitations.
- D. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Jurisdictional Authority Submittal: After review and approval of specified submittals by Architect, submit to jurisdictional authority and local fire department complete product data indicating proposed product characteristics, performance characteristics, limitation criteria, and documentation of proposed firestop materials and systems for actual project conditions.
 - 1. Include manufacturer's complete installation instructions and UL Design or other approved testing agency data sheets for each proposed firestop system.
 - 2. Include complete test data forms or jurisdictional acceptance for proposed assemblies not conforming to specific UL Design numbers or other approved testing agency system designs.
 - 3. Submit certificate from authority having jurisdiction indicating approval of materials and systems to be used, with one complete copy, for information only, of the approved jurisdictional authority submittal.
- G. Installer Qualification: Submit qualification statements for installing mechanics.

1.7 QUALITY ASSURANCE

- A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
 - 1. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.
 - 2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at www.icces.org will be considered as constituting an acceptable test report.
 - 3. Submission of actual test reports is required for assemblies for which none of the above substantiation exists.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this Section with minimum three years documented experience.
- C. Installer Qualifications: Company specializing in performing the work of this Section and:
 - 1. Trained by manufacturer.
 - 2. Approved by Factory Mutual Research Corporation under FM 4991, or meeting any two of the following requirements:
 - a. Verification of minimum three years documented experience installing work of this type.
 - b. Verification of at least five satisfactorily completed projects of comparable size and type.
 - c. Licensed by local authorities having jurisdiction (AHJ).
- D. Obtain firestop systems for each type and condition of penetration from a single manufacturer; intermixing of system components for each type and condition of penetration by different manufacturers is not permitted.
- E. Listed and tested assemblies and systems must be utilized, if they exist, before alternative systems requiring Engineering Judgement (EJ) or Equivalent Fire Resistance Rated Assembly (EFRRA) will be considered. Comply with IFC and FCIA for EJ and EFRRA design and submittal requirements.

1.8 REGULATORY REQUIREMENTS

A. Comply with execution requirements of authority having jurisdiction including, if applicable, the requirement that all firestopping work be performed by a single qualified firm or subcontractor.

1.9 DELIVERY, STORAGE, AND PROTECTION

- A. Deliver materials in original unopened containers identified with manufacturer's brand designation and applicable UL label.
- B. Do not use damaged or expired materials.
1.10 FIELD CONDITIONS

- A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.
- B. Provide ventilation in areas where solvent-cured materials are being installed.

1.11 WARRANTY

A. Include agreement to repair or replace joint sealers which fail in joint adhesion, extrusion resistance, migration resistance, general durability, or apparent deterioration beyond manufacturer's printed limitations for stipulated warranty period from Date of Substantial Completion.

PART 2 PRODUCTS

2.1 NOT USED

2.2 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. 3M Fire Protection Products: www.3m.com/firestop.
 - 2. A/D Fire Protection Systems Inc.: www.adfire.com.
 - 3. GCP Applied Technologies: www.gcpat.com.
 - 4. Hilti, Inc: www.us.hilti.com/#sle.
 - 5. Nelson FireStop Products: www.nelsonfirestop.com.
 - 6. Pecora Corporation: www.pecora.com.
 - 7. RectorSeal: www.rectorseal.com.
 - 8. Specified Technologies Inc.: www.stifirestop.com/#sle.
 - 9. Tremco Sealants and Coatings: www.tremcofirestop.com.
 - 10. USG: www.usg.com.
 - 11. Comparable products by other manufacturers will be considered.

2.3 MATERIALS - GENERAL

- A. Firestopping Materials: Any materials meeting requirements specified.
 - 1. Comply with ASTM E814, UL 1479, and UL 2079 as applicable to achieve indicated fire ratings.
- B. Mold and Mildew Resistance: Provide firestoppping materials with mold and mildew resistance rating of zero(0) in accordance with ASTM G21.

C. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.

2.4 FIRESTOPPING ASSEMBLY REQUIREMENTS

- A. General: Use firestopping systems which are acceptable for those applications for which they are specifically designed. Use of other UL listed systems is Contractor's Option, subject to compliance with specified performance, regulatory, and guality assurance requirements.
 - 1. Where there is no specific tested and classified firestop system for an indicated condition, obtain from the firestopping system manufacturer an Engineering Judgement (EJ) or Equivalent Fire Resistance Rated Assembly (EFRRA) according to IFC and FCIA.
- B. Scope: Install firestopping at all locations requiring protected openings where piping, conduit, cables, sleeves, ductwork and similar items penetrate fire-resistive, fire-rated, and smoke assemblies, including but not limited to:
 - 1. Penetrations through wall, floor, and roof assemblies, including empty openings and openings containing penetrations.
 - 2. Membrane penetrations where items penetrate one side of the barrier assembly.
 - 3. Joints between rated assemblies to allow independent movement.
 - 4. Perimeter barriers between exterior wall assemblies and floor and roof assemblies.
 - 5. Joints, through-penetrations, and membrane penetrations in smoke-rated assemblies.
- C. Through Penetration Firestopping: Use system that has been tested according to ASTM E814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.
 - 1. Temperature Rise: Provide systems that have been tested to show T Rating as indicated.
 - 2. Air Leakage: Provide systems that have been tested to show L Rating as indicated.
 - 3. Watertightness: Provide systems that have been tested to show W Rating as indicated.
 - 4. Listing by FM (AG), ITS (DIR), UL (DIR), or UL (FRD) in their certification directories will be considered evidence of successful testing.
- D. Fire Rated Joint Systems: Integrity and indicated fire-resistance ratings as determined by UL 2079, ASTM E1399, or ASTM E1996 as applicable.
- E. Fire Rated Construction: Maintain barrier and structural floor fire resistance ratings including resistance to cold smoke at all penetrations, connections with other surfaces and types of construction, at separations required to permit building movement and sound or vibration absorption, and at other construction gaps.
- F. Smoke Barrier Construction: Maintain barrier and structural floor resistance to cold smoke at all penetrations, connections with other surfaces and types of construction, at separations required to permit building movement and sound or vibration absorption, and at other construction gaps.
- G. Other General Characteristics:
 - 1. Surface Burning: ASTM E84 and UL 723; flame spread less than 25, smoke developed less than 450.
 - 2. Air Leakage of Perimeter Firestopping Barriers and Penetrations: UL 2079; L-rating less than 2.0 cfm/sf or 5.0 cfm/lf as applicable to the type and location of joint.

- 3. Durability and Longevity: Permanent.
- 4. Side Effects During Installation: Non-toxic.
- 5. Side Effects Under Fire Exposure: Non-toxic.
- 6. Long Term Side Effects: None.

2.5 MATERIALS

- A. General: Comply with volatile organic compound (VOC) product requirements specified in Division 01.
- B. Putty Compound: 100 percent solids intumescent or vinyl-type formulation, free of asbestos, silicones, solvents, halogens, PCB's, and inorganic fibers; flame spread/smoke developed rating 0/0 when tested in accordance with ASTM E84; paintable, not sensitive to freezing after set.
- C. Sealant Compound: One-part intumescent, endothermic, ablative, or elastomeric acrylic waterbased calking material required by applicable UL Design; flame spread/smoke developed rating 0/0 when tested in accordance with ASTM E84.
- D. Spray-Applied Compound: Water-based, flexible coating which drys to form a flexible seal; tested in accordance with ASTM E1399, complying with wind sway and thermal category, 500 cycles at minimum 10 cycles/minute.
- E. Foam Compound: Two-part, liquid-silicone elastomer formulated to foam in place when mixed; flame spread/smoke developed rating 0/0 when tested in accordance with ASTM E84.
- F. Plastic Pipe Device: Intumescent strip material, factory or site fabricated in flexible metal collar with adjustable, screw-tightened stainless steel clamp; UL classified for use with PVC, CPVC, CCPVC, CCABS, PVDF, PP, PB, and FRPP plastic pipe.
- G. Composite Sheet: Composite, intumescent sheet, designed for firestopping large openings in conjunction with other firestopping components, capable of being cut to size in the field and fabricated to fit required penetration openings.
- H. Fire-Safing Insulation: ASTM C612, Type I; high-melt mineral fibers and resinous binders formed into blankets, density not less than 4.0 lbs/cu ft, tested for 3-hour fire containment for required depths and dimensions.
- I. Firestopping Pads: Intumescent, dielectric fire putty formed to 7 x 7 or 9.5 x 9.5 inch selfadhering pads, 2-hour fire rating listed by UL.

2.6 ACCESSORIES

- A. Provide necessary accessory materials specified in UL Design to achieve complete firestop system at each penetration. Include collars, sleeves, attachment devices, intumescent materials, and other items required.
- B. Primers, Sleeves, Forms, and Accessories: Type required for tested assembly design, and as recommended by firestopping manufacturer for specific substrate surfaces.

- C. Dam Material: Mineral fiberboard, mineral fiber matting, sheet metal, alumina silicate fire board, or other permanent material required as part of the firestopping system, or removable if not specifically required as part of the firestopping system.
- D. Retainers: Impale type clips to support mineral fiber safing blankets.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify openings are ready to receive the work of this Section.

3.2 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.
- B. Remove incompatible materials that could adversely affect bond.
- C. Install backing or damming materials required to arrest liquid material leakage.

3.3 INSTALLATION - GENERAL

- A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.
- B. Do not cover installed firestopping until inspected by Owner's Independent Testing Agency.
- C. Apply firestopping materials in sufficient thicknesses to achieve scheduled fire ratings, to uniform density and texture.
- D. Install material at openings which contain penetrating sleeves, piping, ductwork, conduit and other items requiring firestopping.
- E. Remove dam material after firestopping material has cured only if dam material is not required as part of the firestopping system; otherwise dam material to remain permanently in place.
- F. Do not cover installed firestopping until inspected by authorities having jurisdiction.
- G. Install labeling required by code.

3.4 INSTALLATION - FIRESTOPPING PADS

A. Install firestopping pads on back side of electrical junction boxes in fire-rated walls where boxes are located in same stud space on opposite sides of same wall, and elsewhere required by jurisdictional authority and local fire department.

3.5 THROUGH-PENETRATION FIRESTOPPING IDENTIFICATION

- A. Identify firestopping systems with pre-printed metal or plastic labels. Attach label permanently to surfaces immediately adjacent to and within 6 inches of edge of firestop installation so that label will be visible to anyone seeking to remove penetrating items or firestop system.
 - 1. Metal Labels: Use mechanical fasteners.
 - 2. Plastic Labels: Use self-adhering type with adhesive capable of permanently bonding lebel to substrate and, in combination with label material, will result in partial destruction of label if removal is attempted.
- B. Include following information on each label:
 - 1. The words "Warning Through-Penetration Firestop System Do Not Disturb. Notify Building Management of Any Damage."
 - 2. Installing contractor's name, address, and phone number.
 - 3. Firestop system designation, including applicable testing and inspection agency.
 - 4. Date of installation.
 - 5. Firestop system manufacturer's name.
 - 6. Installer's name.

3.6 FIELD QUALITY CONTROL

- A. Perform field inspection and testing in accordance with Section 01 4000.
- B. Independent Testing Agency: Inspection agency employed and paid by Owner, will examine penetration firestopping in accordance with ASTM E2174, and ASTM E2393.
- C. Repair or replace penetration firestopping and joints at locations where inspection results indicate firestopping or joints do not meet specified requirements.

3.7 CLEANING

A. Clean adjacent surfaces of firestopping materials.

3.8 PROTECTION

A. Protect adjacent surfaces from damage by material installation.

END OF SECTION 07 8400

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SECTION 07 9200 - JOINT SEALANTS

PART 1 GENERAL

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

1.2 SECTION INCLUDES

- A. Nonsag gunnable joint sealants.
- B. Self-leveling pourable joint sealants.
- C. Joint backings and accessories.
- D. Owner-provided field quality control.

1.3 RELATED REQUIREMENTS

- A. Section 07 8400 Firestopping: Firestopping sealants.
- B. Section 09 2116 Gypsum Board Assemblies: Sealing acoustical and sound-rated walls and ceilings.

1.4 REFERENCE STANDARDS

- A. ASTM C794 Standard Test Method for Adhesion-In-Peel of Elastomeric Joint Sealants.
- B. ASTM C1087 Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems.
- C. ASTM C1193 Standard Guide for Use of Joint Sealants.
- D. ASTM C1248 Standard Test Method for Staining of Porous Substrate by Joint Sealants.
- E. ASTM C1330 Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants.
- F. ASTM C1521 Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints.

1.5 SUBMITTALS

- A. See Section 01 3300 Submittal Procedures, for submittal procedures.
- B. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes the following.
 - 1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
 - 2. List of backing materials approved for use with the specific product.
 - 3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
 - 4. Substrates the product should not be used on.
 - 5. Substrates for which use of primer is required.
 - 6. Substrates for which laboratory adhesion and/or compatibility testing is required.
 - 7. Installation instructions, including precautions, limitations, and recommended backing materials and tools.
 - 8. Sample product warranty.
 - 9. Certification by manufacturer indicating that product complies with specification requirements.
- C. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.
- D. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.
- E. Samples for Verification: Where custom sealant color is specified, obtain directions from Architect and submit at least two physical samples for verification of color of each required sealant.
- F. Samples for Verification: Submit selected sealant sample, minimum 6" with adjacent materials.
- G. Joint-Sealant Schedule: Include the following information:
 - 1. Joint-sealant application, joint location, and designation.
 - 2. Joint-sealant manufacturer and product name.
 - 3. Joint-sealant formulation.
 - 4. Joint-sealant color.
- H. Preconstruction Laboratory Test Reports: Submit at least four weeks prior to start of installation.
- I. Preinstallation Field Adhesion Test Plan: Submit at least two weeks prior to start of installation.
- J. Field Quality Control Plan: Submit at least two weeks prior to start of installation.

- K. Preinstallation Field Adhesion Test Reports: Submit filled out Preinstallation Field Adhesion Test Reports log within 10 days after completion of tests; include bagged test samples and photographic records.
- L. Field Quality Control Log: Submit filled out log for each length or instance of sealant installed, within 10 days after completion of inspections/tests; include bagged test samples and photographic records, if any.

1.6 NOT USED

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section and with at least three years of documented experience.
- C. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.
- D. Preconstruction Laboratory Testing: Arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories.
 - 1. Adhesion Testing: In accordance with ASTM C794.
 - 2. Compatibility Testing: In accordance with ASTM C1087.
 - 3. Stain Testing: In accordance with ASTM C1248; required only for masonry substrates.
 - 4. Allow sufficient time for testing to avoid delaying the work.
 - 5. Deliver to manufacturer sufficient samples for testing.
 - 6. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.
 - 7. Testing is not required if sealant manufacturer provides data showing previous testing, not older than 24 months, that shows satisfactory adhesion, lack of staining, and compatibility.
- E. Preinstallation Field Adhesion Test Plan: Include destructive field adhesion testing of one sample of each combination of sealant type and substrate, except interior acrylic latex sealants, and include the following for each tested sample.
 - 1. Identification of testing agency.
 - 2. Name(s) of sealant manufacturers' field representatives who will be observing
 - 3. Preinstallation Field Adhesion Test Log Form: Include the following data fields, with known information filled out.
 - a. Substrate; if more than one type of substrate is involved in a single joint, provide two entries on form, for testing each sealant substrate side separately.
 - b. Test date.
 - c. Location on project.
 - d. Sealant used.

- e. Stated movement capability of sealant.
- f. Test method used.
- g. Date of installation of field sample to be tested.
- h. Date of test.
- i. Copy of test method documents.
- j. Age of sealant upon date of testing.
- k. Test results, modeled after the sample form in the test method document.
- I. Indicate use of photographic record of test.
- F. Owner will employ an independent testing agency to perform the field quality control inspection and testing as referenced in PART 3 of this section and as follows, to prepare and submit the field quality control plan and log, and to provide recommendations of remedies in the case of failure.
 - 1. Contractor shall cooperate with testing agency and repair failures discovered and destructive test location damage.
- G. Field Quality Control Plan:
 - 1. Visual inspection of entire length of sealant joints.
 - 2. Non-destructive field adhesion testing of sealant joints, except interior acrylic latex sealants.
 - a. For each different sealant and substrate combination, allow for one test every 12 inches in the first 10 linear feet of joint and one test every 24 inches thereafter.
 - b. If any failures occur in the first 10 linear feet, continue testing at 12 inch intervals at no extra cost to Owner.
 - 3. Destructive field adhesion testing of sealant joints, except interior sealant joints.
 - a. For each different sealant and substrate combination, allow for one test every 100 feet in the first 1000 linear feet, and one test per 1000 linear feet thereafter, or once per floor on each elevation.
 - b. If any failures occur in the first 1000 linear feet, continue testing at frequency of one test per 500 linear feet at no extra cost to Owner.
 - 4. Field Quality Control Log Form: Show same data fields as on Preinstallation Field Adhesion Test Log, with known information filled out and lines for multiple tests per sealant/substrate combinations; include visual inspection and specified field testing; allow for possibility that more tests than minimum specified may be necessary.
- H. Field Adhesion Test Procedures:
 - 1. Allow sealants to fully cure as recommended by manufacturer before testing.
 - 2. Have a copy of the test method document available during tests.
 - 3. Take photographs or make video records of each test, with joint identification provided in the photos/videos; for example, provide small erasable whiteboard positioned next to joint.
 - 4. Record the type of failure that occurred, other information required by test method, and the information required on the Field Quality Control Log.
 - 5. When performing destructive tests, also inspect the opened joint for proper installation characteristics recommended by manufacturer, and report any deficiencies.

- 6. Deliver the samples removed during destructive tests in separate sealed plastic bags, identified with project, location, test date, and test results, to Owner.
- 7. If any combination of sealant type and substrate does not show evidence of minimum adhesion or shows cohesion failure before minimum adhesion, report results to Architect.
- I. Non-Destructive Field Adhesion Test: Test for adhesion in accordance with ASTM C1521, using Nondestructive Spot Method.
 - 1. Record results on Field Quality Control Log.
 - 2. Repair failed portions of joints.
- J. Destructive Field Adhesion Test: Test for adhesion in accordance with ASTM C1521, using Destructive Tail Procedure.
 - 1. Sample: At least 18 inch long.
 - 2. Minimum Elongation Without Adhesive Failure: Consider the tail at rest, not under any elongation stress; multiply the stated movement capability of the sealant in percent by two; then multiply 1 inch by that percentage; if adhesion failure occurs before the "1 inch mark" is that distance from the substrate, the test has failed.
 - If either adhesive or cohesive failure occurs prior to minimum elongation, take necessary measures to correct conditions and re-test; record each modification to products or installation procedures.
 - 4. Record results on Field Quality Control Log.
 - 5. Repair failed portions of joints.
- K. Field Adhesion Tests of Joints: Test for adhesion using most appropriate method in accordance with ASTM C1521, or other applicable method as recommended by manufacturer.

1.8 WARRANTY

- A. See Section 01 7800 Closeout Submittals, for additional warranty requirements.
- B. Correct defective work within a five year period after Date of Substantial Completion.
- C. Warranty: Include coverage for installed sealants and accessories that fail to achieve watertight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.1 JOINT SEALANT APPLICATIONS

- A. Scope:
 - 1. Exterior Joints: Seal open joints, whether or not the joint is indicated on drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to, the following items.
 - a. Wall expansion and control joints.
 - b. Joints between door, window, and other frames and adjacent construction.
 - c. Joints between different exposed materials.

- d. Openings below ledge angles in masonry.
- e. Other joints indicated below.
- 2. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
 - a. Joints between door, window, and other frames and adjacent construction.
 - b. In sound-rated wall and ceiling assemblies, gaps at electrical outlets, wiring devices, piping, and other openings; between wall/ceiling and other construction; and other flanking sound paths.
 - 1) Exception: Through-penetrations in sound-rated assemblies that are also fire-rated assemblies.
 - c. Other joints indicated below.
- 3. Do not seal the following types of joints.
 - a. Intentional weepholes in masonry.
 - b. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.
 - c. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
 - d. Joints where installation of sealant is specified in another section.
 - e. Joints between suspended panel ceilings/grid and walls.

2.2 JOINT SEALANTS - GENERAL

- A. Sealants and Primers: Provide products with levels of volatile organic compound (VOC) content as indicated in Division 01.
- B. Colors for concealed locations: Manufacturer's Standard.
- C. Colors for exposed locations: As selected by Architect from Manufacturer's Standard Range.

2.3 ACCESSORIES

- A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
 - 1. Type for Joints Not Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type O Open Cell Polyurethane.
 - 2. Type for Joints Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type B Bi-Cellular Polyethylene.
 - 3. Open Cell: 40 to 50 percent larger in diameter than joint width.
 - 4. Closed Cell and Bi-Cellular: 25 to 33 percent larger in diameter than joint width.
- B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.

- C. Masking Tape: Self-adhesive, nonabsorbent, non-staining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.
- D. Joint Cleaner: Non-corrosive and non-staining type, type recommended by sealant manufacturer; compatible with joint forming materials.
- E. Primers: Type recommended by sealant manufacturer to suit application; non-staining.
- F. Strip Seal: Type recommended by sealant manfucaturer to suit application. BOD: Tremco Willseal 600(S).

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that joints are ready to receive work.
- B. Verify that backing materials are compatible with sealants.
- C. Verify that backer rods are of the correct size.
- D. Preinstallation Adhesion Testing: Install a sample for each test location indicated in the test plan.
 - 1. Test each sample as specified in PART 1 under QUALITY ASSURANCE article.
 - 2. Notify Architect of date and time that tests will be performed, at least 7 days in advance.
 - 3. Arrange for sealant manufacturer's technical representative to be present during tests.
 - 4. Record each test on Preinstallation Adhesion Test Log as indicated.
 - 5. If any sample fails, review products and installation procedures, consult manufacturer, or take whatever other measures are necessary to ensure adhesion; re-test in a different location; if unable to obtain satisfactory adhesion, report to Architect.
 - 6. After completion of tests, remove remaining sample material and prepare joint for new sealant installation.

3.2 PREPARATION

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.
- E. Concrete Floor Joints That Will Be Exposed in Completed Work: Test joint filler in inconspicuous area to verify that it does not stain or discolor slab.

3.3 INSTALLATION

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform installation in accordance with ASTM C1193.
- C. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.
- D. Install bond breaker backing tape where backer rod cannot be used.
- E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
- F. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.
- G. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

3.4 FIELD QUALITY CONTROL

- A. Perform field quality control inspection/testing as specified in PART 1 under QUALITY ASSURANCE article.
- B. Non-Destructive Adhesion Testing: If there are any failures in first 100 linear feet, notify Architect immediately.
- C. Destructive Adhesion Testing: If there are any failures in first 1000 linear feet, notify Architect immediately.
- D. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.
- E. Repair destructive test location damage immediately after evaluation and recording of results.

3.5 POST-OCCUPANCY

A. Post-Occupancy Inspection: Perform visual inspection of entire length of project sealant joints at a time that joints have opened to their greatest width; i.e. at low temperature in thermal cycle. Report failures immediately and repair.

END OF SECTION 07 9200

JOINT SEALANT USAGE SCHEDULE

Joint Location		Acceptable Chemistry Class						Class	Color			
	Acoustical (A)	Butyl (B)	Hybrid (H)	Latex (L)	MR Silicone (MR)	Polysulfide (P)	Silicone (S)	STPE (PE)	STPU (PU)	Urethane (U)	(minimum)	
Exterior Vertical & Horizontal Non-Traffic Joints												
Joints between metal flashings, concealed lapped joints		В									71⁄2	Standard
Joints between metal flashings, exposed, unfinished							S				50	Standard
Setting bed for flashing receivers		В									71⁄2	Standard
Setting bed for metal flashing		В									71⁄2	Standard
Interior Horizontal Traffic Joints												
Isolation & contraction joints in concrete slabs, concealed or covered with other flooring	None required								N/A	N/A		
Isolation & contraction joints in concrete slabs, exposed								PE	PU	U	25	Standard
Interior Vertical & Horizontal Non-Traffic Joints												•
Control & expansion joints in cast-in-place concrete	T		1	1	1	1	1			U	25	Standard
Joints subject to water immersion						Р				U	50	Custom
Control & expansion joints in unit masonry, concrete, painted										U	25	Standard
Control & expansion joints in unit masonry, concrete, unfinished										U	25	Standard
Perimeter joints around frames, metal, field painted				L							71⁄2	Standard
Perimeter joints around frames, metal, prefinished							S				50	Custom
Control joints in gypsum board ceilings & partitions				L							71⁄2	Standard
Penetrations and joints in fire-resistance-rated construction	Firestopping per 07 84 00 - movement capability to suit joint movement potential										Standard	
Control joints in acoustic walls & partitions including gaps at electrical outlets, penetrations, and other openings	А										5	Standard
Setting bed for thresholds & sills		B									71/2	Standard

Colors of Exposed Joint Sealants:

Standard Color: As selected by Architect from manufacturer's full range for this characteristic.

Custom Color: Provide a custom color matching Architect's sample that complies with requirements.

END OF SCHEDULE 07 92 00.13

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					MOVEMENT	EXPOSURE			SUBSTRATE			
MANUFACTURER	PRODUCT	CHEMISTRY	TYPE	GRADE	CLASS	Т	NT	Ι	М	G	Α	0
USG	Firecode Smoke-Sound Sealant	Acoustical	S	NS	25		NT					
USG	SHEETROCK Acoustical Sealant	Acoustical	S	NS	25		NT					
Pecora Corp.	AC-20 FTR Acoustical and Insulation Sealant	Acoustical	S	NS	71⁄2		NT					
Pecora Corp.	AIS-919 Acoustical and Insulation Sealant	Acoustical	S	NS	71⁄2		NT					
Specified Technologies	SpecSeal Smoke 'N' Sound Sealant	Acoustical	S	NS	N/A		NT					
Tremco	Tremco Acoustical Sealant	Acoustical	S	NS	N/A		NT					
Pecora Corp.	BC-158 Butyl Rubber Sealant	Butyl	S	NS	71⁄2		NT					
Tremco	Tremco Butyl Sealant	Butyl	S	NS	71⁄2		NT					
Pecora Corp.	BA-98	Butyl	S	NS	5		NT					
Pecora Corp.	AVW-920 High Performance Acrylic Latex	Latex	S	NS	25		NT		Μ	G	А	0
Pecora Corp.	Tilt-Seal High Performance Acrylic Latex	Latex	S	NS	25		NT		Μ	G	А	0
Tremco	Tremflex 834	Latex	S	NS	12½		NT					
Pecora Corp.	AC-20+Silicone	Latex	S	NS	71⁄2		NT					
Meadows, W. R.	Deck-O-Seal 150	Polysulfide	М	Р	25	Т				G	Α	0
Meadows, W. R.	Deck-O-Seal Gun Grade	Polysulfide	М	NS	25	Т	NT		Μ	G	Α	0
Pecora Corp.	Synthacalk GC-2+	Polysulfide	М	NS	25	Т	NT	Ι	М	G	Α	
Pecora Corp.	890 FTS	Silicone	S	NS	100/50		NT		М	G	А	0
Dow Corning Corp.	DOWSIL 790 Silicone Building Sealant	Silicone	S	NS	100/50	Т	NT		М	G	Α	0
Pecora Corp.	890 FTS/TXTR	Silicone	S	NS	100/50		NT		М	G	Α	0
Pecora Corp.	890 NST	Silicone	S	NS	100/50	<u> </u>	NT		M	G	A	0
Tremco	Spectrem 1	Silicone	S	NS	100/50		NT		M	G	A	0
Dow Corning Corp.	DOWSIL 756 SMS Silicone Building Sealant	Silicone	S	NS	50		NT		М	G	Α	0
Dow Corning Corp.	DOWSIL 791 Silicone Weatherproofing Sealant	Silicone	S	NS	50		NT		М	G	Α	0
Dow Corning Corp.	DOWSIL 795 Silicone Building Sealant	Silicone	S	NS	50		NT			G	Α	0
Pecora Corp.	895 NST	Silicone	S	NS	50		NT		М	G	Α	0
Pecora Corp.	864 NST Silicone Sealant	Silicone	S	NS	50		NT		Μ	G	Α	0
Sika Corp. U.S.	Sikasil WS-295	Silicone	S	NS	50		NT		М	G	Α	0
Tremco	Spectrem 2	Silicone	S	NS	50		NT		М	G	Α	0
Dow Corning Corp.	DOWSIL Contractors Weatherproofing Sealant	Silicone	S	NS	35		NT		М		Α	0
Dow Corning Corp.	DOWSIL 758 Silicone Weather Barrier Sealant	Silicone	S	NS	25		NT			G	Α	0
Pecora Corp.	AVB Silicone Sealant	Silicone	S	NS	25		NT		М	G	Α	0
BASF Const. Chemicals	MasterSeal NP 150	STPE	S	NS	100/50		NT		М		А	0
Pecora Corp.	DynaTrol I-XL Hybrid	STPU	S	NS	50		NT	Ι	М	G	А	0
Pecora Corp.	Urexpan NR-201	STPU	S	Р	25	Т	NT		М		Α	0
Sika Corp. U.S.	Sikaflex 15 LM	Urethane	S	NS	100/50	Т	NT		М	G	Α	0
BASF Const. Chemicals	MasterSeal NP 100	Urethane	S	NS	50		NT		Μ		Α	0
Pecora Corp.	Dynatrol II	Urethane	М	NS	50		NT		М	G	Α	0
Tremco	Dymonic 100	Urethane	S	NS	50	Т	NT	Ι	М		Α	0
Bostik	Bostik 915	Urethane	S	NS	35		NT		Μ		Α	
Bostik	Bostik 915FS	Urethane	S	NS	35		NT		М		Α	
Bostik	915FS	Urethane	S	NS	35		NT		М	G	А	
Sherwin-Williams	Loxon S1 Smooth Polyurethane Sealant	Urethane	S	NS	35	Т	NT		М		А	0
Sika Corp. U.S.	Sikaflex 1a	Urethane	S	NS	35	Т	NT	Ι	М	G	Α	0
Bostik	Bostik 505	Urethane	М	NS	25	т			М	G	А	
Bostik	Chem-Calk 915	Urethane	S	NS	25		NT		М		А	
Bostik	Chem-Calk 505	Urethane	М	NS	25	т	NT		М	G	А	
Bostik	Chem-Calk 915	Urethane	S	NS	25		NT		М		А	
Pecora Corp.	NR-201	Urethane	S	Р	25	Т	NT		М		А	0
Pecora Corp.	Dynatrol I-XL	Urethane	S	NS	25	Т	NT	I	М	G	А	0

JOINT SEALANT PRODUCTS SCHEDULE

			-		USE RELATED TO						
				MOVEMENT	EXPOSURE			SUBSTRATE			Έ
PRODUCT	CHEMISTRY	TYPE	GRADE	CLASS	Т	NT	I	М	G	Α	0
Type: S = Single Component; M = Multiple Component											
Grade: NS = Non-Sag; P = Pourable or Self-Leveling											
Class: Numerical values represent percent elongation/compression capability; "Min" implies "minimal"											
= Non-Traffic; I = Immersion Service											
ss; A = Aluminum; O = Other											
	PRODUCT ent; M = Multiple Component Pourable or Self-Leveling epresent percent elongation/compression capability; "N = Non-Traffic; I = Immersion Service ss; A = Aluminum; O = Other	PRODUCT CHEMISTRY ent; M = Multiple Component	PRODUCT CHEMISTRY TYPE ent; M = Multiple Component	PRODUCT CHEMISTRY TYPE GRADE ent; M = Multiple Component	PRODUCT CHEMISTRY TYPE GRADE CLASS ent; M = Multiple Component class class class expresent percent elongation/compression capability; "Min" implies "minimal" class class = Non-Traffic; I = Immersion Service ss; A = Aluminum; O = Other class	PRODUCT CHEMISTRY TYPE GRADE EXF ent; M = Multiple Component T T T ent; M = Multiple Component EXF T T epresent percent elongation/compression capability; "Min" implies "minimal" EXF T = Non-Traffic; I = Immersion Service S; A = Aluminum; O = Other EXF	PRODUCT CHEMISTRY TYPE GRADE CLASS T NT PRODUCT CHEMISTRY TYPE GRADE T NT ent; M = Multiple Component Pourable or Self-Leveling perferent elongation/compression capability; "Min" implies "minimal" Non-Traffic; I = Immersion Service ss; A = Aluminum; O = Other	PRODUCT CHEMISTRY TYPE GRADE CLASS T NT I Provement Pourable or Self-Leveling Provement elongation/compression capability; "Min" implies "minimal" Non-Traffic; I = Immersion Service SS; A = Aluminum; O = Other	USE RELATI MOVEMENT EXPOSURE SU PRODUCT CHEMISTRY TYPE GRADE T NT I M ent; M = Multiple Component	USE RELATED T MOVEMENT EXPOSURE SUBST PRODUCT CHEMISTRY TYPE GRADE CLASS T NT I M G ent; M = Multiple Component epresent percent elongation/compression capability; "Min" implies "minimal" Non-Traffic; I = Immersion Service ss; A = Aluminum; O = Other	USE RELATED TO MOVEMENT EXPOSURE SUBSTRAT PRODUCT CHEMISTRY TYPE GRADE CLASS T NT I M G A ent; M = Multiple Component epresent percent elongation/compression capability; "Min" implies "minimal" Non-Traffic; I = Immersion Service ss; A = Aluminum; O = Other

END OF SCHEDULE 07 92 00.14

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SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes:
 - 1. Interior standard steel doors and frames.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include the following:
 - 1. Elevations of each door type.
 - 2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
 - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
- C. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.4 QUALITY ASSURANCE

- A. Fire-Rated Door Inspector Qualifications: Inspector for field quality control inspections of firerated door assemblies shall meet the qualifications set forth in NFPA 80, Section 5.2.3.1 and the following:
 - 1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.
- B. Egress Door Inspector Qualifications: Inspector for field quality control inspections of egress door assemblies shall meet the qualifications set forth in NFPA 101, Section 7.2.1.15.4 and the following:

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
 - 1. Apex Industries, Inc.
 - 2. Ceco Door Products; an Assa Abloy Group company
 - 3. Curries Company; an Assa Abloy Group company
 - 4. Custom Metal Products
 - 5. LaForce, Inc
 - 6. MPI Group, LLC
 - 7. Pioneer Industries
 - 8. Premier Products, Inc
 - 9. Security Metal Products; an Assa Abloy Group company
 - 10. Steelcraft; an Allegion brand

2.2 PERFORMANCE REQUIREMENTS

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

2.3 INTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Standard-Duty Doors and Frames: ANSI/SDI A250.8, Level 1; ANSI/SDI A250.4, Level C. [At locations indicated in the Door and Frame Schedule] <Insert locations>.
 - 1. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches (44.5 mm).
 - c. Face: Prime-coat finish steel sheet, minimum thickness of 0.032 inch (0.8 mm).
 - d. Edge Construction: Model 1, Full Flush.
 - e. Fire-Rated Core: Manufacturer's standard laminated mineral board core for firerated doors.
 - 2. Frames:
 - a. Materials: Prime finish steel sheet, minimum thickness of 0.042 inch (1.0 mm).
 - b. Construction: Face welded.

2.4 FRAME ANCHORS

- A. Jamb Anchors:
 - 1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
 - 2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches (610 mm) of frame height above 7 feet (2.1 m).
 - 3. Postinstalled Expansion Anchor: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.
- B. Floor Anchors: Provide floor anchors for each jamb.
- C. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.

2.5 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A153/A153M.
- D. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.

2.6 FABRICATION

- A. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.
 - 1. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
- B. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to ANSI/SDI A250.6, the Door Hardware Schedule, and templates.
 - 1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
 - 2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.

2.7 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
 - 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.
- B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

- A. Hollow-Metal Frames:
 - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
 - a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
 - b. Install frames with removable stops located on secure side of opening.
 - 2. Fire-Rated Openings: Install frames according to NFPA 80.
 - 3. Floor Anchors: Secure with postinstalled expansion anchors.
 - 4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.
- B. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below..
 - 1. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
 - 2. Smoke-Control Doors: Install doors according to NFPA 105.
- C. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollowmetal manufacturer's written instructions.

3.3 FIELD QUALITY CONTROL

- A. Inspections:
 - 1. Fire-Rated Door Inspections: Inspect each fire-rated door according to NFPA 80, Section 5.2.
- B. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- C. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.
- D. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80 and NFPA 101.

3.4 REPAIR

- A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- B. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081113

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SECTION 087100 - DOOR HARDWARE

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 commercial door hardware for the following:
 - 1. Swinging doors.
- B. Related Sections:
 - 1. Division 08 "Hollow Metal Doors and Frames" for door silencers provided as part of hollow-metal frames.
- C. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
 - 1. ANSI A117.1 Accessible and Usable Buildings and Facilities.
 - 2. ICC/IBC International Building Code.
 - 3. NFPA 70 National Electrical Code.
 - 4. NFPA 80 Fire Doors and Windows.
 - 5. NFPA 101 Life Safety Code.
 - 6. NFPA 105 Installation of Smoke Door Assemblies.
 - 7. Michigan Building Codes, Local Amendments.
- D. Standards: All hardware specified herein shall comply with the following industry standards:
 - 1. ANSI/BHMA Certified Product Standards A156 Series
 - 2. UL10C Positive Pressure Fire Tests of Door Assemblies

1.3 ACTION SUBMITTALS

- A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.
- B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures

and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

- 1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
- 2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
- 3. Content: Include the following information:
 - a. Type, style, function, size, label, hand, and finish of each door hardware item.
 - b. Manufacturer of each item.
 - c. Fastenings and other pertinent information.
 - d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
 - e. Explanation of abbreviations, symbols, and codes contained in schedule.
 - f. Mounting locations for door hardware.
 - g. Door and frame sizes and materials.
 - h. Warranty information for each product.
- 4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.
- C. Shop Drawings: Details of electrified access control hardware indicating the following:
 - 1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:
 - a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
 - b. Complete (risers, point-to-point) access control system block wiring diagrams.
 - c. Wiring instructions for each electronic component scheduled herein.
- D. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent

cylinders/cores.

E. INFORMATIONAL SUBMITTALS

1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of door hardware to include in maintenance manuals. Include final hardware and keying schedule.

1.5 QUALITY ASSURANCE

- A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.
- B. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- C. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.
- D. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.
 - 1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
 - 2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.
- E. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.
- F. Keying Conference: Conduct conference and Project Site with Owner and Owner representatives to incorporate the following criteria into the final keying schedule document:

- 1. Function of building, purpose of each area and degree of security required.
- 2. Plans for existing and future key system expansion.
- 3. Requirements for key control storage and software.
- 4. Installation of permanent keys, cylinder cores and software.
- 5. Address and requirements for delivery of keys
- G. Preinstallation Conference: Conduct coordination conference at Project Site with attendance by representatives of Owner, Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.
 - 1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electrome-chanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
 - 2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
 - 3. Review sequence of operation narratives for each unique access controlled opening.
 - 4. Review and finalize construction schedule and verify availability of materials.
 - 5. Review the required inspecting, testing, commissioning, and demonstration procedures
- H. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.
- B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.

1.9 WARRANTY

- A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance

by the Owner. Failures include, but are not limited to, the following:

- 1. Structural failures including excessive deflection, cracking, or breakage.
- 2. Faulty operation of the hardware.
- 3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
- 4. Electrical component defects and failures within the systems operation.
- C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.
- D. Special Warranty Periods:
 - 1. Ten years for mortise locks and latches.
 - 2. Five years for exit hardware.
 - 3. Twenty five years for manual surface door closer bodies.
 - 4. Five years for motorized electric latch retraction exit devices.
 - 5. Two years for electromechanical door hardware.

1.10 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.
- B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:
- C. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.
- D. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 HANGING DEVICES

- A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles as specified in the Door Hardware Sets.
 - 1. Quantity: Provide the following hinge quantity, unless otherwise indicated:
 - a. Two Hinges: For doors with heights up to 60 inches.
 - b. Three Hinges: For doors with heights 61 to 90 inches.
 - c. Four Hinges: For doors with heights 91 to 120 inches.
 - d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.
 - 2. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
 - a. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.
 - 3. Hinge Options: Comply with the following where indicated in the Hardware Sets or on Drawings:
 - a. Non-removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the all out-swinging lockable doors.
 - 4. Acceptable Manufacturers:
 - a. Bommer Industries (BO).
 - b. McKinney Products (MK).
 - c. Stanley Hardware (ST).
 - d. Hager Companies (HA)
- 2.3 CYLINDERS AND KEYING
 - A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.
 - B. Manufacturers:
 - 1. Best (BE)
 - 2. No substitution
 - C. Cylinders: Original manufacturer cylinders complying with the following:
 - 1. Mortise Type: Threaded cylinders with rings and cams to suit hardware application.
 - 2. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
 - 3. Bored-Lock Type: Cylinders with tailpieces to suit locks.
 - 4. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.

- 5. Keyway: Match Facility Standard.
- D. Permanent Cores: Manufacturer's standard; finish face to match lockset; complying with the following:
 - 1. Interchangeable Cores: Core insert, removable by use of a special key; usable with other manufacturers' cylinders.
- E. Keying System: Each type of lock and cylinders to be factory keyed.
 - 1. Conduct specified "Keying Conference" to define and document keying system instructions and requirements.
 - 2. Existing System: Key locks to Owner's existing system.
- F. Construction Keying: Provide temporary keyed construction cores.

2.4 MECHANICAL LOCKS AND LATCHING DEVICES

- A. Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 certified. Locksets are to be manufactured with a corrosion resistant steel case and be field-reversible for handing without disassembly of the lock body.
 - 1. Acceptable Manufacturers:
 - a. Corbin Russwin Hardware (RU) ML2000 Series.
 - b. Sargent Manufacturing (SA) 8200 Series.
 - c. Schlage (SCH) L9000 Series.

2.5 DOOR CLOSERS

- A. All door closers specified herein shall meet or exceed the following criteria:
 - 1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers including installation and adjusting information on inside of cover.
 - 2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
 - 3. Cycle Testing: Provide closers which have surpassed 15 million cycles in a test witnessed and verified by UL.
 - 4. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the physically handicapped, provide units complying with ANSI ICC/A117.1.

5. Closer Arms: Provide heavy duty, forged steel closer arms unless oth-DOOR HARDWARE erwise indicated in Hardware Sets.

- 6. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
- 7. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.
- B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.
 - 1. Acceptable Manufacturers:
 - a. Corbin Russwin Hardware (RU) DC6000 Series.
 - b. LCN Closers (LC) 4040 Series.
 - c. Sargent Manufacturing (SA) 351 Series.
 - d. Norton Door Controls (NO) 7500 Series.

2.6 ARCHITECTURAL TRIM

- A. Door Protective Trim
 - 1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
 - 2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1" LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
 - 3. Where plates are applied to fire rated doors with the top of the plate more than 16" above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer's catalog and template book for specific requirements for size and applications.
 - 4. Protection Plates: ANSI/BHMA A156.6 certified protection plates (kick, armor, or mop), fabricated from the following:
 - a. Stainless Steel: 300 grade, 050-inch thick.
 - 5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.

- 6. Acceptable Manufacturers:
 - a. Hiawatha, Inc. (HI).
 - b. Rockwood Products, ASSA ABLOY Architectural Door Accessories (RO).
 - c. Ives (IV).
 - d. Hager Companies. (HA)

2.7 DOOR STOPS AND HOLDERS

- A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.
- B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.
 - 1. Acceptable Manufacturers:
 - a. Ives Allegion (IV)
 - b. Hiawatha, Inc. (HI).
 - c. Rockwood Manufacturing (RO).
 - d. Trimco (TC).
- C. Overhead Door Stops and Holders: ANSI/BHMA A156.6, Grade 1 certified overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.
 - 1. Manufacturers:
 - a. Glynn Johnson (GJ).
 - b. Rixson Door Controls (RF).

2.8 DOOR GASKETING

- A. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.
- B. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NPFA 252, Standard Methods of Fire Tests of Door Assemblies. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.
- C. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

- D. Acceptable Manufacturers:
 - 1. National Guard Products (NG).
 - 2. Pemko Manufacturing (PE).
 - 3. Reese Enterprises, Inc. (RE).

2.9 FABRICATION

A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.10 FINISHES

- A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.
 - 1. BHMA 619: Satin nickel plated, clear coated, over brass or bronze base metal.
 - 2. BHMA 626: Satin chromium plated over nickel, over brass or bronze base metal.
 - 3. BHMA 627: Satin aluminum, clear coated, over aluminum base metal.
 - 4. BHMA 628: Satin aluminum, clear anodized, over aluminum base metal.
 - 5. BHMA 630: Satin stainless steel, over stainless-steel base metal.
 - 6. BHMA 652: Satin chromium plated over nickel, over steel base metal.
 - 7. BHMA 718: Satin aluminum, uncoated; aluminum base metal.
- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.

3.3 INSTALLATION

- A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
 - 1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.
- B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
 - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
 - 2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
 - 3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
 - 4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.
- C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
- D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."
- E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

A. Field Inspection: Supplier will perform a final inspection of installed door hardware and state in report whether work complies with or deviates from requirements, including whether door hardware is properly installed, operating and adjusted.

- B. Fire Door Assembly Inspection: Reference Division 01 Sections "Closeout Procedures" and "Cash Allowances" for testing and inspection allowances, including cost of engaging testing agencies, performing on-site inspections, and required documentation reporting.
 - 1. Allowance to perform the inspection and provide report documentation for an initial Fire Door Assembly Inspection upon completion of final hardware installation. A qualified fire door assembly (FDAI) inspector to certify swinging fire door openings are installed in accordance and NFPA 80 Standard for Fire Doors and Other Opening Protectives paragraph 5.2.4, regulatory compliance agencies, and local Authorities Having Jurisdiction (AHJ).

3.5 ADJUSTING

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

3.6 CLEANING AND PROTECTION

- A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.
- B. Clean adjacent surfaces soiled by door hardware installation.
- C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SETS

- A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.
- B. The supplier is responsible for handing and sizing all products and providing the correct option for the appropriate door type and material where more than one is presented in the hardware sets. Quantities listed are for each pair of doors, or for each single door.
- C. Manufacturer's Abbreviations:
 - 1. BE - Best
 - GJ Glynn-Johnson 2.

3.9

IV LC - L MK - Mc, MR - Marka, OT - Other 8. PE - Pemko 9. RF - Rixson 10. RO - Rockwood 11. RU - Corbin Russwin 12. SA - Sargent 13. SU - Securitron 14. VD - Von Duprin HARDWARE SCF *o Ef Hardware Set 1.0 – Door to Elevator Machine Room

3	Hinge	TA2714 / TA4714	US26	MK
1	Storage Lock	ML2057 NSA LC	626	RU
1	Mort. Cylinder	Match Owner's existing BEST	626	BE
		key system		
1	Surface Closer	DC6210 A4	689	RU
1	Kick Plate	K1050 10" high 4BE CSK	US32D	RO
1	Smoke / Sound Seal	S88D – head and jambs		ΡE

Notes: Function: Latch bolt operated by key outside or lever inside. Outside lever always rigid. Inside lever always free for egress.

Hardware Set 2.0 – Door to Mechanical Room

3	Hinge	TA2714 / TA4714	US26	MK
1	Storage Lock	ML2057 NSA LC	626	RU
1	Mort. Cylinder	Match Owner's existing BEST	626	BE
		key system		
1	Surface Closer	DC6210 A4	689	RU
1	Kick Plate	K1050 10" high 4BE CSK	US32D	RO

Notes: Function: Latch bolt operated by key outside or lever inside. Outside lever always rigid. Inside lever always free for egress.

END OF SECTION 087100 DOOR HARDWARE

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SECTION 096513 - RESILIENT BASE AND 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.** Thermoplastic Rubber Base.
 - 2. Vinyl Transition Accessories.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified, not less than 12 inches (300 mm) long.
- C. Samples for Initial Selection: For each type of product indicated.
- D. Product Schedule: For resilient base and accessory products. Use same designations indicated on Drawings.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - **1.** Furnish not less than 10 linear feet (3 linear m) for every 200 linear feet (70 linear m) or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

1.6 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than [95 deg F (35 deg C), in spaces to receive resilient products during the following periods:
 - **1.** 48 hours before installation.
 - **2.** During installation.
 - **3.** 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

- 2.1 THERMOPLASTIC RUBBER BASE (RB-1)
 - A. Manufacturers: Subject to compliance with requirements, and as indicated on Drawings or a comparable product by one of the following:
 - **1.** Johnsonite
 - 2. Armstrong World Industries, Inc.
 - **3.** Roppe Corporation, USA
 - 4. Mannington.
 - B. Product Standard: ASTM F1861, Type TP (rubber, thermoplastic),
 - **1.** Group I (solid, homogeneous).
 - **2.** Style and Location:
 - a. Style: Cove: Provide in areas with resilient floor coverings.
 - C. Thickness: 0.125 inch (3.2 mm).
 - D. Height: 4 inches (102 mm).
 - E. Lengths: Coils in manufacturer's standard length.
 - F. Outside Corners: Job formed or preformed.
 - G. Inside Corners: Job formed or preformed.
 - H. Colors: Match Architect's sample. Refer to Material and Finish Schedule on drawings

2.2 VINYL MOLDING ACCESSORY

- A. Manufacturers: Subject to compliance with requirements, and as indicated on Drawings or a comparable product by one of the following:
 - 1. Basis of Design: Johnsonite. Provide the Basis of Design or comparable product.
- B. Description: Vinyl reducer strip for resilient floor covering and tile transition strips.

- C. Profile and Dimensions: As indicated on drawings.
- D. Locations: Provide vinyl molding accessories in areas indicated.
- E. Colors and Patterns: Match Architect's sample. Manufacturer's standard colors.

2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - **1.** Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install resilient products until materials are the same temperature as space where they are to be installed.
 - **1.** At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.
- D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Preformed Corners: Install preformed corners before installing straight pieces.
- H. Job-Formed Corners:
 - **1.** Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches (76 mm) in length.
 - a. Form without producing discoloration (whitening) at bends.
 - **2.** Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches (76 mm) in length.
 - a. Miter or cope corners to minimize open joints.

3.4 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Perform the following operations immediately after completing resilient-product installation:
 - 1. Remove adhesive and other blemishes from surfaces.
- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 09 6513

SECTION 096519 - RESILIENT TILE FLOORING

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. Rubber Tile Covering for the elevator floor
 - 2. Tile for elevator alcove / entry

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Initial Selection: For each type of floor tile indicated.
- C. Product Schedule: For floor tile. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- 1.5 CLOSEOUT SUBMITTALS
 - A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.
 - 1. Engage an installer who employs workers for this Project who are trained or certified by floor tile manufacturer for installation techniques required.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C). Store floor tiles on flat surfaces.

1.8 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive floor tile during the following periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- C. Close spaces to traffic during floor tile installation.
- D. Close spaces to traffic for 48 hours after floor tile installation.
- E. Install floor tile after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For resilient floor tile, as determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
- B. Smoke Density (ASTM E662 / NFPA 258): less than 450
- C. Slip Resistance (ASTM D2047): greater than or equal to 0.5 is required.
- D. Bacteria Resistance (ASTM E2180 / ASTM G21): Resistant to bacteria, fungi, and microorganism activity.
- E. Hardness (ASTM D2240): greater than or equal to 85 is required.
- F. Abrasion Resistance (ASTM D3389): less than or equal to 0.035 oz. (1.0g) is required.

2.2 RUBBER TILE – ELEVATOR FLOOR

- A. Basis of Design: Nora by Interface, "norament 825 round". Provide the basis of design or a comparable product approved by the Architect and Owner.
- B. Description: Vulcanize rubber compound 925 with environmentally compatible color pigments that are free of toxic heavy metals like lead, cadmium, or mercury.
- C. Wearing Surface: Round Pastille.
- D. Thickness: 0.13 inch (3.2 mm).

- E. Size: 19.72 by 19.72 inches (501 by 501 mm).
- F. Colors and Patterns: As selected by the Architect from Manufactures standard colors and patterns.

2.3 RUBBER TILE – ELEVATOR LOBBY

- A. Basis of Design: Nora by Interface, "norament 0749 Stone Gray". Provide the basis of design or a comparable product approved by the Architect and Owner.
- B. Description: Vulcanize rubber compound 925 with environmentally compatible color pigments that are free of toxic heavy metals like lead, cadmium, or mercury.
- C. Wearing Surface: Hammered.
- D. Thickness: 0.11 inch (2.7 mm).
- E. Size: 19.76 inches by 19.76 inches (502 by 502 mm).
- F. Colors and Patterns: As selected by the Architect from Manufactures standard colors and patterns.

2.4 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated. Refer to drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.

- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install floor tiles until materials are the same temperature as space where they are to be installed.
 - 1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.
- D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.3 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
- C. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- D. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
- E. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.
- F. Adhere floor tiles to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.
- B. Perform the following operations immediately after completing floor tile installation:
 - 1. Remove adhesive and other blemishes from surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.
- C. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

END OF SECTION 096519

SECTION 09 9123 - PAINTING

PART 1 GENERAL

- 1.1 RELATED DOCUMENTS
 - A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- 1.2 SECTION INCLUDES
 - A. Surface preparation.
 - B. Field application of paints.
 - C. Materials for back priming woodwork.
 - D. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
 - 1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
 - 2. Prime surfaces to receive wall coverings.
 - 3. Mechanical and Electrical:
 - a. In finished areas, paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.
 - E. Do Not Paint or Finish the Following Items:
 - 1. Items factory-finished unless otherwise indicated; materials and products having factoryapplied primers are not considered factory finished.
 - 2. Items indicated to receive other finishes.
 - 3. Items indicated to remain unfinished.
 - 4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
 - 5. Stainless steel, anodized aluminum, bronze, terne coated stainless steel, and lead items.
 - 6. Marble, granite, slate, and other natural stones.
 - 7. Floors, unless specifically indicated.
 - 8. Ceramic and other tiles.
 - 9. Brick, architectural concrete, cast stone, integrally colored plaster and stucco.
 - 10. Glass.
 - 11. Acoustical materials, unless specifically indicated.
 - 12. Concealed pipes, ducts, and conduits.

1.4 DEFINITIONS

A. Comply with ASTM D16 for interpretation of terms used in this section.

1.5 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency.
- B. ASTM D16 Standard Terminology for Paint, Related Coatings, Materials, and Applications.
- C. ASTM D4258 Standard Practice for Surface Cleaning Concrete for Coating.
- D. ASTM D4442 Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials.
- E. MPI (APL) Master Painters Institute Approved Products List; Master Painters and Decorators Association.
- F. MPI (APSM) Master Painters Institute Architectural Painting Specification Manual.
- G. SCAQMD 1113 South Coast Air Quality Management District Rule No.1113.
- H. SSPC-SP 1 Solvent Cleaning.
- I. SSPC-SP 2 Hand Tool Cleaning.
- J. SSPC-SP 6 Commercial Blast Cleaning.
- K. SSPC-SP 13 Surface Preparation of Concrete; (Reaffirmed 2015).

1.6 SUBMITTALS

- A. See Section 01 3300 Submittal Procedures, for submittal procedures.
- B. Product Data: Provide complete list of products to be used, with the following information for each:
 - 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
 - 2. MPI product number (e.g. MPI #47).
 - 3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
- C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
 - 1. Where sheen is specified, submit samples in only that sheen.
 - 2. Where sheen is not specified, discuss sheen options with Architect before preparing samples, to eliminate sheens definitely not required.

- 3. Paint color submittals will not be considered until color submittals for major materials not to be painted, such as masonry, factory finished metals, wood cabinets, and wood doors, have been approved.
- D. Certification: By manufacturer that paints and finishes comply with VOC limits specified.
- E. Manufacturer's Instructions: Indicate special surface preparation procedures.
- F. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, material safety data sheets (MSDS), care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Extra Paint and Finish Materials: 1 gallon of each color; from the same product run, store where directed.
 - 2. Label each container with color in addition to the manufacturer's label.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum five years documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum five years' experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.9 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Do not apply materials when relative humidity exceeds 85 percent; at temperatures less than 5 degrees F above the dew point; or to damp or wet surfaces.

- D. Minimum Application Temperatures for Paints: 50 degrees F for interiors unless required otherwise by manufacturer's instructions.
- E. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.1 PAINT WITH LOW ODOR / VOC

- A. Interior, Latex, Institutional Low Odor/VOC, Flat: White or colored latex paint with low-odor characteristics and a VOC of less than 10 grams per liter, for use in areas, such as hospitals and other occupied buildings, where the odor and VOC levels of conventional latex products would preclude their use.
 - 1. MPI Gloss and Sheen Leve1: Manufacturer's standard flat finish. Maximum gloss of 5 units at 60 degrees and maximum sheen of 10 units at 85 degrees when tested in accordance with ASTM D523.
- B. Interior, Latex, Institutional Low Odor/VOC, Low Sheen: White or colored latex paint with lowodor characteristics and a VOC of less than 10 grams per liter, for use in areas, such as hospitals and other occupied buildings, where the odor and VOC levels of conventional latex products would preclude their use.
 - 1. MPI Gloss and Sheen Level 2: Manufacturer's standard low-sheen finish. Maximum gloss of 10 units at 60 degrees and sheen of 10 to 35 units at 85 degrees when tested in accordance with ASTM D523.
- C. Interior, Latex, Institutional Low Odor/VOC, Eggshell: White or colored latex paint with low-odor characteristics and a VOC of less than 10 grams per liter, for use in areas, such as hospitals and other occupied buildings, where the odor and VOC levels of conventional latex products would preclude their use.
 - 1. MPI Gloss and Sheen Level 3: Manufacturer's standard eggshell finish. Gloss of 10 to 25 units at 60 degrees and sheen of 10 to 35 units at 85 degrees when tested in accordance with ASTM D523.
- D. Interior, Latex, Institutional Low Odor/VOC, Satin: White or colored latex paint with low-odor characteristics and a VOC of less than 10 grams per liter, for use in areas, such as hospitals and other occupied buildings, where the odor and VOC levels of conventional latex products would preclude their use.
 - 1. MPI Gloss and Sheen Level 4: Manufacturer's standard low-sheen finish. Gloss of 20 to 35 units at 60 degrees and minimum sheen of 35 units at 85 degrees when tested in accordance with ASTM D523.
- E. Interior, Latex, Institutional Low Odor/VOC, Semigloss: White or colored latex paint with low-odor characteristics and a VOC of less than 10 grams per liter, for use in areas, such as hospitals and other occupied buildings, where the odor and VOC levels of conventional latex products would preclude their use.
 - 1. MPI Gloss Level 5: Manufacturer's standard semigloss finish. Gloss of 35 to 70 units at 60 degrees when tested in accordance with ASTM D523.

- F. Interior, Latex, Institutional Low-Odor/VOC, Gloss: White or colored latex paint with low-odor characteristics and a VOC of less than 10 grams per liter, for use in areas, such as hospitals and other occupied buildings, where the odor and VOC levels of conventional latex products would preclude their use.
 - 1. MPI Gloss Level 6: Manufacturer's standard gloss finish. Gloss of 70 to 85 units at 60 degrees when tested in accordance with ASTM D523.

2.2 PAINTS AND FINISHES - GENERAL

- A. Paints and Finishes: Ready mixed, unless intended to be a field-catalyzed paint.
 - 1. Where MPI paint numbers are specified, provide products listed in Master Painters Institute Approved Product List, current edition available at www.paintinfo.com, for specified MPI categories, except as otherwise indicated.
 - 2. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
 - 3. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
 - 4. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.
 - 5. Supply each paint material in quantity required to complete entire project's work from a single production run.
 - 6. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.
- B. Flammability: Comply with applicable code for surface burning characteristics.
- C. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.
- D. Colors: Match existing color and finish of existing surfaces.
 - 1. Refer to drawings for color notes.
 - 2. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling they are mounted on/under.

2.3 PRIMERS

A. General: Provide the scheduled primer unless other primer is required or recommended by manufacturer of top coats.

2.4 ACCESSORY MATERIALS

- A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.
- B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin application of paints and finishes until substrates have been properly prepared.
- B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.
- D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- E. Test shop-applied primer for compatibility with subsequent cover materials.
- F. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
 - 1. Gypsum Wallboard: 12 percent.
 - 2. Masonry, Concrete, and Concrete Masonry Units: 12 percent.

3.2 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or repair existing paints or finishes that exhibit surface defects.
- D. Remove surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
- E. Seal surfaces that might cause bleed through or staining of topcoat.
- F. Concrete:
 - 1. Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
 - 2. Clean concrete according to ASTM D4258. Allow to dry.
 - Prepare surface as recommended by top coat manufacturer and according to SSPC-SP 13.

- G. Masonry:
 - 1. Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.
 - 2. Prepare surface as recommended by top coat manufacturer.
 - 3. Clean surfaces with pressurized water. Use pressure range of 600 to 1,500 psi at 6 to 12 inches. Allow to dry.
- H. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.
- I. Galvanized Surfaces:
 - 1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
 - 2. Prepare surface according to SSPC-SP 2.
- J. Ferrous Metal:
 - 1. Solvent clean according to SSPC-SP 1.
 - 2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
 - Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning". Protect from corrosion until coated.
- K. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

3.3 APPLICATION

- A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- B. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
- C. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.
- D. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- E. Apply each coat to uniform appearance in thicknesses specified by manufacturer.
- F. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply as many coats as necessary for complete hide.
- G. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

- H. Mechanical Work: Painting of mechanical work is limited to the following:
 - 1. Interior Occupied Areas: Unless otherwise indicated, paint the following when exposed to view in finished construction:
 - a. Structural supports for mechanical equipment.
 - b. Mechanical equipment (except pre-finished equipment).
 - c. Piping, pipe hangers, and supports.
 - d. Ductwork.
 - e. Insulation on pipe and ductwork.
 - f. Accessory items.
 - g. Fire suppression system piping.
 - 2. Interior Service Areas (Equipment Rooms, Mechanical Rooms, Stairs and Utility Spaces): Unless otherwise indicated, paint the following items when exposed to view in finished construction:
 - a. Structural supports for mechanical equipment.
 - b. Mechanical equipment (except pre-finished equipment).
 - c. Piping, pipe hangers, and supports.
 - d. Ductwork.
 - e. Insulation on pipe and ductwork.
 - f. Accessory items.
 - g. Fire suppression system piping.
 - 3. Interior Spaces, Concealed Above Acoustic Ceilings: Unless otherwise indicated, paint the following:
 - a. Fire suppression piping, 3-inch diameter and larger.
- I. Electrical Work: Painting of electrical work is limited to the following:
 - 1. Interior Occupied Areas: Unless otherwise indicated, paint the following when items exposed to view in finished construction:
 - a. Structural supports for electrical equipment.
 - b. Electrical equipment (except pre-finished equipment).
 - c. Conduit and fittings, panels and boxes, and wiremold.
 - d. Panelboards, including telephone equipment.
 - e. Accessory items.
 - 2. Interior Service Areas (Elevator Equipment and Mechanical Rooms): Unless otherwise indicated, paint the following items exposed to when view in finished construction:
 - a. Structural supports for electrical equipment.
 - b. Electrical equipment (except pre-finished equipment).
 - c. Conduit and fittings, panels and boxes, and wiremold.
 - d. Panelboards, including telephone equipment.
 - e. Accessory items.

J. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.4 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.
- B. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from Project site.
 - 1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping without scratching or damaging adjacent finished surfaces.

3.5 PROTECTION

- A. Protect finishes until completion of project.
- B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION 09 9123

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National Elevator Consultants, Inc. 9231 Maynard St Clay TWP Mi 48801 (517) 927-5147

WAYNE STATE UNIVERSITY – ART BUILDING ART BUILDING 5400 GULLEN MALL DETROIT, MI 48202 HYDRAULIC ELEVATOR MODERNIZATION

SECTION 1 BID INVITATION

- **OWNER: WAYNE STATE UNIVERSITY**
- CONSULTANT: NATIONAL ELEVATOR CONSULTANTS 9231 MAYNARD RD CLAY TWP, MI 48001
- PROJECT: ELEVATOR MODERNIZATION ART BUILDING 5400 GULLEN MALL DETROIT, MI 48202
- MODERNIZE: ONE HYDRAULIC ELEVATOR COMPLETE CITY SERIAL NUMBER 7525
- 1. <u>APPROVED BIDDERS:</u> (The Owner reserves the right to qualify or disqualify any Bidder based on their local performance within sixty (60) miles of the project location).

Otis Elevator Co.	ThyssenKrupp Elevator Co.
Kone Elevator Co.	
Great Lakes Elevator	Toledo Elevator

2. ELEVATOR DOCUMENTS ON FILE WITH: NATIONAL ELEVATOR CONSULTANTS, INC. 1227 GOODRICH ST LANSING, MI 48910 Phone: 866-241-6324 EMAIL: <u>mswright147@gmail.com</u>

3. <u>APPROVED MANUFACTURERS</u>

A.	ELEVATOR CONTROL EQUIPMENT:		
	Smart Rise Elevator Controls	M.C.E Elevator Controls	
	Vertitron	G.A.L. Elevator Controls	

B. PUMPING UNITS: Canton Elevator Inc. MEI Minnesota Elevator

EECO

- C. ELEVATOR CABS/DOOR PANELS: Snap Cab Eklunds Elevator Columbia Elevator Forms & Surfaces
- D. ELEVATOR FIXTURE COMPANIES: Innovation Industries Inc. PTL MAD
- E. NON-PROPRIETARY PACKAGES: SHUMACHER ALLIANCE
- **F. OTHER APPROVED SUBCONTRACTORS: (**The Owner and/or the Consultant reserve the right to approve or disapprove subcontractor and material suppliers.)

PROJECT DESCRIPTION

This Specification is intended to cover the modernization, furnishing and installing of **ONE (1)**_hydraulic passenger elevators, as described herein. All work will be performed in a workmanlike manner and is to include all work and material in accordance with specifications herein. In all cases where a device or part of the equipment is herein referred to in the singular number, it is intended that such reference will apply to as many such devices as are required to complete the installation.

At all times the consultant's final specifications, and performance requirements take precedence over any area of dispute of difference between the elevator contractor and the consultant, his representative, or the owner. All verbal agreements or representations not properly documented will always be superseded by the plans and specifications.

PERMITS FEES AND INSPECTIONS

It shall be the elevator contractor's responsibility to apply for, obtain and pay for any and all permanent and temporary installation permits that are required by the state or municipality covering the project. Primary modernization installation permits will be applied for within 30 days of a fully executed contract. Furthermore, the elevator contractor must arrange for and conduct all inspections and tests required for certificate of operation and final acceptance by both the code authority and the owners/owner's representatives.

CODE REQUIREMENTS

Unless otherwise specified, all elevator material, design, clearances, construction, workmanship, and tests, shall conform to the latest requirements of all applicable codes, including the American National Standard Safety code for "Elevators, Dumbwaiters, Escalators, and Moving Sidewalks", ANSI-A17.1. This Code represents minimum standards and can only be superseded by a local or state Code having over-riding jurisdiction.

Additional compliances (as may apply) shall be to the "National Board of Fire Underwriters", "National Electric Code", and BOCA. Compliance shall meet revisions and authorized standards necessary. Equipment and all installation, when completed, shall be in full compliance with ADA (Americans with Disabilities Act).

The intent of these specifications is to be in total compliance with all applicable codes. Should there be a variation between these specifications and the codes, then the latest and applicable codes shall take precedence. The Contractor will be responsible for 100% code compliance.

CONTRACTOR AND EQUIPMENT STANDARDS:

The Contractor shall be regularly engaged in the business of manufacturing, and/or installing and servicing equipment of the type and character required by the specifications and in the interest of undivided responsibility may also be the manufacturer of major components.

Furthermore, the local service facility must be owned or leased by the installer/manufacturer and shall consist of management, field supervision and residing local journeyman.

The Contractor shall have previously manufactured and/or installed and serviced equipment of a similar size, speed control, and capacity in at least four (4) different buildings.

The job site installation shall be supervised by qualified, full-time employees of the Contractor. They shall be experienced in installing equipment having the type of control system specified.

The owner/consultant reserve the right to approve or disapprove of any bidder using equipment manufactured by a division or subdivision of the parent company.

MANAGEMENT MEETINGS

The contractor agrees to attend a monthly management meeting to discuss the job progress. The meetings will start at the beginning of work and will continue until final completion of all elevators.

MATERIAL FINISH SUBMITTALS

If incorporated, as part of this specification, Two (2) samples of each of the following shall be submitted upon request, for approval before installation:

- a. Paint and enamel finishes for color selection.
- b. Plastic laminated finishes.
- c. All fixture cover finishes.
- d. All other exposed surfaces.

SHOP DRAWINGS, MEASUREMENTS, & SUBMITTALS

Before starting fabrication, shop drawings in the form of reproducible submissions of uniform size in accordance with GENERAL CONDITIONS, shall be submitted to the consultant for approval. **The following items shall be included in the elevator shop drawings:**

- a. Cuts or drawings showing detail of the signal and operating devices and such other devices as specified or required.
- b. Complete and dimensioned layouts of any changes from the original installation, as now specified; showing changes in the elevator machine, controller, governor, cab, car sling, platform, counterweights, sheaves, supporting beams, guide rails, buffers, reaction at points of support, weights of principle parts, top and bottom clearances and the over-travel of the car and counterweight location and sizes of conduit and junction boxes, etc.
- c. Complete drawing of any changes in the elevator hoist-way entrances, sills and doors showing the method of operation, details of construction, and the method of fastening to the structural members of the building.
- d. Complete drawings of the elevator cabs showing details of construction and the location of the car equipment.
- e. Cuts or drawings showing detail of the signal and operating devices and such other drawings as may be required to inform the architect (if involved) of all details of the installation.
- f. Architect's drawings show the general arrangement of the installation. They may not be scaled for dimensions or used as shop drawings. (Contractor to take all field measurements necessary for removing materials and fitting the installation to the building construction and arrangements. Contractor must verify all dimensions including complete travel of each elevator).
- g. At the final completion of the project, provide three (3) sets of parts catalogs for all equipment furnished and installed.

COOPERATION WITH OTHERS:

The contractor shall cooperate in the successful completion of this project, by providing all labor and materials as specified, with the Consultant, Owner, General Contractor and other involved trades.

POWER REQUIREMENTS AND DISCONNECTS

Prior to the manufacturing or fabricating on any new elevator equipment, the elevator contractor must confirm all existing power at the installation site. All new equipment installed must meet available conditions. If there's any power equipment, that does not meet necessary requirements, the contractor must submit the requirements in writing to the owner and the consultant at the submission of the bid. Failure to do so will result in the expense of any changes being the responsibility of the contractor.

RECEIVING AND UNLOADING OF MATERIAL:

The receiving and unloading of material at the job site shall be performed by the Elevator Contractor, as part of the work covered by this proposal. The job site storage area of materials and tools shall be provided by the

Owner or General Contractor. Any additional or other storage requirements will be by the Elevator Contractor.

TEAROUT/REMOVAL OF MATERIALS

Included in this agreement and classified as work by the Elevator Contractor, the Elevator Company shall include all necessary labor and material for the removal of all unused equipment, both directly and indirectly related to the subject elevators. All refuse containers are by the Elevator Contractor. This equipment shall be removed from the premises and become the property of the Elevator Contractor unless previously determined by owner.

WASTE DISPOSAL

All oils, lubricants, flushing and cleaning materials shall be disposed of in accordance with the requirements of the EPA (Environmental Protection Agency) standards and shall be the responsibility of the Elevator Contractor. (INCLUDING COST AND MANIFESTING)

HOLES AND FASTENINGS:

The Elevator Contractor will drill and/or cut all necessary holes in the steel, tile, non- masonry, masonry and concrete work as required to install equipment as specified. The Elevator Contractor will do all fastenings necessary to secure guide rails, machine supports and other equipment to the building. Patching with code approved materials is by the Elevator Contractor

EMERGENCY POWER

PROVIDE BATTERY BACK UP FUNCTION FOR UNIT

ADDIONAL WORK BY THE ELEVATOR CONTRACTOR.

The Elevator Contractor shall identify to the owner or owner's representative, all work required by code and to be done by others, including but not limited to items not listed in the specification.

Within three weeks of an executed contract between the elevator contractor and the owner, the elevator contractor will submit to the owner/owner's representative, heat release requirements of newly proposed equipment.

Repair any holes or openings in the hoist-way walls with materials of the same composition as existing or otherwise accepted by code.

Remove, relocate or suitably enclose any existing windows, pipes, wiring, ductwork, conduit, water pipes, drainpipes, etc., to meet the legal hoist-way, machine room, and pit requirements required by the governing codes.

Bevel any existing ledges in the hoist-way (excluding hoist-way separator beams) that are wider than 2" with a minimum of 5/8" drywall or a minimum of 14-gauge galvanized sheet metal set at a bevel of not less than 75 degrees.

Provide as required the power and wiring requirements to the elevator control system(s), including the proper circuit breakers, the properly sized disconnects, the 110-volt lighting circuit, ground faults and any necessary power to the signal system. Structural changes, such as walls, partitions and painting shall be the responsibility of others. All cutting, patching, and plastering, required to install landing push buttons and position indicators shall be by others unless previously specified.

Provide an earth bonding 4th wire ground to all disconnect switches from building power source origination

Provide any necessary 110-volt circuit(s) for the elevator smoke detector system.

Relocate or cover any equipment from machine room and hoist-way, which is unrelated to the elevators.

Others shall be responsible for informing the elevator contractor of any special radio frequency requirements, special filter or power dissipation requirements necessary in the manufacturing and operation of their building.

WIRING BY ELEVATOR CONTRACTOR

The Elevator Contractor will provide all new wiring required to and from the elevator control system, pump motor, hoist-way door interlocks, signal systems, control panels and any elevator management systems. All wire runs except traveling cables shall contain 10% spares and be in rigid conduit, EMT, or duct, except short connections where switches or other equipment may require shifting for adjustments. This wiring shall be installed in "flexible" conduit. All conduit shall terminate in approved EMT wiring duct. Conduit fittings, enclosures and junction boxes shall be galvanized steel.

Control and signal wires shall be brought to accessible numbered terminal blocks located in the elevator controller, car operating panel, and/or control components, that require more than 6 wires.

Conductors in conduit or duct shall be N.E. code type "THW". Intra-panel wiring shall be of a flame-resistant type that complies with the National Electrical Code.

Two pair of RG-6U coaxial CCTV will be included in the traveling cable(s) for a future security camera. These wires will be terminated at the top of the elevator in an approved box or duct. Two pair of shielded wires will be included in each traveling cable for a present or future communication provision.

Traveling cables shall be flame retardant, moisture resistant flexible cable that complies with the National Electrical Code Type "ET".

Traveling cables shall originate at numbered terminal blocks in a steel junction box in the hoist-way or on the controller, and end at numbered terminal blocks in a steel junction box on the car.

Traveling cables shall be fastened by an approved fastening, capable of withstanding a minimum of 200% strain relief. Each travel cable shall be provided with a minimum of ten- percent spare conductors per car and cable or additionally if required by code.

All wiring must test free from short circuits and grounds. The insulation resistance between conductors and ground shall be not less than one meg-ohm.

The elevator contractor shall furnish and deliver to the architect/owner, for approval, three (3) copies of complete wiring diagrams including schematic diagrams of all power, control, and safety devices. Wires shall be numbered, and the numbers shall be shown on all wiring diagrams.

Elevator Contractor shall provide work light fixtures with a GFI receptacle, on the top and bottom of the car. Fixture shall be suitable to accommodate a 150-watt incandescent lamp. Fixtures shall have wire lamp guards and toggle switches. The work light fixtures shall be so located that the work lights will provide good working light to the bottom and top of the car working area.

Elevator Contractor shall provide hoist-way access switches in accordance with the code jurisdiction. Hoist-way shall be equipped with necessary emergency stop switches, required by code, which shall interrupt the elevator control circuit and stop the car. An additional switch shall be provided to safely light the pit area.

All connections between any duct, conduit and/or flexible tubing into any junction box, electrical knockout box or any electrical outlet must have a non-conductive bushing on each end.

WIRING DIAGRAMS

Complete and legible field wiring diagrams, schematic straight-line diagrams, software mapping etc., shall be furnished to the owner, in triplicate, at the completion of the elevator modernization portion of the project. Schematic straight-line diagrams to include all field corrections and additions necessitated as a result of the final adjustment required for acceptance of completed units by the Owner or his representative. Wiring diagrams shall not be stamped as "property of" any elevator company.

SMOKE DETECTOR SYSTEM

The furnishing, installation and/or interface or subcontracting of the Elevator Smoke Detector System will be the responsibility of the elevator contractor. The elevator contractor will be responsible for all smoke system and fire recall requirements per code up to and including coordination with in house fire alarm company.

PAINTING

All existing machine room equipment including the machine room floor, shall receive one (1) field coat of industrial grade gloss enamel paint, prior to job completion. This shall include, the machine, controller, drive cabinets duct, conduit and/or any new equipment that does not have a fresh industrial grade, enamel finish. Paint colors will coordinate with each other. The Owner shall be responsible for the painting of machine room walls and ceilings at his discretion.

Prior to any painting, all rust, oil, grease, etc. shall be removed.

Art Building Elevator Replacement Wayne State University Issued For: Bid Set

All reused equipment located in the hoist-ways, below the first landing and pits, will be included as part of the painting specifications.

CONTRACTOR'S RESPONSIBILITY

The installing firm shall make all acceptance tests and be responsible for the elevator(s) and the safe operation of such equipment during its construction and until it is accepted by the building owner or his legal agent. The Elevator Contractor shall comply with the Elevator Consultant's report and the recommendations relative to all elevators referred to in the report. The elevator contractor shall provide, as part of this quotation, all installation permits, temporary permits and final certificates of operation.

CERTIFICATE OF COMPLIANCE

The operation of the subject elevator(s) being modernized, shall be unlawful by persons other than the installing contractor, until such equipment has been inspected, tested and a final or limited certificate of compliance has been issued by the jurisdictional code authority.

INSPECTIONS:

Upon completion of the work, the Elevator Contractor will furnish the Owner with such certificates of inspection and approval as are customarily issued for this class of work and required by the governing code authorities.

PARTS CATALOGS:

The Elevator Contractor will provide the owner with three (3) sets of parts catalogs for all equipment as finally furnished and installed.

TESTING: ALL ELEVATORS

The Owner will be employing an independent elevator consulting firm, National Elevator Consultants, Inc., or equal, as approved by the Owner, to observe and report on the tests hereinafter specified. These tests shall be performed by the Elevator contractor, who will include the furnishing of all testing equipment, including test weights, at no additional charge. Each elevator turned over will be tested under the watchful eye of the consultant and all data derived will be supplied to the consultant. All tests shall be of the "Performance" type, and not be construed as a substitute for safety tests required by the Local Governing Codes.

TESTS

1. The contract speed-v-actual "full load" speed shall not exceed 10% design.

- 2. All automatic door operation timing devices shall be checked for industry standard conformance.
- 3. All control timing devices shall be checked for industry standard conformance.
- 4. Leveling and stopping accuracy, both full-load and no-load, shall be checked.
- 5. Acceleration and Deceleration, both full load and no load, shall be checked.
- 6. Workmanship and Equipment shall be checked to conformance.
- 7. All signal devices and equipment shall be checked to specification conformance.
- 8. If necessary, tests will be performed for electrical grounds and shorts including a "two meg-ohm or less" test to the pump motor rotor and stator.

ACCEPTANCE/ PERFORMANCE GUARANTEE

Should the foregoing tests reveal any defects or poor workmanship, any variance or noncompliance to the requirements of the specified Codes and/or Ordinances, or any variance or noncompliance with the requirements of these Specifications, the following work and/or repairs shall be completed by the elevator Contractor at no expense to the Owner.

Contractor shall replace any equipment that does not meet code or Specification requirements.

Contractor will perform all work and furnish all materials necessary to complete the specified operation and/or performance.

Contractor will perform all retesting required by the Governing Code Authority and the Owner to verify the specified operation and/or performance at no additional cost to the owner.

Contractor shall reimburse the owner for any additional expenses incurred for re-inspection by the Elevator Consultant due to contractor's non-conformance to the specifications not to exceed \$3,000. per visit.

INTERIM MAINTENANCE SERVICE UPON AWARD

Upon the start of the modernization, contractor will provide interim maintenance at "**no-charge**", (as outlined in the maintenance performance section of this specification) from the start of the modernization work until the final acceptance and completion of all cars. Equipment related overtime callbacks will be included at "no additional charge" during the interim maintenance period.

If requested, (before the start of modernization) the Elevator Contractor that is awarded the contract for modernization will provide maintenance at the regular maintenance price submitted upon award of contract.

GUARANTEE AND FREE MAINTENANCE:

All labor and materials furnished and installed in accordance with these plans and specifications (and performing under local, normal operating conditions) shall be guaranteed for a period of one (1) year from the date of final acceptance of the **last unit completed**. The cost to correct any defects covered under this guarantee, shall be the responsibility of the elevator contractor. At "no charge", and as part of the base bid of the modernization contract, equipment related overtime callbacks and complete maintenance, as specified under the section "MAINTENANCE", SHALL BE FURNISHED THROUGHOUT THE ONE (1) YEAR WARRANTY PERIOD.

ADDITIONAL WORK REQUIRED BY CODE

The following is a list of items that code requires in addition to the work by the Elevator Contractor. All electrical, plumbing, HVAC, pit water proofing (if required) and fire/smoke/fireman's service shall be the responsibility of the elevator contractor.

All machine room/hoistway work must be performed under the supervision of a licensed elevator journeyman.

Machine Room

- 1. Provide environmental conditions capable of maintaining the elevator machine room temperature in a range between 65 degrees F. and 95 degrees F. at a height that is a minimum of 6'0" above the floor and 1' 0" out from any part of the elevator controllers, drives and hoist machines. Relative humidity is not to exceed 95% non-condensing.
- 2. Provide a new code approved, Three Phase, Main Line Electrical Disconnect for each elevator.
- 3. Provide a 4th wire earth bonding ground wire to each disconnect. Earth bonding ground shall be sized greater than the largest feeder wire and shall connect directly to the disconnect and each machine room component using a "daisy chain" or "tree" layout.
- 4. Provide a new lockable single pole/single throw disconnect for car lighting and ventilation fir each elevator.
- 5. Provide a new lockable power supply and disconnect for the fire recall system if required and not incorporated into the elevator control system.
- 6. Provide an individual phone line for each elevator, to monitor emergency communications
- 7. Provide GCFI receptacles to all outlets in the machine room.
- 8. Provide proper machine room lighting.

Hoist-way Work

All hoist-way work must be performed under the supervision of a licensed elevator journeyman.

- 1. Provide GCFI's to all pit outlets.
- 2. Provide code approved lighting in pits.
- 3. Provide code approved pit ladder for pits 36" deep or more.

- 4. Waterproof damp or leaking pits.
- 5. Cutting and patching with code approved materials.

DEMOLITION, INSTALLATION AND PRODUCT REQUIREMENTS

- **DEMOLITION:** Remove existing elevator assembly including machine room pump unit, controller, all wiring and hydraulic piping, cab, door equipment, hoistway wiring and devices, hydraulic jack, casing and associated devices including pit equipment (buffers and pit channels, etc.), rails. Hoistway must be clear of any equipment and prepared for the installation of new hoistway walls to be built within the existing hoistway. All entrances shall be barricaded with a solid barricade extending from floor to ceiling with a lockable 42" door at each landing around the opening of the hoistway. A suitable work location at each landing shall be provided within the barricade to allow for outside of hoistway work at each landing. All demolition materials shall be removed from site upon removal from service as soon as possible.
- **INSTALLATION:** A new non-proprietary, direct plunger, 100 FPM, 3000-pound capacity, hydraulic passenger elevator shall be installed within the reconstructed hoistway. (See attached hoistway layout). Elevator shall have 2 speed 42" doors. See below:

Job: WSU- ART BLDG. ELEVATOR MODERNIZATION

National Elevator

NEW EQUIPMENT PROFILE-HYDRAULIC ELEVATOR

A. GENERAL

Elevator Identification: City (WSU)	7525 (040-01)
Loading Classification:	PASSENGER
Capacity: (Lbs.)	3000#

Floors Served:	BASEMENT, 1, 2,3 REAR
Rate Speed: (fpm)	100 FPM
Rise:	54' (APPROX)
Doors:	84" x 42" - 2 SPEED SIDE SLIDE

CONTROL SYSTEM:

Manufacturer Reference: SIMPLEX OPERATION system with electronic soft start and auto lowering provision.

CODE COMPLIANCE

The elevator controller shall comply with all applicable elevator and electrical safety codes.

ADA REQUIREMENTS

The elevator controllers shall comply with Title III of the Americans with Disabilities Act (ADA).

Leveling Accuracy - The controller shall have a self-leveling feature that shall automatically bring the car to floor landings within a tolerance of .5" (12.7 mm) or better under all loading conditions up to the rated load.

In Car Lanterns - The controller shall have outputs to drive the visible and audible signals that are required for the car entrance to indicate which direction the car is traveling. Audible signals shall sound once for up, twice for down.

Car Position Indicators - The controller shall have a position indicator output to drive the required position indicator which shall indicate the corresponding floor numbers as the car passes or stops at a floor. An audible signal shall sound as the position indicator changes floors.

DIAGNOSTICS

The control system shall provide comprehensive means of accessing the computer memory for elevator diagnostic purposes. It shall have permanent indicators for important elevator statuses as an integral part of the controller.

INTENDED OPERATION OF CRITICAL COMPONENTS

Failure of any single magnetically operated switch, contactor, or relay to release in the intended manner; the failure of any static control device, speed measuring circuit, or speed pattern generating circuit to operate as intended; the occurrence of a single accidental ground or short circuit shall not permit the car to start or run if any hoist-way door or gate interlock is unlocked or if any hoist-way door or car door or gate contact is not in the made position. Furthermore, while on car top inspection or hoist-way access operation, failure of any single magnetically operated switch, contactor or relay to release in the intended manner, failure of any static control device to operate as intended or the occurrence of a single accidental ground, shall not permit the car to move even with the hoist-way door locks and car door contacts in the closed or made position.

STATUS INDICATORS

Dedicated permanent status indicators shall be provided on the controller to indicate when the safety string is closed, when the door locks are closed, when the elevator is operating at high speed, when the elevator is on independent service, when the elevator is on Inspection/Access, when the elevator is on fire service, when the elevator out of service timer has elapsed, and when the elevator has failed to successfully complete its intended movement. In addition, a means shall be provided to display other special or error conditions that are detected by the microprocessor.

DOOR OPERATION

Door protection timers shall be provided for both the opening and closing directions, which will protect the door motor and will help prevent the car from getting stuck at a landing. The door open protection timer shall cease attempting to open the door after a predetermined time in the event that the doors are prevented from reaching the open position. In the event that the door closing attempt fails to make up the door locks after a predetermined time, the door close protection timer shall reopen the doors for a short time. If, after a predetermined number of attempts, the doors cannot successfully be closed, the doors shall be opened and the car removed from service.

A minimum of four different door standing open times shall be provided. A car call time value shall predominate when only a car call is canceled. A hall call time value shall predominate whenever a hall call is canceled. In the event of a door reopen caused by the safety edge, photo eye, etc., a separate short door time value shall predominate. A separate door standing open time shall be available for lobby return.

CAR AND HALL CALL REGISTRATION

Car and hall call registration and lamp acknowledgment shall be by means of a single wire per call, in addition to the ground and the power bus. Systems that register the call with one wire, and light the call acknowledgment lamp with a separate wire are not acceptable.

FIRE SERVICE OPERATION

Fire Phase I emergency recall operation, alternate level Phase I emergency recall operation and Phase II emergency in-car operation shall be provided according to applicable local codes.

LEVELING

The car shall be equipped with two-way leveling to automatically bring the car level at any landing, within the required range of leveling accuracy, with any load up to full load.

UNCANCELED CALL BYPASS

A timer shall be provided to limit the amount of time a car is held at a floor due to a defective hall call or car call, including stuck pushbuttons. Call demand at another floor shall cause the car, after a predetermined time, to ignore the defective call and continue to provide service in the building.

ON-BOARD DIAGNOSTICS

The microprocessor boards shall be equipped with on-board diagnostics for ease of troubleshooting and field programmability of specific control variables. Field changes shall be stored permanently, using non-volatile memory. The microprocessor board shall provide the features listed below.

On-board diagnostic switches and an alphanumeric display shall provide user-friendly interaction between the mechanic and the controller.

On-board real time clock shall display the time and date and is adjustable by means of on-board switches. Field programmability of specific timer values (i.e., door times, shutdown times, etc.) may be viewed and/or altered through use of the on-board switches and pushbuttons.

GENERAL SPECIFICATIONS

The elevator shall not require the functioning or presence of the microprocessor to operate on car top inspection or hoist-way access operation (if provided) to provide a reliable means of moving the car if the microprocessor fails.

A motor limit timer function shall be provided which, in case of the pump motor being energized longer than a predetermined time, shall cause the car to descend to the lowest landing and park, open the doors automatically and then close them. Car calls shall be canceled, and the car taken out of service automatically. Operation may be restored by cycling the main line disconnect switch or putting the car on access or inspection operation. Door reopening devices shall remain operative.

A valve limit timer shall be provided which shall automatically cut off current to the down valve solenoids if they have been energized longer than a predetermined time. The car calls shall then be canceled, and the car taken out of service automatically. Operation may be restored by cycling the main line disconnect switch or putting the car on access or inspection operation. Door reopening devices shall remain operative. A selector switch shall be provided on the controller to select high or low speed during access or inspection

BATTERY LOWERING/DOOR OPENING DEVICE

operation as long as contract speed does not exceed 150 feet per minute.

In the event of the failure of the primary power supply, the hydraulic controller will be equipped with a battery lowering device pre-wired, pre-tested and integrated into the standard enclosure. The device will incorporate the ability to open the doors after it has been lowered to the lowest landing.

SPECIFICS: PROGRAMMABLE LOGIC

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All available programming options or parameters shall be field programmable, without need for any external device or knowledge of any programming languages. Programmable options and parameters shall be stored in nonvolatile memory. As a minimum, there shall be a 32-character alphanumeric display used for programming and diagnostics. Programmable parameters and options shall include, but are not limited to, the following: Number of Stops/Openings Served (Each Car) Simplex operation Floor Encoding (Absolute PI) **Digital Position Indicator** Programmable Door Times Programmable Motor Limit Timer External Car Shutdown Input (e.g., battery lowering device) External Low Oil Sensor Input External Viscosity Control Input Parking Floors Hall or Car Audible Selection

NEW FIXTURES AND OPERATING PANELS:

All new fixtures specified will be vandal resistant brushed stainless steel and will be surface mounted.

New Car Operating Panel(s) will incorporate swing panels, 3 position keyed fan switches, keyed emergency light test switch, L.E.D. position indicators and direction arrows, independent service key switch, door open, door close buttons, fire call cancel button, SES 2 switch, plus all A.D.A. compliant requirements.

The "hands free" ADA phone button will be centered at the bottom of the car operating panel and will have a one row space between any buttons located above or below. There shall not be any other buttons located in the same row.

All hall push buttons shall incorporate position indicators and direction of elevator within the fixture.

Furnish and install new main lobby combination position indicator/lantern.

Direction lanterns will be surface mounted, vandal resistant design with L.E.D. Illumination

All signal displays and haloes shall be **RED LED**.

FIXTURE FASTENINGS:

All new fixtures shall be fastened with tamper-resistant screws.

LANDING DOORS:

Furnish new 84" x 42", 2 speed side slide doors.

CAB ENCLOSURE:

Provide new cab shell and interior with 5WL hanging panes with #4 stainless steel reveals between panels to prevent scratches. Provide new ceiling with LED downlights. Provide one piece rubber flooring with sealed edges to prevent fluid penetration into subflooring.

NEW CAR DOOR OPERATORS/HARDWARE:

Install new GAL high speed door operator of the "closed loop" design. As specified herein, furnish and install new car door hangars, rollers, clutch and door gibs.

HOISTWAY DOOR HARDWARE

Install all new hoist-way door locks, hanger rollers, closures. All door operation shall be in like new condition for smooth, noise free operation.

PERFORMANCE AND RIDE QUALITY

All elevators shall operate in a like new condition. Any and all vibrations or noise in the ride quality, or door operation shall be remedied prior to the acceptance of each elevator as determined by the owner and owners representative.
MODERNIZATION - ADDITIONAL WORK ATTACHMENT

Billing Rates: (Premium Time will be the Straight Time and Overtime amount without fringe benefits included for the overtime portion.)

<u>Straight Time:</u>

Mechanic Billing Rate: \$	
Helper Billing Rate: \$	_
Team Billing Rate: \$	_
Normal Overtime:	Normal Overtime Portion:
Mechanic Billing Rate: \$	\$
Helper Billing Rate: \$	\$
Team Billing Rate: \$	\$
Double Overtime:	Double Overtime Portion:
Mechanic Billing Rate: \$	\$
Helper Billing Rate: \$	\$
Team Billing Rate: \$	\$

NATIONAL ELEVATOR CONSULTANTS, INC. SPECIFICATIONS

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SECTION 20 05 00 - COMMON WORK RESULTS

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. Division 20, Common Work Results for Mechanical, requirements apply to this section.
- C. Division 01 Project Management and Coordination, applies to this section and will require the contractors' participation in the Above Ceiling Coordination Program.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Mechanical sleeve seals.
 - 5. Sleeves.
 - 6. Escutcheons.
 - 7. Grout.
 - 8. Equipment installation requirements common to equipment sections.
 - 9. Supports and anchorages.
 - 10. Coordination drawings.

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 materials:
 - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
 - 2. CPVC: Chlorinated polyvinyl chloride plastic.
 - 3. PE: Polyethylene plastic.
 - 4. PVC: Polyvinyl chloride plastic.
 - 5. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 6. NBR: Acrylonitrile-butadiene rubber.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Transition fittings.
 - 2. Dielectric fittings.
 - 3. Mechanical sleeve seals.
 - 4. Escutcheons.
 - 5. Coordination drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 SUBMITTALS

- A. Welding certificates.
- B. Shop drawings: Submit for all major equipment including, but not limited to the items listed in Division 20, 21, 22, 23. Submittals shall be provided in electronic format.
- C. As-built Drawings: Submit as-built drawings that include accurate dimensioned record drawings of all underground work, above ground piping, and ductwork systems. As-built drawings shall be submitted in electronic format.
- D. Operation and Maintenance Manuals: When the building is substantially complete and before the building is taken over by the Owner for maintenance purposes, the contractor shall provide four sets of complete operation and maintenance manuals. The manual shall consist of an indexed loose-leaf binder containing the equipment data, manufacturer's installation, operating, and maintenance, repair parts manual for each system component, test reports, and as-built temperature control diagrams. Refer to Divisions 20, 21, 22, and 23 for additional submittal requirements. Provide an electronic copy of the operation and maintenance manual in addition to three (3) sets of loose-leaf hard copy binders. Preliminary copy of O&M manuals shall be submitted to commissioning agent for review. Schedule of preliminary submittal will be reviewed

with Commissioning Agent at the commissioning kick off meeting.

- E. Substitutions: The contractors' base bid must be in accordance with the materials or products specified. Any exceptions to this must be approved in writing by the Architect/Engineer, 10 days or more prior to bidding. Voluntary alternates may be submitted for consideration on the proposal, with listed addition or deductions to the base bid, but will not affect the awarding of the contract.
- F. Coordination Drawings: Contractor shall prepare above ceiling coordination drawings for efficient installation of different components and coordination for installation of products and materials fabricated by each trade. The coordination drawings shall be based on the design intent of the contract documents and shall include all required offsets, fittings, and specialties. Design intent may appear on the drawings or in written form withing the specification. Any installation that occurs prior to full coordination is subject to rework at not additional cost to the project if required.
 - 1. Content: Project-specific information, drawn accurately to scale, 1/4 inch per foot. Do not base Coordination Drawings on reproductions of the Contract Documents or standard printed data. Include the following information, as applicable:
 - a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - b. Indicate required installation sequences.
 - c. Indicate dimensions shown on the Contract Drawings and make specific note of dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect for resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
 - 2. Sheet Size: 30 by 42 inches.
 - 3. Number of Copies: Electronic submissions are preferred. Where not feasible, provide the following.
 - a. Submit two opaque copies of each submittal. Architect will return one copy.
 - b. Submit five copies where Coordination Drawings are required for operation and maintenance manuals. Architect will retain two copies; remainder will be returned. Mark up and retain one returned copy as a Project Record Drawing.
 - 4. Refer to individual Sections for Coordination Drawing requirements for Work in those Sections.

1.7 QUALITY ASSURANCE

- A. Codes and Standards: Perform all Work in accordance with applicable Federal, State and local codes rules, ordinances and regulations. The electrical and physical properties of all materials, and the design, performance characteristics, and methods of construction of all items of equipment, shall be in accordance with the latest issue of the various, applicable Standards, Rules and Regulations of NFPA, UL, and as follows unless otherwise indicated.
 - 1. Elevator Code
 - 2. USGBC
 - 3. ASHRAE 55
 - 4. ASHRAE 62.1

5. ASHRAE 90.1

- B. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- C. 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.
- D. Electrical Characteristics for 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 at no additional cost to the project. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.
- E. Permits and inspections: Obtain and pay for all permits (temporary and permanent), fees, and inspections as required by any applicable laws and ordinances. Post such permits and inspection Certificates in a prominent place adjacent to the work. Deliver all certificates of final inspection or approval to the Architect/Engineer. Do not cover any concealed work until final inspection has been made and approval certificates obtained.

1.8 DELIVERY, STORAGE, HANDLING, AND INSTALLATION

- A. Deliver ductwork, pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent ductwork and 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.
- C. During installation, provide temporary caps of sufficient material to prevent entrance of dirt, debris, and moisture.

1.9 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for 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 items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."
- D. Refer to the Owner/Utility tie-in schedule.
- E. Each contractor shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work.

- 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
- 2. Coordinate installation of different components with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
- 3. Make adequate provisions to accommodate items scheduled for later installation.
- 4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components, including mechanical and electrical.

1.10 WARRANTIES

- A. In the event that any part of the work or equipment fails (abuse and causes beyond control of the contractor excepted), within this period of guarantee, it shall be replaced by the contractor at no cost to the owner.
- B. All mechanical system components and controls shall be provided with a minimum 1-year warranty. Specific mechanical components may have longer warranty periods. Warranty shall be unconditional and include material, labor and response with 24 hours of notification. All warranties to begin at substantial completion and extend for period indicated in the contract documents.

1.11 SYSTEM STARTUP

- A. Special mechanical equipment such as sump pumps, etc., shall have initial start-up of equipment assigned to a trained manufacturer's representative who can check and report on items such as installation, lubrication, alignment, etc., and see that the equipment starts and operates properly.
- B. Activation of the heating, ventilating and air conditioning equipment for testing and balancing will be allowed only after the construction is substantially complete, or by permission of the owner's construction representative.

1.12 MAINTENANCE

- A. Contractor shall be responsible for maintenance of equipment and systems installed until final acceptance by Owner.
- B. Lubricate rotating equipment in accordance with manufacturer's recommendations before activation. Re-lubricate as required during activation and prior to final acceptance.
- C. Provide readily accessible and secured copper extensions to bearing lubrication fittings on equipment bearings.

1.13 SITE INSPECTION

A. Contractor shall visit the site prior to submitting Proposal and examine and verify existing conditions. Additional charges will not be allowed due to failure to complete site visit or to include

necessary materials and labor to complete the work. Proposal being submitted implies site visit has occurred and contractor understands the conditions which the work will be conducted.

1.14 CONSTRUCTION DOCUMENT INTERPRETATION

A. Any conflict within the documents shall be included with the highest cost.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 21, 22, and 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 21, 22, and 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 maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 2. AWWA C110, rubber, flat face, 1/8-inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- F. 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.

G. 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 TRANSITION FITTINGS

- A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
 - 1. Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Dresser Industries.
 - c. Ford Meter Box Company.
 - d. JCM Industries.
 - e. Smith-Blair.
 - f. Viking Johnson.
 - 2. Aboveground Pressure Piping: Pipe fitting.

2.5 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F .
 - 1. Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Eclipse.
 - d. Epco Sales.
 - e. Hart Industries.
 - f. Watts.
 - g. Zurn Industries.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig working pressure as required to suit system pressures.
 - 1. Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.

- c. Epco Sales.
- d. Watts.
- E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-faceor ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - 1. Manufacturers:
 - a. Advance Products & Systems.
 - b. Calpico.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator.
 - 2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.
- F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
 - 1. Manufacturers:
 - a. Calpico.
 - b. Lochinvar.
- G. 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.
 - b. Precision Plumbing Products.
 - c. Sioux Chief Manufacturing Co.
 - d. Victaulic Company.

2.6 MECHANICAL SLEEVE SEALS

- A. Manufacturers:
 - 1. Advance Products & Systems.
 - 2. Flexicraft Pipeseal.
 - 3. Calpico.
 - 4. Metraflex.
 - 5. Pipeline Seal and Insulator.
- B. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
- C. Pressure Plates: Glass reinforced plastic. Include two for each sealing element.

D. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Advance Products & Systems, Inc.
 - 2. CALPICO, Inc.
 - 3. GPT; an EnPro Industries company.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop collar.
- C. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, anti-corrosion coated, with plain ends and integral welded waterstop collar.
- D. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.8 STACK-SLEEVE FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Smith, Jay R. Mfg. Co.
 - 2. Zurn Specification Drainage Operation.
- B. Description: Manufactured, Dura-coated or Duco-coated cast-iron sleeve with integral clamping flange for use in waterproof floors and roofs. Include clamping ring, bolts, and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with setscrews.

2.9 ESCUTCHEONS

- A. Description: Manufactured chrome plated 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, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
- C. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
- D. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.
- E. Split-Casting Brass Type: With polished, chrome-plated finish and with concealed hinge and setscrew.

F. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed hinge, and spring-clip fasteners.

2.10 FLOOR PLATES

- A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
- B. Split-Casting Floor Plates: Cast brass with concealed hinge.

2.11 GROUT

- A. Description: Nonshrink, recommended for interior and exterior sealing openings in nonfire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi , 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.12 SILICONE SEALANTS

- A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant, ASTM C920, Type S, Grade NS, Class 25, use NT.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. GE Construction Sealants; Momentive Performance Materials Inc.
 - b. Pecora Corporation.
 - c. Permathane®/Acryl-R®; ITW Polymers Sealants North America.
 - d. Polymeric Systems, Inc.
 - e. Sherwin-Williams Company (The).
 - f. The Dow Chemical Company.
 - 2. Sealant shall have a VOC content of 250 g/L or less.
 - 3. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Silicone, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade P, Class 25, Uses T and NT. Grade P Pourable (self-leveling) formulation is for opening in floors and other horizontal surfaces that are not fire rated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:

- a. May National Associates, Inc.; a subsidiary of Sika Corporation.
- 2. Sealant shall have a VOC content of 250 g/L or less.
- 3. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- C. Silicone Foam: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Smooth-On.
 - 2. Sealant shall have a VOC content of 250 g/L or less.
 - 3. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

PART 3 - EXECUTION

3.1 MECHANICAL DEMOLITION

- A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Sections "Selective Demolition" and "Structure Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove Fire Protection systems, HVAC systems, Plumbing systems, equipment, and components indicated to be removed.
 - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 - 3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - 4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
- 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 WORK IN EXISTING BUILDINGS

- A. Access to the existing building will be provided by the owner as required and a project schedule will identify access requirements to occupied buildings. Work shall be completed by the Contractor without interruption once Work has begun to facilitate returning the areas of work back to the Owner as soon as possible.
- B. Provide adequate protection of all existing and newly installed Work. Contractor shall promptly

repair any damage to new or existing Work at Contractor's expense.

- C. Contractor shall consult with the Owner on methods of performing Work so the Owner's operation is not disrupted more than absolutely necessary. The Owner shall designate when interruption of existing services may occur. Contractor shall leave all services in operation until such time.
- D. All items and equipment removed as part of the demolition process shall remain property of the owner unless possession rights are waived. Contractor shall meet with Owner prior to start of demolition to determine which items are to be salvaged. Contractor shall remove remaining items from the site.

3.3 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 21, 22, 23 sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping indicated to be exposed in finished areas as high as possible unless noted otherwise.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Install piping to permit valve servicing. Valves shall be located not more than 24 inches above the suspended ceiling grid.
- H. Install piping at indicated slopes.
- I. Install piping free of sags and bends. Piping shall be installed level and plumb where piping slopes are not required.
- J. Install fittings for changes in direction and branch connections.
- K. Install piping to allow application of insulation.
- L. Select system components with pressure rating equal to or greater than system operating pressure.
- M. Install escutcheons for penetrations of walls, ceilings, and floors:
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.

- b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
- c. Piping in High Humidity Areas: One-piece, cast-brass type with polished chromeplated finish.
- d. Insulated Piping: One-piece, stamped-steel type with spring clips.
- e. Bare Piping in Finished Spaces: One-piece, stamped-steel type.
- f. Bare Piping in Unfinished Service Spaces and Equipment Rooms: Split-plate, stamped-steel type with concealed hinge and set screw.
- g. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- N. Install sleeves for pipes passing through footings and foundation walls, masonry walls, gypsumboard partitions, and concrete floor and roof slabs.
 - 1. Cut sleeves to length for mounting flush with both surfaces of walls.
 - a. Exception: Extend sleeves installed in floors 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Schedule 40 Black Steel Sleeves: For pipes smaller than NPS 12 penetrating interior walls.
 - b. 0.375-Inch Wall Black Steel Sleeves: For pipes NPS 12 and larger penetrating interior walls.
 - c. Schedule 40 Galvanized Steel Sleeves: For pipes smaller than NPS 12 penetrating floors, and roof slabs.
 - d. 0.375-Inch Wall Galvanized Steel Sleeves: For pipes NPS 12 and larger penetrating floors and roof slabs.
 - e. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
 - 4. Seal sleeves in concrete floors roof slabs and masonry walls with grout.
 - 5. Seal sleeves in plaster/gypsum board partitions with plaster or dry wall compound and caulk with non-hardening silicone sealant to provide airtight installation.
 - 6. 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.
 - 7. Sleeves through floors and walls shall be sized so that the required pipe insulation is continuous through the sleeve.
- O. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

- P. Verify final equipment locations for roughing-in.
- Q. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
- R. Contractor shall maintain adequate clearances (per the latest edition of the national electric code) above and around any new electrical panels, equipment, and transformers when routing overhead piping.

3.4 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 21, 22, and 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.

3.5 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each control valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to each control valve and at final connection to each piece of equipment.

3.6 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated or coordination with other services dictates different mounting heights.
- 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.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain new mechanical equipment. Provide a minimum of 8 hours of training for new mechanical systems.

3.8 PAINTING

A. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.9 GROUTING

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

END OF SECTION 20 05 00

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SECTION 20 05 13 - COMMON MOTOR REQUIREMENTS FOR MECHANICAL EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Division 20, Common Work Results for Mechanical, requirements apply to this section.
- C. Division 01 Project Management and Coordination, applies to this section and will require the contractors' participation in the Above Ceiling Coordination Program.

1.2 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.
- B. Section does not include motors for fire pumps, elevators, centrifugal chillers, sealed refrigeration equipment, submersible sump pumps, and vertical hollow or solid shaft motors used with vertical turbine pumps.
- C. Related Sections include the following:
 - 1. Section 26 "Enclosed Switches and Circuit Breakers".
 - 2. Section 26 "Enclosed Controllers".

1.3 DEFINITIONS

- A. ABMA: American Bearing Manufacturers Association.
- B. IEEE: Institute of Electrical and Electronics Engineers.
- C. NEMA: National Electrical Manufacturers Association.
- D. MG 1: (NEMA) Motors and Generators Standard.
- E. VFD: Variable frequency drive.

1.4 SUBMITTALS

- A. Submit the following product data for approval:
 - 1. Manufacturer information.

- 2. Dimensions and elevations.
- 3. Complete NEMA nameplate electrical data including design type, insulation, service factor, and efficiency.
- 4. Materials of construction.
 - 1) Bearing type, L10 bearing life, and seal construction (open, single, or double shielded).
- 5. Certification that VFD driven motors comply with all parts of NEMA MG-1 Part 31.

1.5 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following:
 - 1. Baldor Electric Company
 - 2. Dayton.
 - 3. General Electric.
 - 4. Leeson Electric.
 - 5. Marathon Electric.
 - 6. Reliance Electric.
 - 7. Toshiba Corporation.
 - 8. U.S. Electrical Motors.

2.2 GENERAL MOTOR REQUIREMENTS

- A. Comply with requirements in this Section except when stricter requirements are specified in Fire Protection, Plumbing or HVAC equipment schedules or Sections.
- B. Comply with NEMA MG 1 unless otherwise indicated.
- C. Comply with ABMA 9 for bearing life calculations. For belted applications, calculations shall be based on maximum external side load limits per NEMA MG 1 Table 14-1A. L10 life calculations

for vertical motors and horizontal motors mounted in the vertical position shall consider the application's thrust loading.

2.3 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 104 deg F and at altitude of 3300 feet above sea level. Maximum hot spot temperature shall not exceed the insulation temperature limit, when operated in an ambient temperature of 104 deg F, except as otherwise indicated.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
- C. Noise: Motors shall not exceed dBA levels listed in NEMA MG 1 section 12.54 at all speeds.

2.4 POLYPHASE MOTORS (1/2 HP and larger)

- A. Description: NEMA MG 1, Design B, squirrel cage, medium induction motor with open drip proof enclosure unless noted otherwise in equipment specifications of schedules. When totally enclosed fan cooled motors are specified or scheduled, provide external shaft slinger on drive end.
- B. Efficiency: Nominal (nameplate) full load efficiency and corresponding minimum efficiency equal to or greater than that stated in NEMA MG 1 Table 12-12 Premium Efficient Motors Nominal Full Load Efficiencies.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Separate winding for each speed.
- E. Rotor: Random-wound, squirrel cage.
- F. Temperature Rise: Match insulation rating.
- G. Insulation: Class F.
- H. Code Letter Designation:
 - 1. Motors smaller than 15 HP: Manufacturer's standard starting characteristic.
- I. Enclosure Material and Bearings:
 - 1. Motors less than 3 HP: Steel or cast iron motor frames, cast aluminum, cast iron, or steel end plates, steel or cast iron terminal box, copper windings.
 - a. Bearings shall be regreasable with relief plugs, pre-lubricated ball bearings suitable for radial and thrust loading of the application, with grease fittings, selected for a minimum L10 bearing life of 26,280 hours, for belted and direct drive.

2.5 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - 2. Inverter-Duty Motors: Class B temperature rise; Class H insulation.
 - 3. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
 - 4. For VFD driven motors up to 100 HP, provide a maintenance free, circumferential conductive micro-fiber ground ring installed on the motor to discharge stray shaft currents to ground. Grounding ring shall be AEGIS SGR (shaft grounding ring). Motors protected by AEGIS SGR shall be warranted for the term of the manufacturer's motor warranty from induced current bearing damage.
 - 5. For VFD driven motors 100 HP and greater, provide a maintenance free, circumferential conductive micro-fiber ground ring installed on the motor to discharge stray shaft currents to ground. Grounding ring shall be AEGIS SGR (shaft grounding ring). In addition, motors shall utilize an insulated ceramic bearing assembly on the non-drive end of the motor, in conformance with the AEGIS installation requirements.
 - 6. Motors protected by AEGIS SGR shall be warranted for the term of the manufacturer's motor warranty from induced current bearing damage.

2.6 SINGLE-PHASE MOTORS (less than 1/2 HP)

- A. Motors larger than 1/20 HP shall be one permanent-split-capacitor type, to suit starting torque and requirements of specific motor application:
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.
- F. Furnish with sliding base/slotted mounting holes adequate for proper belt tensioning and alignment of motor or motor/load.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install and align motors in accordance with the equipment manufacturer's recommendations.
- B. For VFD driven motors using a shaft grounding ring: Install grounding ring in accordance with the manufacturer's recommendations, including application of a colloidal silver shaft coating on the motor shaft.

3.2 ADJUSTING, CLEANING, PROTECTION

- A. Assure motor nameplate is legible and properly affixed.
- B. Verify bearings are factory lubricated before starting motors. Lubricate per manufacturer's instructions. Do not over lubricate bearings.
- C. Check motors for unusual heating, noise, or excessive vibration during operation. Correct any such deficiencies.
 - 1. Any motors with vibration exceeding specified limits, as noted in the Testing, Adjusting, and Balancing Section, or manufacturer's recommendations, whichever is more stringent, shall be corrected, at no cost to the Owner, until reduced below those limits.
- D. Clean the motor prior to start-up and immediately prior to final turn-over to the Owner.

END OF SECTION 20 05 13

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SECTION 20 05 29 - HANGERS AND SUPPORTS

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. Division 20, Common Work Results for Mechanical, requirements apply to this section.
- C. Division 01 Project Management and Coordination, applies to this section and will require the contractors' participation in the Above Ceiling Coordination Program.

1.2 SUMMARY

- A. This Section includes the following hangers and supports for HVAC system piping and equipment:
 - 1. Steel pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Non-metallic pipe hangers and supports.
 - 4. Non-metallic strut systems
 - 5. Fastener systems.
 - 6. Pipe stands.
 - 7. Pipe positioning systems.
 - 8. Equipment supports.
- B. Related Sections include the following:
 - 1. Division 05 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
 - 2. Division 20 "Vibration Controls" for vibration isolation devices.
 - 3. Division 23 "Metal Ducts" for duct hangers and supports.

1.3 DEFINITIONS

- A. ASCE: American Society of Civil Engineers.
- B. ASME: American Society of Mechanical Engineers.
- C. ASTM: American Society for Testing and Materials.
- D. AWS: American Welding Society.

- E. IAPMO: International Association of Plumbing and Mechanical Officials.
- F. MFMA: Metal Framing Manufacturers Association.
- G. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry Inc.
- H. SSPC: Steel Structures Painting Council now the Society for Protective Coatings.
- I. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 DELEGATED DESIGN PERFORMANCE REQUIREMENTS

- A. This specification is a performance based delegated design. These elements of the design are deferred submittal components. The Contractor is required to submit the stamped component system documents to the building official for approval.
- B. The Contractor is responsible for the design of the system including the structural integrity and connections to the primary structure, including all connections and secondary supports and secondary support framing. Structural elements in the building have been designed for the anticipated vertical loads. The design responsibility of the Contractor applies to all miscellaneous metals that are found to be necessary to support the piping systems and equipment.
- C. Any miscellaneous steel support framing that is determined to be necessary based on the Contractors design, including but not limited to braces, added reinforcing, and or ties shall be designed and supplied by the Contractor.
- D. Design supports for individual pipes 2-1/2" and larger, all spring support assemblies, multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, pipe insulation, and test water.
- E. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel pipe hangers and supports.
 - 2. Non-metallic pipe hangers and supports.
 - 3. Thermal-hanger shield inserts.
- B. Shop Drawings: Show fabrication and installation details and include calculations stamped by a structural engineer licensed to perform work in the State of Michigan for the following:
 - 1. Trapeze pipe hangers. Include Product Data for components.
 - 2. Non-metallic strut systems. Include Product Data for components.
 - 3. Pipe stands. Include Product Data for components.
 - 4. Equipment supports.

- C. Welding certificates.
- 1.6 QUALITY ASSURANCE
 - A. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code--Steel."
 - 2. AWS D1.2, "Structural Welding Code--Aluminum."
 - 3. AWS D1.3, "Structural Welding Code--Sheet Steel."
 - 4. AWS D1.4, "Structural Welding Code--Reinforcing Steel."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

2.2 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AAA Technology & Specialties Co., Inc.
 - 2. Anvil International.
 - 3. Bergen-Power Pipe Supports.
 - 4. B-Line Systems, Inc.; a division of Cooper Industries.
 - 5. Carpenter & Paterson, Inc.
 - 6. Empire Industries, Inc.
 - 7. ERICO/Michigan Hanger Co.
 - 8. Globe Pipe Hanger Products, Inc.
 - 9. Grinnell Corp.
 - 10. GS Metals Corp.
 - 11. National Pipe Hanger Corporation.
 - 12. PHD Manufacturing, Inc.
 - 13. PHS Industries, Inc.

- 14. Piping Technology & Products, Inc.
- 15. Tolco Inc.
- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- D. Non-metallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

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

2.4 NON-METALLIC PIPE HANGERS

- A. Clevis-Type, Fiberglass Pipe Hangers: Similar to MSS Type 1, steel pipe hanger except hanger is made of fiberglass and continuous-thread rod and nuts are made of polyurethane or stainless steel.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International.
 - b. B-Line Systems, Inc.; a division of Cooper Industries.
 - c. Champion Fiberglass, Inc.
 - d. Cope, T. J., Inc.; Tyco International, Ltd.
 - e. Seasafe, Inc.
 - f. Unistrut Corp.; Tyco International, Ltd.
 - g. Wesanco, Inc.

2.5 THERMAL-HANGER SHIELD INSERTS

- A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Carpenter & Paterson, Inc.
 - 2. ERICO/Michigan Hanger Co.
 - 3. PHS Industries, Inc.
 - 4. Pipe Shields, Inc., a subsidiary of Piping Technology & Products, Inc.
 - 5. Rilco Manufacturing Company, Inc.
 - 6. Value Engineered Products, Inc.

- C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass with vapor barrier.
- D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass.
- E. Insulation-Insert Material for Closed Cell Foam Insulated Piping: As manufactured by Klo-Sure or approved equal.
- F. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- G. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- H. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

- A. Mechanical-Expansion Anchors: Insert-wedge-type [**zinc-coated**] [**stainless**] steel, for use in hardened Portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. B-Line Systems, Inc.; a division of Cooper Industries.
 - b. Empire Industries, Inc.
 - c. Hilti, Inc.
 - d. ITW Ramset/Red Head.
 - e. MKT Fastening, LLC.
 - f. Powers Fasteners.

2.7 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel or stainless steel shapes with appropriate finish based on location of use.

2.8 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Stainless Steel: ASTM A 304, stainless steel plates, shapes, and bars.
- C. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

- 3.1 HANGER AND SUPPORT APPLICATIONS
 - A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
 - B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
 - C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
 - D. Use non-metallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
 - E. Use padded hangers for piping that is subject to scratching.
 - F. Holes shall not be drilled or punched in beams and supporting members. Do not support piping from roof deck, other piping, ducts, or equipment.
 - G. Hangers and supports shall also be provided at every change in direction and within 12 inches of any pipe fitting and valves.
 - H. Pipe hangers in fan rooms and in mechanical equipment rooms shall be provided with spring hangers with elastomeric inserts to eliminate noise transmission between piping and the building structure. Refer to Division 20 "Vibration Controls."
 - I. Hanger components shall not be used for purposes other than for which they were designed.
 - J. Vertical runs of piping not subject to appreciable expansion shall be supported by approved wrought steel clamps or collars, securely clamped to the risers. Where required, spring supports and guides shall be provided.
 - K. Where negligible movement of pipe occurs at hanger locations, rod hangers may be used for suspended lines. For piping supported from below, braces, brackets or structural cross members may be used.
 - L. If the vertical angle of the hanger is greater than 4 degrees, a traveling device shall be provided for horizontal movement. For piping supported from below, rollers or roll carriages shall be used.
 - M. Where significant vertical movement of the pipe occurs at the hanger location, a resilient support shall be used. Spring cushion hangers may be used where vertical movement does not exceed 1/4 inches.
 - N. Pipe attachments for insulated pipe shall be outside the insulation. Insulation protection shields or high density insulation inserts shall be provided to protect the insulation.
 - O. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.

- 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
- 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
- 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
- 5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow offcenter closure for hanger installation before pipe erection.
- 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.
- 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
- 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
- 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
- 10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
- 11. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
- 12. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
- 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
- 14. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
- 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
- Adjustable, Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
- 17. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
- 18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.
- 19. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
- 20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
- 21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

- P. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
 - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- Q. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 - 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 - 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 - 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 - 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- R. Building Attachments: Use of "C" clamps and beam clamps of "C" pattern and any modification thereof for pipe sizes 2-1/2 inches and larger is prohibited unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 - 2. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 - 3. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 - 4. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 - 5. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 - 6. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 - 7. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel Ibeams for heavy loads.
 - 8. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel Ibeams for heavy loads, with link extensions.
 - 9. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 - 10. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb..
 - b. Medium (MSS Type 32): 1500 lb..
 - c. Heavy (MSS Type 33): 3000 lb..
 - 11. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 - 12. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

- 13. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- S. Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 - 2. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- T. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 - 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 - 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 - 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 - 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.
 - 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
 - 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.
 - 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- U. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- V. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.
- W. Use pipe positioning systems (Sioux Chief or approved equal) in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Provide necessary piping and equipment supporting elements including building structure attachments, supplementary steel, hanger rods, stanchions and fixtures, vertical pipe attachments, horizontal pipe attachments, anchors, guides, spring supports in accordance with the referenced codes, standards, and requirements specified. Support piping and equipment from building structure, not from roof deck, floor slab, or other pipes, ducts, or equipment.
- B. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- C. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- D. Non-metallic Pipe Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.
- E. Non-metallic Strut System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled fiberglass struts.
- F. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- G. Fastener System Installation:
 - 1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- H. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- I. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- J. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- K. Install lateral bracing with pipe hangers and supports to prevent swaying.
- L. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- M. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

- N. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.
- O. Insulated Piping: Comply with the following:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weightdistribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weightdistribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
 - 5. Pipes NPS 8 and Larger: Include wood inserts.
 - 6. Insert Material: Length at least as long as protective shield.
 - 7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 SUPPLEMENTARY STEEL

A. Where it is necessary to frame structural members between existing structural steel members or where structural steel members are used in lieu of commercially rated supports, install such supplementary steel in accordance with American Institute of Steel Construction Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings. Connection to the existing steel shall be with clamps unless otherwise approved by the Engineer.

3.4 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.5 METAL FABRICATIONS

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

3.6 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.7 PAINTING

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

END OF SECTION 20 05 29
SECTION 20 05 48 - VIBRATION CONTROLS 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.
- B. Division 20, Common Work Results for Mechanical, requirements apply to this section.
- C. Division 01 Project Management and Coordination, applies to this section and will require the contractors' participation in the Above Ceiling Coordination Program.

1.2 SUMMARY

- A. Section Includes:
 - 1. Spring hangers.
 - 2. Restrained isolation roof-curb rails.

1.3 SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
 - 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device type required.
- B. Shop Drawings:
 - 1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
 - 2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
- C. Delegated-Design Submittal: For each vibration isolation device.
 - 1. Include design calculations for selecting vibration isolators and for designing vibration isolation bases.
- D. Coordination Drawings: Show coordination of vibration isolation device installation for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.
- E. Qualification Data: For testing agency.

- F. Welding certificates.
- 1.4 QUALITY ASSURANCE
 - A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code Steel."

PART 2 - PRODUCTS

2.1 SPRING HANGERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Kinetics Noise Control.
 - 2. Mason Industries.
 - 3. Vibro-Acoustics.
 - 4. Vibration Eliminator Co.
 - 5. Vibration Mountings & Controls.
- B. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression.
- C. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
- D. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
- E. Minimum Additional Travel: 50 percent of the required deflection at rated load.
- F. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
- G. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
- H. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
- I. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
- J. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

2.2 RESTRAINED ISOLATION ROOF-CURB RAILS

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

- 1. Kinetics Noise Control.
- 2. Mason Industries, Inc.
- 3. Thybar Corporation.
- 4. Vibro-Acoustics.
- B. Description: Factory-assembled, fully enclosed, insulated, air- and watertight curb rail designed to resiliently support equipment.
- C. Upper Frame: Upper frame shall provide continuous and captive support for equipment.
- D. Lower Support Assembly: The lower support assembly shall be formed sheet metal section containing adjustable and removable steel springs that support upper frame. The lower support assembly shall have a means for attaching to building structure and a wood nailer for attaching roof materials and shall be insulated with a minimum of 2 inches of rigid glass-fiber insulation on inside of assembly. Adjustable, restrained-spring isolators shall be mounted on elastomeric vibration isolation pads and shall have access ports, for level adjustment, with removable waterproof covers at all isolator locations. Isolators shall be located so they are accessible for adjustment at any time during the life of the installation without interfering with the integrity of the roof.
- E. Snubber Bushings: All-directional, elastomeric snubber bushings at least 1/4 inch thick.
- F. Water Seal: Galvanized sheet metal with EPDM seals at corners, attached to upper support frame, extending down past wood nailer of lower support assembly, and counterflashed over roof materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 VIBRATION CONTROL DEVICE INSTALLATION

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Division 03 "Miscellaneous Cast-in-Place Concrete."
- B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

END OF SECTION 20 05 48

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SECTION 20 05 53 – MECHANICAL IDENTIFICATION

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. Division 20, Common Work Results for Mechanical, requirements apply to this section.
- C. Division 01 Project Management and Coordination, applies to this section and will require the contractors' participation in the Above Ceiling Coordination Program.

1.2 SUMMARY

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

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

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

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following:
 - 1. Brady Co.
 - 2. Bramer.
 - 3. Craftmark.
 - 4. Emed.
 - 5. Marking Services, Inc.
 - 6. Seton Name Plate Corp.

2.2 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
 - 1. Material and Thickness: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 4. Fasteners: Stainless-steel self-tapping screws
 - 5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
- C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

- C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.

2.4 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2inch numbers.
 - 1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass wire-link or beaded chain; or S-hook
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Valve-tag schedule shall be included in operation and maintenance data.

PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.

- 4. At access doors, manholes, and similar access points that permit view of concealed piping.
- 5. Near major equipment items and other points of origination and termination.
- 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
- 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- B. Pipe Label Color Schedule:
 - 1. Sanitary Waste and Vent Piping:
 - a. Background Color: Green.
 - b. Letter Color: White.
 - 2. Refrigerant Piping:
 - a. Background Color: Black.
 - b. Letter Color: White.

3.4 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
 - 1. Valve-Tag Size and Shape:
 - a. Sanitary: 2 inches, round.
 - b. Refrigerant: 2 inches, round.
 - 2. Valve-Tag Color:
 - a. Sanitary: Natural
 - b. Refrigerant: Natural.
 - 3. Letter Color: Black

END OF SECTION 20 05 53

SECTION 20 05 93 - TESTING, ADJUSTING, AND BALANCING

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. Division 20, Common Work Results for Mechanical, requirements apply to this section.
- C. Division 01 Project Management and Coordination, applies to this section and will require the contractors' participation in the Above Ceiling Coordination Program.

1.2 SUMMARY

- A. This Section includes TAB to produce design objectives for the following:
 - 1. Air Systems:
 - a. Constant-volume air systems.
 - 2. Vibration measuring.
 - 3. Existing systems TAB.
 - 4. Verifying that automatic control devices are functioning properly.
 - 5. Reporting results of activities and procedures specified in this Section.

1.3 DEFINITIONS

- A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.
- C. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.
- D. 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. NC: Noise criteria.
- F. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.

- G. RC: Room criteria.
- 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. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
- O. Test: A procedure to determine quantitative performance of systems or equipment.
- P. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

1.4 SUBMITTALS

- A. Qualification Data: Within **15** days from Contractor's Notice to Proceed, submit electronic copies of evidence that TAB firm and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 15 days from Contractor's Notice to Proceed, submit electronic copies of the Contract Documents review report as specified in Part 3.
- C. Strategies and Procedures Plan: Within 30 days from Contractor's Notice to Proceed, submit electronic copies of TAB strategies and step-by-step procedures as specified in Part 3 "Preparation" Article. Include a complete set of report forms intended for use on this Project.
- D. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.
- E. Warranties specified in this Section.

1.5 QUALITY ASSURANCE

- A. TAB Firm Qualifications: Engage a TAB firm certified by NEBB or TABB.
- B. Acceptable TAB Firms: Subject to compliance with requirements, select from one of the following TAB firms:
 - 1. Absolut Balance Co.

- 2. Air Flow Testing, Inc.
- 3. Barmatic Inspecting Co.
- 4. Ener-Tech.
- 5. EnviroAire Total Balance, Inc.
- 6. International Test & Balance, Inc
- C. TAB Conference: Meet with Owner's and Architect's representatives on approval of TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, HVAC controls installers, and other support personnel. Provide seven days' advance notice of scheduled meeting time and location.
 - 1. Agenda Items: Include at least the following:
 - a. Submittal distribution requirements.
 - b. The Contract Documents examination report.
 - c. TAB plan.
 - d. Work schedule and Project-site access requirements.
 - e. Coordination and cooperation of trades and subcontractors.
 - f. Coordination of documentation and communication flow.
- D. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 - 2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.
- E. TAB Report Forms: Use standard forms from NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."
- F. Instrumentation Type, Quantity, and Accuracy: As described in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."
- G. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.
 - 1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

1.6 PROJECT CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.7 COORDINATION

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.
- B. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
- C. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.8 WARRANTY

- A. Special Guarantee: Provide a guarantee on NEBB forms stating that NEBB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee shall include the following provisions:
 - 1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
 - 2. Systems are balanced to optimum performance capabilities within design and installation limits.
- PART 2 PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
 - 1. Contract Documents are defined in the General and Supplementary Conditions of Contract.
 - 2. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flowcontrol devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- B. Examine approved submittal data of systems and equipment.
- C. Examine Project Record Documents described in Division 01 Section "Project Record Documents."
- D. Examine design data, including system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about system and equipment controls.

- E. Examine equipment performance data including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.
- F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.
- G. Examine system and equipment test reports.
- H. Examine system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
- J. Examine equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- K. Examine strainers for clean screens and proper perforations.
- L. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- M. Examine system pumps to ensure absence of entrained air in the suction piping.
- N. Examine equipment for installation and for properly operating safety interlocks and controls.
- O. Examine automatic temperature system components to verify the following:
 - 1. Dampers, valves, and other controlled devices are operated by the intended controller.
 - 2. Dampers and valves are in the position indicated by the controller.
 - 3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
 - 4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
 - 5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
 - 6. Sensors are located to sense only the intended conditions.
 - 7. Sequence of operation for control modes is according to the Contract Documents.
 - 8. Controller set points are set at indicated values.
 - 9. Interlocked systems are operating.
 - 10. Changeover from heating to cooling mode occurs according to indicated values.

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

3.2 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system readiness checks and prepare system readiness reports. Verify the following:
 - 1. Permanent electrical power wiring is complete.
 - 2. Automatic temperature-control systems are operational.
 - 3. Equipment and duct access doors are securely closed.
 - 4. Balance, smoke, and fire dampers are open.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" or SMACNA's TABB "HVAC Systems - Testing, Adjusting, and Balancing" and this Section.
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.
- C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 - 1. Manufacturer, model, and serial numbers.
 - 2. Motor horsepower rating.
 - 3. Motor rpm.
 - 4. Efficiency rating.
 - 5. Nameplate and measured voltage, each phase.
 - 6. Nameplate and measured amperage, each phase.
 - 7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation.

Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.5 PROCEDURES FOR CONDENSING UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record compressor data.

3.6 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Refrigerant Coils: Measure the following data for each 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.

3.7 PROCEDURES FOR TEMPERATURE MEASUREMENTS

- A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.
- B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of two successive eight-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.
- C. Measure outside-air, wet- and dry-bulb temperatures.

3.8 PROCEDURES FOR VIBRATION MEASUREMENTS

- A. Use a vibration meter meeting the following criteria:
 - 1. Solid-state circuitry with a piezoelectric accelerometer.
 - 2. Velocity range of 0.1 to 10 inches per second.
 - 3. Displacement range of 1 to 100 mils.
 - 4. Frequency range of at least 0 to 1000 Hz.
 - 5. Capable of filtering unwanted frequencies.
- B. Calibrate the vibration meter before each day of testing.
 - 1. Use a calibrator provided with the vibration meter.
 - 2. Follow vibration meter and calibrator manufacturer's calibration procedures.

- C. Perform vibration measurements when other building and outdoor vibration sources are at a minimum level and will not influence measurements of equipment being tested.
 - 1. Turn off equipment in the building that might interfere with testing.
 - 2. Clear the space of people.
- D. Perform vibration measurements after air and water balancing and equipment testing is complete.
- E. Clean equipment surfaces in contact with the vibration transducer.
- F. Position the vibration transducer according to manufacturer's written instructions and to avoid interference with the operation of the equipment being tested.
- G. Measure and record vibration on rotating equipment over 3 hp.
- H. Measure and record equipment vibration, bearing vibration, equipment base vibration, and building structure vibration. Record velocity and displacement readings in the horizontal, vertical, and axial planes.
 - 1. Pumps:
 - a. Pump Bearing: Drive end and opposite end.
 - b. Motor Bearing: Drive end and opposite end.
 - c. Pump Base: Top and side.
 - d. Building: Floor.
 - e. Piping: To and from the pump after flexible connections.
 - 2. HVAC Equipment with Compressors:
 - a. Compressor Bearing: Drive end and opposite end.
 - b. Motor Bearing: Drive end and opposite end.
 - c. Equipment Casing: Top and side.
 - d. Equipment Base: Top and side.
 - e. Building: Floor.
 - f. Piping: To and from equipment after flexible connections.
- I. For equipment with vibration isolation, take floor measurements with the vibration isolation blocked solid to the floor and with the vibration isolation floating. Calculate and report the differences.
- J. Inspect, measure, and record vibration isolation.
 - 1. Verify that vibration isolation is installed in the required locations.
 - 2. Verify that installation is level and plumb.
 - 3. Verify that isolators are properly anchored.
 - 4. For spring isolators, measure the compressed spring height, the spring OD, and the travelto-solid distance.

5. Measure the operating clearance between each inertia base and the floor or concrete base below. Verify that there is unobstructed clearance between the bottom of the inertia base and the floor.

3.9 TEMPERATURE-CONTROL VERIFICATION

- A. Verify that controllers are calibrated and commissioned.
- B. Check transmitter and controller locations and note conditions that would adversely affect control functions.
- C. Record controller settings and note variances between set points and actual measurements.
- D. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).
- E. Check free travel and proper operation of control devices such as damper and valve operators.
- F. Check the sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water flow measurements. Note the speed of response to input changes.
- G. Check the interaction of electrically operated switch transducers.
- H. Check the interaction of interlock and lockout systems.
- I. Check main control supply-air pressure and observe compressor and dryer operations.
- J. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or nongrounded power supply.
- K. Note operation of electric actuators using spring return for proper fail-safe operations.

3.10 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.11 FINAL REPORT

A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in threering binder, tabulated and divided into sections by tested and balanced systems.

- B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
 - 1. Include a list of instruments used for procedures, along with proof of calibration.
- C. Final Report Contents: In addition to certified field report data, include the following:
 - 1. Pump curves.
 - 2. Manufacturers' test data.
 - 3. Field test reports prepared by system and equipment installers.
 - 4. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.
- D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
 - 1. Title page.
 - 2. Name and address of TAB firm.
 - 3. Project name.
 - 4. Project location.
 - 5. Architect's name and address.
 - 6. Engineer's name and address.
 - 7. Contractor's name and address.
 - 8. Report date.
 - 9. Signature of TAB firm who certifies the report.
 - 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 - 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 - 12. Nomenclature sheets for each item of equipment.
 - 13. Data for terminal units, including manufacturer, type size, and fittings.
 - 14. Notes to explain why certain final data in the body of reports varies from indicated values.
 - 15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outside-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Other system operating conditions that affect performance.
- E. 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 o.c.
- f. Make and model number.
- g. Face area in sq. ft..
- h. Tube size in NPS.
- i. Tube and fin materials.
- j. Circuiting arrangement.
- 2. Test Data (Indicated and Actual Values):
 - a. Airflow rate in cfm.
 - b. Average face velocity in fpm.
 - c. Air pressure drop in inches wg.
 - d. Outside-air, wet- and dry-bulb temperatures in deg F.
 - e. Return-air, wet- and dry-bulb temperatures in deg F.
 - f. Entering-air, wet- and dry-bulb temperatures in deg F.
 - g. Leaving-air, wet- and dry-bulb temperatures in deg F.
 - h. Refrigerant expansion valve and refrigerant types.
 - i. Refrigerant suction pressure in psig.
 - j. Refrigerant suction temperature in deg F.
- F. Compressor and Condenser Reports: For refrigerant side of unitary systems, stand-alone refrigerant compressors, air-cooled condensing units, or water-cooled condensing units, include the following:
 - 1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Unit make and model number.
 - d. Compressor make.
 - e. Compressor model and serial numbers.
 - f. Refrigerant weight in lb.
 - g. Low ambient temperature cutoff in deg F.
 - 2. Test Data (Indicated and Actual Values):
 - a. Inlet-duct static pressure in inches wg.
 - b. Outlet-duct static pressure in inches wg.
 - c. Entering-air, dry-bulb temperature in deg F.

- d. Leaving-air, dry-bulb temperature in deg F.
- e. Condenser entering-water temperature in deg F.
- f. Condenser leaving-water temperature in deg F.
- g. Condenser-water temperature differential in deg F.
- h. Condenser entering-water pressure in feet of head or psig.
- i. Condenser leaving-water pressure in feet of head or psig.
- j. Condenser-water pressure differential in feet of head or psig.
- k. Control settings.
- I. Unloader set points.
- m. Low-pressure-cutout set point in psig.
- n. High-pressure-cutout set point in psig.
- o. Suction pressure in psig.
- p. Suction temperature in deg F.
- q. Condenser refrigerant pressure in psig.
- r. Condenser refrigerant temperature in deg F.
- s. Voltage at each connection.
- t. Amperage for each phase.
- u. Kilowatt input.
- v. Crankcase heater kilowatt.
- w. Number of fans.
- x. Condenser fan rpm.
- y. Condenser fan airflow rate in cfm.
- z. Condenser fan motor make, frame size, rpm, and horsepower.
- aa. Condenser fan motor voltage at each connection.
- bb. Condenser fan motor amperage for each phase.
- G. 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 and serial numbers.
 - f. Water flow rate in gpm.
 - g. Water pressure differential in feet of head or psig.
 - h. Required net positive suction head in feet of head or psig.

- i. Pump rpm.
- j. Impeller diameter in inches.
- k. Motor make and frame size.
- I. 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.
 - b. Pump shutoff pressure in feet of head or psig.
 - c. Actual impeller size in inches.
 - d. Full-open flow rate in gpm.
 - e. Full-open pressure in feet of head or psig.
 - f. Final discharge pressure in feet of head or psig.
 - g. Final suction pressure in feet of head or psig.
 - h. Final total pressure in feet of head or psig.
 - i. Final water flow rate in gpm.
 - j. Voltage at each connection.
 - k. Amperage for each phase.
- H. Vibration Measurement Reports:
 - 1. Date and time of test.
 - 2. Vibration meter manufacturer, model number, and serial number.
 - 3. Equipment designation, location, equipment, speed, motor speed, and motor horsepower.
 - 4. Diagram of equipment showing the vibration measurement locations.
 - 5. Measurement readings for each measurement location.
 - 6. Calculate isolator efficiency using measurements taken.
 - 7. Description of predominant vibration source.
- I. Instrument Calibration Reports:
 - 1. Report Data:
 - a. Instrument type and make.
 - b. Serial number.
 - c. Application.
 - d. Dates of use.
 - e. Dates of calibration.

3.12 INSPECTIONS

- A. Initial Inspection:
 - 1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the Final Report.
 - 2. Randomly check the following for each system:
 - a. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
 - b. Verify that balancing devices are marked with final balance position.
 - c. Note deviations to the Contract Documents in the Final Report.
- B. Final Inspection:
 - 1. After initial inspection is complete and evidence by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Architect.
 - 2. TAB firm test and balance engineer shall conduct the inspection in the presence of [Architect.
 - 3. Architect shall randomly select measurements documented in the final report to be rechecked. The rechecking shall be limited to either 10 percent of the total measurements recorded, or the extent of measurements that can be accomplished in a normal 8-hour business day.
 - 4. If the rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
 - 5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
 - 6. TAB firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.
 - 7. Request a second final inspection. If the second final inspection also fails, Owner shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment.

3.13 ADDITIONAL TESTS

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

END OF SECTION 20 05 93

SECTION 20 07 00 - MECHANICAL 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.
- B. Division 20, Common Work Results for Mechanical, requirements apply to this section.
- C. Division 01 Project Management and Coordination, applies to this section and will require the contractors' participation in the Above Ceiling Coordination Program.

1.2 SUMMARY

- A. Section Includes:
 - 1. Insulation Materials:
 - a. Flexible elastomeric.
 - 2. Adhesives.
 - 3. Mastics.
 - 4. Sealants.
 - 5. Factory-applied jackets.
 - 6. Tapes.
 - 7. Securements.
 - 8. Corner angles.

1.3 DEFINITIONS

- A. ASHRAE/IESNA: American Society of Heating, Refrigeration, Air Conditioning Engineers/Illuminating Engineering Society of North America.
- B. ASTM: American Society for Testing and Materials.
- C. CFC: Chlorinated Fluorocarbon.
- D. HCFC: Hydrogenated Chlorofluorocarbon.
- E. LEED: Leadership in Energy and Environmental Design.
- F. MIL: Military.
- G. NPS: Nominal Pipe Size.

H. VOC: Volatile Organic Compound.

1.4 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 attachment and covering of heat tracing inside insulation.
 - 3. Detail insulation application at pipe expansion joints for each type of insulation.
 - 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 5. Detail removable insulation at piping specialties, equipment connections, and access panels.
 - 6. Detail application at linkages of control devices.
- C. Qualification Data: For qualified Installer.
- D. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- E. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.
- C. Comply with the following applicable standards and other requirements specified for miscellaneous components:
 - 1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.6 DELIVERY, STORAGE, AND HANDLING

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

1.7 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 20 "Hangers and Supports."
- 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.

1.8 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. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
 - 1. Products: Subject to compliance with requirements, provide one of the following:

- a. Aeroflex USA, Inc.; Aerocel.
- b. Armacell LLC; AP Armaflex.
- c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.

2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Flexible Elastomeric: 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 LLC; Armaflex 520 Adhesive.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
 - d. K-Flex USA; R-373 Contact Adhesive.
 - 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. 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.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
 - b. Eagle Bridges Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
 - d. Mon-Eco Industries, Inc.; 22-25.
 - 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
 - 1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
 - b. Vimasco Corporation; 749.
- 2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
- 3. Service Temperature Range: Minus 20 to plus 180 deg F.
- 4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
- 5. Color: White.
- C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30.
 - b. Eagle Bridges Marathon Industries; 501.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35.
 - d. Mon-Eco Industries, Inc.; 55-10.
 - 2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
 - 3. Service Temperature Range: 0 to 180 deg F.
 - 4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
 - 5. Color: White.
- D. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
 - b. Eagle Bridges Marathon Industries; 550.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
 - d. Mon-Eco Industries, Inc.; 55-50.
 - e. Vimasco Corporation; WC-1/WC-5.
 - 2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 4. Solids Content: 60 percent by volume and 66 percent by weight.
 - 5. Color: White.

2.4 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Eagle Bridges Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
 - d. Mon-Eco Industries, Inc.; 44-05.
- 2. Materials shall be compatible with insulation materials, jackets, and substrates.
- 3. Fire- and water-resistant, flexible, elastomeric sealant.
- 4. Service Temperature Range: Minus 40 to plus 250 deg F.
- 5. Color: Aluminum.
- 6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- 7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.5 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
 - 1. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with Kraft-paper backing; complying with ASTM C 1136, Type II.
 - 2. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested according to ASTM E 96, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.6 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 428 AWF ASJ.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
 - c. Compac Corporation; 104 and 105.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 - 2. Width: 3 inches.
 - 3. Thickness: 11.5 mils.
 - 4. Adhesion: 90 ounces force/inch in width.
 - 5. Elongation: 2 percent.
 - 6. Tensile Strength: 40 lbf/inch in width.

- 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 491 AWF FSK.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - c. Compac Corporation; 110 and 111.
 - d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
 - 2. Width: 3 inches.
 - 3. Thickness: 6.5 mils.
 - 4. Adhesion: 90 ounces force/inch in width.
 - 5. Elongation: 2 percent.
 - 6. Tensile Strength: 40 lbf/inch in width.
 - 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 488 AWF.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - c. Compac Corporation; 120.
 - d. Venture Tape; 3520 CW.
 - 2. Width: 2 inches.
 - 3. Thickness: 3.7 mils.
 - 4. Adhesion: 100 ounces force/inch in width.
 - 5. Elongation: 5 percent.
 - 6. Tensile Strength: 34 lbf/inch in width.

2.7 SECUREMENTS

- A. Bands:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ITW Insulation Systems; Gerrard Strapping and Seals.
 - b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs
 - 2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 316; 0.015 inch thick, 1/2 inch wide with wing seal.
- B. Insulation Pins and Hangers:

- 1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, [0.106-inch-] [0.135-inch-] diameter shank, length to suit depth of insulation indicated.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; CWP-1.
 - 2) GEMCO; CD.
 - 3) Midwest Fasteners, Inc.; CD.
 - 4) Nelson Stud Welding; TPA, TPC, and TPS.
- 2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; CHP-1.
 - 2) GEMCO; Cupped Head Weld Pin.
 - 3) Midwest Fasteners, Inc.; Cupped Head.
 - 4) Nelson Stud Welding; CHP.
- 3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
 - 2) GEMCO; Perforated Base.
 - 3) Midwest Fasteners, Inc.; Spindle.
 - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Aluminum, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
- 4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) GEMCO; Nylon Hangers.
 - 2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
 - b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
 - c. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.

- d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
- 5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; Tactoo Self-Adhering Insul-Hangers.
 - 2) GEMCO; Peel & Press.
 - 3) Midwest Fasteners, Inc.; Self Stick.
 - b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Aluminum, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive-backed base with a peel-off protective cover.
- 6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, aluminum sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; RC-150.
 - 2) GEMCO; R-150.
 - 3) Midwest Fasteners, Inc.; WA-150.
 - 4) Nelson Stud Welding; Speed Clips.
 - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
- 7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inchthick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) GEMCO.
 - 2) Midwest Fasteners, Inc.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
- D. Wire: 0.062-inch soft-annealed, stainless steel.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. C & F Wire.

2.8 CORNER ANGLES

A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

- B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.
- C. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or 316.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
 - 1. Verify that systems and equipment to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
 - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation (Conditioned Spaces): Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Surface Preparation (Unconditioned Spaces and Exposed to Weather): Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
 - Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
 - 2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.

- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at [2 inches] [4 inches] o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- C. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
 - 1. Comply with requirements in Division 07 "Penetration Firestopping" and fire-resistive joint sealers.
- D. Insulation Installation at Floor Penetrations:
 - 1. Pipe: Install insulation continuously through floor penetrations.
 - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

- 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
- 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
- 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
- 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
- 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
- 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
- 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
- 8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
- 9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
 - 1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 - 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe

insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.

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

3.6 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

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

- A. Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.
 - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.
- 3.8 FIELD QUALITY CONTROL
 - A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
 - B. Perform tests and inspections.
 - C. Tests and Inspections:
 - 1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
 - D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.9 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

3.10 INDOOR PIPING INSULATION SCHEDULE

- A. Refer to "Piping Application Schedule" in the drawings.
- B. Condensate and Equipment Drain Water below 60 Deg F:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Flexible Elastomeric: 1 inch thick.

- C. Refrigerant Suction and Hot-Gas Flexible Tubing:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Flexible Elastomeric: 1 inch thick.

3.11 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

- A. Refer to "Piping Application Schedule" in the drawings.
- B. Refrigerant Suction and Hot-Gas Flexible Tubing:
 - 1. All Pipe Sizes: Insulation shall be[**one of**] the following:
 - a. Flexible Elastomeric: 2 inches thick.

END OF SECTION 20 07 00

SECTION 22 13 16 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Division 20, Common Work Results for Mechanical, requirements apply to this section.
- C. Division 01 Project Management and Coordination, applies to this section and will require the contractors' participation in the Above Ceiling Coordination Program.

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipe, tube, and fittings.
 - 2. Specialty pipe fittings.
 - 3. Encasement for underground metal piping.
- B. Related Sections:
 - 1. Division 22 "Sump Pumps" for sump pumps.

1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.
- C. NBR: Acrylonitrile-butadiene rubber.
- D. PVC: Polyvinyl chloride plastic.

1.4 ACTION SUBMITTALS

- A. Coordination Drawings: Detail sanitary waste and vent piping. Show support locations, type of support, weight on each support, required clearances, and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Structural members to which drainage piping will be attached or suspended from.

- B. Coordination Drawings: Piping in congested areas such as mechanical rooms, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Fire suppression piping.
 - 2. Domestic water piping.
 - 3. Storm drainage piping.
 - 4. Compressed air piping.
 - 5. HVAC hydronic piping.
 - 6. Ductwork systems.
 - 7. Building structural systems.
 - 8. Electrical raceway systems.
 - 9. Electrical equipment working space and clearances.
 - 10. Items penetrating finished ceiling include the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Fire alarm devices.
 - e. Audio visual equipment.
- C. Product Data: For each type of product indicated.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

1.7 PROJECT CONDITIONS

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10-foot head of water.
 - 2. Waste, Force-Main Piping: 50 psig.

2.2 PIPING MATERIALS

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

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 and CISPI 301 stamped with the Cast Iron Soil Pipe Institute trademark. Pipe shall be cast vertically or by centrifugal process and the inside and outside diameters shall be concentric, smooth, and free from cracks, sand holes, and other defects.
- B. CISPI, Hubless-Piping Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ANACO-Husky.
 - b. Charlotte Pipe and Foundry Company
 - c. Fernco Inc.
 - d. Ideal Clamp Products
 - e. Josam Company.
 - f. MIFAB, Inc.
 - g. Mission Rubber Company; a division of MCP Industries, Inc.
 - h. Tyler Pipe; a subsidiary of McWane Inc.
 - 2. Couplings shall bear CISPI collective trademark and NSF certification mark.
 - 3. Standards: ASTM C 1277 and CISPI 310.
 - 4. Description: Stainless-steel corrugated shield with a minimum of four stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.4 COPPER TUBE AND FITTINGS

- A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
- B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solderjoint fittings.

- C. Hard Copper Tube: ASTM B 88, Type L and Type M, water tube, drawn temper.
- D. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.5 SPECIALTY PIPE FITTINGS

A. Specialty pipe fitting requirements are specified in Section 20 "Common Work Results."

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
 - 1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
 - 2. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install wall-penetration fitting at each service pipe penetration through foundation wall. Make installation watertight.
- J. Install piping to allow application of insulation.
- K. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.
 - 1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
 - 2. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.

- a. Straight tees, elbows, and crosses may be used on vent lines.
- 3. Do not change direction of flow more than 90 degrees.
- 4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
 - a. Reducing size of waste piping in direction of flow is prohibited.
- L. Install soil and waste drainage and vent piping at the minimum slopes required by code.
- M. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- N. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."
- O. Install engineered soil and waste drainage and vent piping systems as follows:
 - 1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
 - 2. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.
- P. Install force mains at elevations indicated.
- Q. Plumbing Specialties:
 - 1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping.
 - Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping. Comply with requirements for cleanouts specified in Division 22 "Sanitary Waste Piping Specialties."
- R. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section Division 20 "Common Work Results for Mechanical."
- T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 20 "Common Work Results for Mechanical."
- U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 20 "Common Work Results for Mechanical."

3.2 JOINT CONSTRUCTION

- A. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- B. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1.
 - 1. Cut threads full and clean using sharp dies.
 - 2. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

- a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
- b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- c. Do not use pipe sections that have cracked or open welds.
- C. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.
- D. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.
- E. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.

3.3 SPECIALTY PIPE FITTING INSTALLATION

A. Specialty pipe fitting installation requirements are specified in Division 20 "Common Work Results for Mechanical."

3.4 VALVE INSTALLATION

- A. General valve installation requirements are specified in Division 22 "General-Duty Valves for Plumbing Piping."
- B. Shutoff Valves:
 - 1. Install shutoff valve on each sump pump discharge.
 - 2. Install gate or full-port ball valve for piping NPS 2 and smaller.
- C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sump pump discharge.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hanger and support devices and installation specified in Section 20 "Hangers and Supports for Piping and Equipment."
 - 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
 - 2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
 - 3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
 - 4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
 - 5. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 6. Install individual, straight, horizontal piping runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.

- b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
- c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
- 7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
- 8. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.
- E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
 - 2. NPS 3: 60 inches with 1/2-inch rod.
 - 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
 - 4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
 - 5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.
 - 6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- F. Install supports for vertical cast-iron soil piping every 15 feet.
- G. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/4: 72 inches with 3/8-inch rod.
 - 2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 - 3. NPS 2-1/2: 108 inches with 1/2-inch rod.
 - 4. NPS 3 and NPS 5: 10 feet with 1/2-inch rod.
 - 5. NPS 6: 10 feet with 5/8-inch rod.
 - 6. NPS 8: 10 feet with 3/4-inch rod.
- H. Install supports for vertical copper tubing every 10 feet.
- I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

- C. Connect drainage and vent piping to the following:
 - 1. Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
 - 2. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
 - 3. Comply with requirements for cleanouts and drains specified in Section 22 "Sanitary Waste Piping Specialties."
 - 4. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.
- D. Connect force-main piping to the following:
 - 1. Sump Pump: To sump pump discharge.
- E. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- F. Make connections according to the following unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.7 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Division 20 "Mechanical Identification."

3.8 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

- 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
- 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
- 3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water . From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
- 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
- 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
- 6. Prepare reports for tests and required corrective action.
- E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - 3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 - 4. Prepare reports for tests and required corrective action.

3.9 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Repair damage to adjacent materials caused by waste and vent piping installation.

3.10 PIPING SCHEDULE

A. Refer to "Plumbing Piping System Application Schedule" in drawings.

END OF SECTION 22 13 16

SECTION 22 13 19 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Division 20, Common Work Results for Mechanical, requirements apply to this section.
- C. Division 01 Project Management and Coordination, applies to this section and will require the contractors' participation in the Above Ceiling Coordination Program.

1.2 SUMMARY

- A. Section Includes:
 - 1. Cleanouts.
 - 2. Miscellaneous sanitary drainage piping specialties.
 - 3. Oil interceptors.

1.3 SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
- 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.

1.7 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 "Cast-in-Place Concrete."
- B. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTIONS

- A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic sanitary waste piping specialty components.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing, and marked for intended location and application.

2.2 CLEANOUTS

- A. Cast-Iron Exposed Cleanouts:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.
 - d. Tyler Pipe.
 - e. Watts Water Technologies, Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 - 2. Standard: ASME A112.36.2M.
 - 3. Size: Same as connected drainage piping
 - 4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
 - 5. Closure: Countersunk , brass plug.
 - 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
- B. Cast-Iron Exposed Floor Cleanouts:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company.
 - b. Oatey.

- c. Sioux Chief Manufacturing Co., Inc.
- d. Smith, Jay R. Mfg. Co.
- e. Tyler Pipe.
- f. Watts Water Technologies, Inc.
- g. Zurn Plumbing Products Group; Specification Drainage Operation.
- 2. Standard: ASME A112.36.2M for heavy-duty, adjustable housing cleanout.
- 3. Size: Same as connected branch.
- 4. Type: Heavy-duty, adjustable housing .
- 5. Body or Ferrule Material: Cast iron.
- 6. Clamping Device: Required .
- 7. Outlet Connection: Spigot .
- 8. Closure: Brass, bronze or plastic with tapered threads .
- 9. Adjustable Housing Material: Cast iron with threads, set-screws or other device .
- 10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy . In finished areas provide a recessed cover for finished floor material.
- 11. Frame and Cover Shape: Round .
- 12. Top-Loading Classification: Medium Duty .
- 13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
- C. Cast-Iron Wall Cleanouts:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.
 - d. Tyler Pipe.
 - e. Watts Water Technologies, Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 - 2. Standard: ASME A112.36.2M. Include wall access.
 - 3. Size: Same as connected drainage piping.
 - 4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
 - 5. Closure: Countersunk, drilled-and-threaded brass or bronze plug with tapered threads.
 - 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
 - 7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.

2.3 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Air-Gap Fittings:

- 1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
- 2. Body: Bronze or cast iron.
- 3. Inlet: Opening in top of body.
- 4. Outlet: Larger than inlet.
- 5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

2.4 OIL INTERCEPTORS

- A. Oil Interceptors:
 - 1. Cast-Iron or Steel Oil Interceptors:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Highland Tank
 - 2. Type: Factory-fabricated interceptor for separating and removing oil from wastewater.
 - 3. Body Material: Cast iron or steel.
 - 4. Interior Lining: Corrosion-resistant enamel.
 - 5. Exterior Coating: Corrosion-resistant enamel.
 - 6. End Connections: Threaded.
 - 7. Filter: Integral.
 - 8. Diffusion baffle: required.
 - 9. Cleanout: Integral or field installed on outlet.
 - 10. Mounting: Above floor.
 - 11. Two float level sensor: required. Provide control panel as recommended by manufacturer.
 - 12. Power: 120v/1 phase.
 - 13. Unit to be capable of pumped through operation.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Equipment Mounting:
 - 1. Set interceptors level and plumb.
- B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 - 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.

- 2. Locate at each change in direction of piping greater than 45 degrees.
- 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
- 4. Locate at base of each vertical soil and waste stack.
- C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- E. Install air-gap fittings on indirect-waste piping discharge into sanitary drainage system.
- F. Install oil interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.

3.2 CONNECTIONS

- A. Comply with requirements in Section 22 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Oil Interceptors: Connect inlet, outlet, vent, and gravity drawoff piping to unit; flow-control fitting and vent to unit inlet piping; and gravity drawoff and suction piping to oil storage tank.
- D. Ground equipment according to Section 26 "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Section 26 "Low-Voltage Electrical Power Conductors and Cables."

3.3 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Oil interceptors.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 20 "Identification for Piping and Equipment."

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled oil separator and their installation, including piping and electrical connections, and to assist in testing.
- B. Tests and Inspections:

- 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
- 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.5 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.
- C. Protect sanitary waste interceptors from damage during construction period.
- D. Repair damage to adjacent materials caused by sanitary waste interceptor installation

3.6 DEMONSTRATION

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

END OF SECTION 22 13 19

SECTION 22 14 29 - SUMP PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Division 20, Common Work Results for Mechanical, requirements apply to this section.
- C. Division 01 Project Management and Coordination, applies to this section and will require the contractors' participation in the Above Ceiling Coordination Program.

1.2 SUMMARY

- A. Section Includes:
 - 1. Submersible sump pumps.
 - 2. Sump-pump basins and basin covers.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and mounting details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
 - 4. Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pumps and controls, to include in operation and maintenance manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Retain shipping flange protective covers and protective coatings during storage.
- B. Protect bearings and couplings against damage.
- C. Comply with pump manufacturer's written rigging instructions for handling.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- 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. UL Compliance: Comply with UL 778 for motor-operated water pumps.

2.2 SUBMERSIBLE SUMP PUMPS

- A. Submersible, Fixed-Position, Single-Seal Sump Pumps:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Barnes; Crane Pumps & Systems.
 - b. Bell & Gossett; a Xylem brand.
 - c. Goulds Pumps; ITT Corporation.
 - d. Grundfos Pumps Corp.
 - e. Pentair Pump Group.
 - f. Weil Pump Company, Inc.
 - g. Zoeller Company.
 - 2. Description: Factory-assembled and -tested sump-pump unit.
 - 3. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal sump pump as defined in HI 1.1-1.2 and HI 1.3.
 - 4. Pump Casing: Cast iron, with strainer inlet, legs that elevate pump to permit flow into impeller, and vertical discharge for piping connection.
 - 5. Impeller: Statically and dynamically balanced, ASTM A 48 Class 30, abrasion-resistant cast iron, semiopen design for clear wastewater handling, and keyed and secured to shaft.
 - 6. Pump and Motor Shaft: Stainless steel, with factory-sealed, grease-lubricated ball bearings.
 - 7. Seal: Mechanical.
 - 8. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.

- 9. Controls:
 - a. Enclosure: NEMA 250, Type 4X; pedestal-mounted.
 - b. Switch Type: Pressure type, in NEMA 250, Type 6 enclosures with mounting rod and electric cables.
 - c. High-Water Alarm: Rod-mounted, NEMA 250, Type 6 enclosure with pressure switch matching control and electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
- 10. Control-Interface Features:
 - a. Remote Alarm Contacts: For remote alarm interface.
 - b. Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:
 - 1) On-off status of pump.
 - 2) Alarm status.

2.3 SUMP PUMP CAPACITIES AND CHARACTERISTICS

A. Capacities and Characteristics: Refer to schedule on drawings.

2.4 SUMP-PUMP BASINS AND BASIN COVERS

- A. Basins: Poured Concrete
- B. Basin Covers: Open grate.
- C. Capacities and Characteristics: Refer to schedule on drawings.

2.5 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 20 "Common Motor Requirements."
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
- B. Motors for submersible pumps shall be hermetically sealed.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation and filling are specified in Section 31 "Earth Moving."

3.2 EXAMINATION

A. Examine roughing-in for plumbing piping to verify actual locations of storm drainage piping connections before sump pump installation.

3.3 INSTALLATION

A. Pump Installation Standards: Comply with HI 1.4 for installation of sump pumps.

3.4 CONNECTIONS

- A. Comply with requirements for piping specified in Division 22 "Sanitary Waste and Vent Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
 - 1. Perform each visual and mechanical inspection.
 - 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Pumps and controls will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.6 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.

3.7 ADJUSTING

- A. Adjust pumps to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust control set points.

3.8 DEMONSTRATION

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

END OF SECTION 22 14 29

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SECTION 23 09 00 - INSTRUMENTATION AND CONTROL 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.
- B. Division 20, Common Work Results for Mechanical, requirements apply to this section.
- C. Division 01 Project Management and Coordination, applies to this section and will require the contractors' participation in the Above Ceiling Coordination Program.
- D. Division 26 "Common Work Results for Electrical" requirements apply to this section and requires contractor participation in the Above Ceiling Coordination Program.

1.2 DEFINITIONS

- A. DDC: Direct Digital Control
- B. EMS: Energy Management System consisting of BAS (typically with a PC and support software), DDC controllers, and networking software/hardware/wiring.
- C. I/O: Input/output
- D. BACnet: A communications protocol for implementing interoperable controllers established by ASHRAE
- E. MS/TP: Master-slave/token-passing network for BACnet
- F. PC: Personal computer
- G. PID: Proportional plus integral plus derivative

1.3 SUMMARY

- A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.
 - 1. Provide Building Automation System (BAS) as shown in the contract documents and described herein.
 - 2. Provide interface to BAS via BACnet as shown in the contract documents and described herein.
 - 3. Sequences modified as a result of start-up, checkout, fine tuning, and/or commissioning shall be resubmitted to the Architect for record.

1.4 SEQUENCE OF OPERATION

A. Sequences of Operation are included on the temperature control drawings (plans).

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.
 - 1. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Bill of materials of equipment indicating quantity, manufacturer, and model number.
 - 2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
 - 3. Wiring Diagrams: Power, signal, and control wiring.
 - 4. Details of control panel faces, including controls, instruments, and labeling.
 - 5. Written description of sequence of operation.
 - 6. Schedule of dampers including size, leakage, and flow characteristics.
 - a. Coordinate dampers sizes with sheet metal and/or mechanical contractor before submitting.
- C. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with ASHRAE 135.
- D. Qualification Data:
 - 1. Manufacturer's product line being submitted shall be in full production for at least two years.
 - 2. Installer shall be factory trained and authorized in the installation, startup, check-out and commissioning of the manufacturer's product line being submitted. Installer's field personnel shall have at least three years' experience in the installation of DDC-style temperature control systems.
- E. Field quality control test reports
- F. Operation and Maintenance Data: For HVAC instrumentation and control system 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. Maintenance instructions and list of spare parts for each type of control device and the compressed air station.

- 2. Interconnection wiring diagrams with identified and numbered system components and devices.
- 3. Inspection period, cleaning methods, recommended cleaning materials, and calibration tolerances.
- 4. Calibration records and list of set points.

1.6 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.

1.7 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.

1.8 COORDINATION

- A. Coordinate location of thermostats, humidistats, DDC control sensors, and other exposed control sensors with plans and room details before installation.
- B. Coordinate equipment with Division 28 Section "Intrusion Detection" to achieve compatibility with equipment that interfaces with that system.
- C. Coordinate equipment with Division 28 Section "Access Control" to achieve compatibility with equipment that interfaces with that system.
- D. Coordinate supply of conditioned electrical branch circuits for control units and operator workstation.
- E. Coordinate equipment with Division 26 Section "Electrical Power Monitoring and Control" to achieve compatibility of communication interfaces.
- F. Coordinate installation of control dampers, instruments with the mechanical contractor.
- G. Coordinate installation of any exterior wall or roof-mounted sensors, instruments, photocells, or controllers required for the temperature control system with the General Contractor and the Architect prior to installation.
- H. Coordinate the color selection process of any sensor or device intended to be mounted on finished surfaces with the Architect prior to installation.

1.9 MAINTENANCE

A. The control system Contractor shall provide and maintain on site working spare parts for the control system during the warranty period including power supplies, modules, sensors, etc. The owner will be custodian of these spare parts and shall be authorized to utilize them in performing first level maintenance. The control contractor Contractor shall refurbish/replace spare parts in exchange for failed items.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STATUS SENSORS AND DEVICES - ELECTRIC

- A. Liquid Leak Detectors
 - 1. Liquid detectors shall utilize microchip technology for detection of conductive liquids through one of the following types of sensors: gold-plated probes, self-adhesive sensor tape with copper electrodes and durable cotton cover, or rope type sensor. Detectors shall be selected based on the best use for the application. Power requirement shall be 11-27 VAC or VDC and have a green LED normal operation indicator. Unit shall have a SPDT pilot duty low voltage alarm contact. Unit shall be waterproof and rustproof. A red LED shall indicate the presence of liquid. Unit shall have an adjustable setpoint.
 - 2. Approved Manufacturers:
 - a. R. E. Technologies.
 - b. Dorlen Products. (Water Alert)
- B. Control Relay: Monitors or controls AC or DC motors or other equipment (as required), with cover, with visual indicator when energized, and two SPDT contacts rated 120/250 VAC at 8 Amps.
 - 1. Manufacturers:
 - a. Dayton.
 - b. Omron.
 - c. Functional Devices.

2.3 THERMOSTATS

- A. Manufacturers:
 - 1. Erie Controls.
 - 2. Danfoss Inc.
 - 3. Heat-Timer Corporation.
 - 4. Sauter Controls Corporation.
 - 5. Tekmar Control Systems.
 - 6. Theben AG Lumilite Control Technology.
- B. Electric, solid-state, microcomputer-based room thermostat with remote sensor.
 - 1. Automatic switching from heating to cooling
 - 2. Preferential rate control to minimize overshoot and deviation from setpoint
 - 3. Capable of providing four separate temperatures per day
 - 4. Instant override of setpoint for continuous or timed period from 1 hour to 31 days.
 - 5. Short-cycle protection.
 - 6. Programming based on [weekday, Saturday, and Sunday] [every day of week].
 - 7. Selection features include degree F display, 24-hour clock, keyboard disable, remote sensor, and fan on-auto.
 - 8. Battery replacement without program loss.
 - 9. Thermostat display features include the following:
 - a. Time of the day
 - b. Actual room temperature
 - c. Programmed temperature setpoints
 - d. Programmed time for occupied/unoccupied
 - e. Duration of timed override
 - f. Day of week
 - g. System mode indications include "heating," "off," "fan auto," and "fan on."
- C. Line-Voltage, On-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch or equivalent solid-state type, with heat anticipator; listed for electrical rating; with concealed setpoint adjustment, 55- to 85-degrees F setpoint range, and 2-degrees F maximum differential.
 - 1. Electric Heating Thermostats: Equip with off position on dial wired to break ungrounded conductors.
 - 2. Selector Switch: Integral, manual, On-Off-Auto.

2.4 ACTUATORS

- A. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
 - 1. Manufacturers:
 - a. Belimo Aircontrols (USA).
 - 2. Dampers: Size for running torque calculated as follows:
 - a. Parallel-Blade Damper with Edge Seals: 7-inch-lb/sq. ft. of damper cross-sectional area.
 - b. Dampers with 2- to 3-inches wg of Pressure Drop or Face Velocities of 1000- to 2500-fpm: Increase running torque by 1.5.
 - 3. Coupling: V-bolt and V-shaped, toothed cradle.
 - 4. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
 - 5. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual, gear release on non-spring-return actuators.
 - 6. Manual Operation: Provided for all valve actuators.
 - 7. Power Requirements (Two-Position Spring Return): 24-V ac.
 - 8. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
 - 9. Temperature Rating: Minus 22- to 122-degrees F.
 - 10. Run Time: 60 seconds.

2.5 CONTROL CABLE

A. Electronic and fiber-optic cables for control wiring are specified in Division 27 Section "Communications Horizontal Cabling."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that a commercial power supply is available to control units and operator workstation.

3.2 INSTALLATION

- A. Control wiring in conduit or installed exposed (when allowed) shall:
 - 1. Run conduit runs along building and steel sight lines (not diagonal or where support is not proper).
 - 2. Support all conduit with independent hangars, not from ductwork/piping or from ductwork/piping hangars/trays/supports and independent of other trade's work.

- Anchor J-hooks to walls or suspend J-hooks using 1/4-inch minimum diameter threaded rod hangers. Do not support J-hooks from ceiling or equipment hangers. J-hooks shall not impede removal of accessible ceiling tiles.
- B. Install temperature control instruments and devices on all controlled equipment per control plans as required for a complete installation.
- C. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation. Installation height of devices
- D. Furnish automatic dampers according to Division 23 Section "Air Duct Accessories" to installing contractor for installation.
- E. Install damper motors on outside of ductwork in warm areas, not in locations exposed to outdoor temperatures.
- F. Install labels and nameplates to identify control components according to Division 23 Section "Identification for HVAC Piping and Equipment."
- G. Install refrigerant instrument wells, valves, and other accessories according to Division 23 Section "Refrigerant Piping."
- H. Install electronic and fiber-optic cables according to Division 27 Section "Communications Horizontal Cabling."

3.3 ELECTRICAL WIRING AND CONNECTION INSTALLATION

- A. Install raceways, boxes, and cabinets according to Division 26 Section "Raceway and Boxes for Electrical Systems."
- B. Install building wire and cable according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- C. Route conduit and plenum cables along building and steel lines (not diagonal) and do not hang conduit or bridle rings from ductwork and piping or their support means
- D. Install signal and communication cable according to Division 27 Section "Communications Horizontal Cabling."
 - 1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
 - 2. Install exposed cable in raceway.
 - 3. Install concealed cable in raceway.
 - 4. Bundle and harness multi-conductor instrument cable in place of single cables where several cables follow a common path.
 - 5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
 - 6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.

7. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.

3.4 FIELD QUALITY CONTROL

A. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.5 ADJUSTING

- A. Calibrating and Adjusting:
 - 1. Calibrate installed devices and instruments, whether electric.
 - 2. Make three-point calibration test for both linearity and accuracy for each analog instrument.
 - 3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
 - 4. Control System Inputs and Outputs:
 - a. Check analog inputs at 0, 50, and 100 percent of span.
 - b. Check analog outputs using milli-ampere meter at 0, 50, and 100 percent output.
 - c. Check digital inputs using jumper wire.
 - d. Check digital outputs using ohmmeter to test for contact making or breaking.
 - e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.
 - 5. Temperature:
 - a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
 - b. Calibrate temperature switches to make or break contacts.
 - 6. Stroke and adjust control dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
 - 7. Provide diagnostic and test instruments for calibration and adjustment of system.
 - 8. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.
- B. Adjust initial temperature set points.

3.6 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 shall be forwarded from the control system contractor to the Owner.
- B. 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.

C. Upon successful completion of system generation the Owner shall be requested in writing to inspect and approve the satisfactory operation of the control system, sub-systems, and accessories.

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SECTION 23 31 13 - 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.
- B. Division 20, Common Work Results for Mechanical, requirements apply to this section.
- C. Division 01 Project Management and Coordination, applies to this section and will require the contractors' participation in the Above Ceiling Coordination Program.
- D. Division 20 "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing requirements for metal ducts.
- E. Division 23 "Air Duct Accessories" for dampers.

1.2 SUMMARY

- A. Section Includes:
 - 1. Single-wall rectangular ducts and fittings.
 - 2. Sheet metal materials.
 - 3. Sealants and gaskets.
 - 4. Hangers and supports.

1.3 DEFINITIONS

- A. ASCE/SEI: American Society of Civil Engineers/Structural Engineers Institute.
- B. ASHRAE: American Society of Heating, Refrigeration, and Air Conditioning Engineers.
- C. AWS: American Welding Society.
- D. CFR: Code of Federal Regulations.
- E. EPA: Environmental Protection Agency.
- F. EPDM: Ethylene-propylene-diene terpolymer rubber.
- G. ICC: International Code Council.
- H. IESNA: Illuminating Engineers Society of North America.
- I. HEPA: High Efficiency Particulate Arrestor.

- J. NADCA: National Air Duct Cleaners Association.
- K. NAIMA: North American Insulation Manufacturers Association.
- L. NFPA: National Fire Protection Association.
- M. NRTL: Nationally Recognized Testing Laboratory.
- N. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.
- O. SPIDA: Spiral Duct Manufacturers Association.
- P. UL: Underwriters Laboratories, Inc.
- Q. VOC: Volatile Organic Compound.

1.4 PERFORMANCE REQUIREMENTS

- A. 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" and ASCE/SEI 7.
- B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 "Systems and Equipment," and Section 7 "Construction and System Startup."
- D. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 "HVAC System Construction and Insulation."
- E. Duct Dimensions: Unless otherwise indicated, all duct dimensions indicated on Drawings are inside clear dimensions and do not include insulation or duct wall thickness.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of the following products:
 - 1. Liners and adhesives.
 - 2. Sealants and gaskets.
- B. Shop Drawings: CAD-generated and drawn to 1/4 inch equals 1 foot scale. Show fabrication and installation details for metal ducts. Shop drawings are to be reviewed by the Architect prior to any fabrication.
 - 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 and bottom 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.

1.6 INFORMATIONAL SUBMITTALS

- A. 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. Fire alarm devices.
 - g. Perimeter moldings.
- B. Welding certificates.
- C. Field quality-control reports.

1.7 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code Steel," for hangers and supports.

- 2. AWS D1.2/D1.2M, "Structural Welding Code Aluminum," for aluminum supports.
- 3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 "Systems and Equipment" and Section 7 "Construction and System Start-Up."
- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 "HVAC System Construction and Insulation."
- D. NFPA Compliance:
 - 1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
 - 2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

PART 2 - PRODUCTS

2.1 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards -Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G90
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
 - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 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.
 - 1. Minimum steel gauge shall be as follows unless pressure class requires thicker gage:
 - a. Ducts through 12 Inches wide: 24 gauge.
 - b. Ducts 13 through 30 inches wide: 22 gauge.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support

intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards Metal and Flexible."

2.3 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
 - 1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
 - 2. Tape Width: 3 inches.
 - 3. Sealant: Modified styrene acrylic.
 - 4. Water resistant.
 - 5. Mold and mildew resistant.
 - 6. Maximum Static-Pressure Class: 10-inch w.g., positive and negative.
 - 7. Service: Indoor and outdoor.
 - 8. Service Temperature: Minus 40 to plus 200 deg F.
 - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
 - 10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Water-Based Joint and Seam Sealant:
 - 1. Application Method: Brush on.
 - 2. Solids Content: Minimum 65 percent.
 - 3. Shore A Hardness: Minimum 20.
 - 4. Water resistant.
 - 5. Mold and mildew resistant.
 - 6. VOC: Maximum 75 g/L (less water).
 - 7. Maximum Static-Pressure Class: 10-inch w.g., 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.
- 10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- 11. VOC: Maximum 395 g/L.
- 12. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- 13. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
- 14. Service: Indoor or outdoor.
- 15. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- D. Flanged Joint Sealant: Comply with ASTM C 920.
 - 1. General: Single-component, acid-curing, silicone, elastomeric.
 - 2. Type: S.
 - 3. Grade: NS.
 - 4. Class: 25.
 - 5. Use: O.
 - 1. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

2.4 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Table 5-1, "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 Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

- F. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- G. Trapeze and Riser Supports:
 - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards Metal and Flexible" unless otherwise indicated.
- C. Install ducts with fewest possible joints.
- D. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- G. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- H. Route ducts to avoid passing through required exit stairwells, elevator hoistways and machinery rooms, transformer vaults and electrical equipment rooms and enclosures.
- I. 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.
- J. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 "Air Duct Accessories" for fire and smoke dampers.
- K. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

3.4 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Division 23 "Air Duct Accessories."

3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Leakage Tests:
 - 1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
 - 2. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
 - 3. Test for leaks before applying external insulation.
 - 4. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
 - 5. Give seven days' advance notice for testing.
- C. Duct system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.7 DUCT CLEANING

A. Clean new duct system(s) before testing, adjusting, and balancing.

3.8 START UP

A. Air Balance: Comply with requirements in Division 23 "Testing, Adjusting, and Balancing for HVAC."

3.9 DUCT SCHEDULE

- A. See duct system application schedule for duct material type, seal class, pressure, leakage rate and liner requirements.
- B. Intermediate Reinforcement:
 - 1. Galvanized-Steel Ducts: Galvanized steel.

END OF SECTION 23 31 13

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SECTION 23 33 00 - 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.
- B. Division 20, Common Work Results for Mechanical, requirements apply to this section.
- C. Division 01 Project Management and Coordination, applies to this section and will require the contractors' participation in the Above Ceiling Coordination Program.
- D. Division 23 "HVAC Gravity Ventilators" for roof-mounted ventilator caps.
- E. Division 28 "Digital, Addressable Fire-Alarm System" for duct-mounted fire and smoke detectors.

1.2 SUMMARY

- A. Section Includes:
 - 1. Control dampers.

1.3 ACTION 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.
 - b. Control damper installations.
 - c. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. 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.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.
- PART 2 PRODUCTS

2.1 ASSEMBLY DESCRIPTION

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with 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.
- C. Comply with AMCA 500-D testing for damper rating.

2.2 MATERIALS

- A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G90
 - 2. Exposed-Surface Finish: Mill phosphatized.
- B. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- C. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 CONTROL DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Greenheck Fan Corporation.
 - 2. Nailor Industries.
 - 3. Ruskin Company.
- B. Low-leakage rating and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
- C. Frames:

- 1. Hat shaped.
- 2. 0.094-inch- thick, galvanized sheet steel.
- 3. Mitered and welded corners.
- D. Blades:
 - 1. Multiple blade with maximum blade width of 6 inches.
 - 2. Parallel- and opposed-blade design.
 - 3. Galvanized-steel.
 - 4. 0.064 inch thick single skin.
 - 5. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.
- E. Blade Axles: 1/2-inch- diameter; galvanized steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.
 - 1. Operating Temperature Range: From minus 40 to plus 200 deg F.
- F. Bearings:
 - 1. Oil-impregnated bronze.
 - 2. Dampers in ducts with pressure classes of 3-inch w.g. or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 - 3. Thrust bearings at each end of every blade.

2.4 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 control dampers at inlet of relief hood as close as possible to hood unless otherwise indicated.
- D. Set dampers to fully open position before testing, adjusting, and balancing.
- E. Install test holes at fan inlets and outlets and elsewhere as indicated.

3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Operate dampers to verify full range of movement.

END OF SECTION 23 33 00

SECTION 23 37 23 - HVAC GRAVITY VENTILATORS

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. Division 20, Common Work Results for Mechanical, requirements apply to this section.
- C. Division 01 Project Management and Coordination, applies to this section and will require the contractors' participation in the Above Ceiling Coordination Program.

1.2 SUMMARY

- A. Section Includes:
 - 1. Roof hoods.

1.3 PERFORMANCE REQUIREMENTS

- A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes, without buckling, opening of joints, overstressing of components, failure of connections, or other detrimental effects.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- B. Water Entrainment: Limit water penetration through unit to comply with ASHRAE 62.1.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For gravity ventilators. Include plans, elevations, sections, details, ventilator attachments to curbs, and curb attachments to roof structure.
 - 1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Roof framing plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Structural members to which roof curbs and ventilators will be attached.

- 2. Sizes and locations of roof openings.
- B. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.3, "Structural Welding Code Sheet Steel."

1.7 COORDINATION

A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Galvanized-Steel Sheet: ASTM A 653/A 653M, G90 zinc coating, mill phosphatized.
- B. Fasteners: Same basic metal and alloy as fastened metal or 300 Series stainless steel unless otherwise indicated. Do not use metals that are incompatible with joined materials.
 - 1. Use types and sizes to suit unit installation conditions.
 - 2. Use Phillips flat-head screws for exposed fasteners unless otherwise indicated.
- C. Post-Installed Fasteners for Concrete and Masonry: Torque-controlled expansion anchors made from stainless-steel components, with capability to sustain without failure a load equal to 4 times the loads imposed for concrete, or 6 times the load imposed for masonry, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
- D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.2 FABRICATION, GENERAL

- A. Factory or shop fabricate gravity ventilators to minimize field splicing and assembly. Disassemble units to the minimum extent as necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.
- B. Fabricate frames, including integral bases, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
- C. Fabricate units with closely fitted joints and exposed connections accurately located and secured.
- D. Fabricate supports, anchorages, and accessories required for complete assembly.

E. Perform shop welding by AWS-certified procedures and personnel.

2.3 ROOF HOODS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Aerovent.
 - 2. Greenheck Fan Corporation.
 - 3. Loren Cook Company.
 - 4. PennBarry.
- B. Factory or shop fabricate according to SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Figures 6-6 and 6-7.
- C. Materials: Galvanized-steel sheet, minimum 0.064-inch- thick base and 0.040-inch- thick hood ; suitably reinforced.
- D. Bird Screening: Galvanized-steel, 1/2-inch- square mesh, 0.041-inch wire.
- E. Capacities and Characteristics: Refer to schedule on drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install gravity ventilators level, plumb, and at indicated alignment with adjacent work.
- B. Install gravity ventilators with clearances for service and maintenance.
- C. Install perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- D. Install concealed gaskets, flashings, joint fillers, and insulation as installation progresses. Comply with Division 07 "Joint Sealants" for sealants applied during installation.
- E. Label gravity ventilators according to requirements specified in Division 20 "Mechanical Identification."
- F. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.
- G. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

3.2 CONNECTIONS

A. Duct installation and connection requirements are specified in Division 23 "Metal Ducts" and Division 23 "Nonmetal Ducts." Drawings indicate general arrangement of ducts and duct accessories.

3.3 ADJUSTING

A. Adjust damper linkages for proper damper operation.

END OF SECTION 23 37 23

SECTION 23 81 26 - SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Division 20, Common Work Results for Mechanical, requirements apply to this section.
- C. Division 01 Project Management and Coordination, applies to this section and will require the contractors' participation in the Above Ceiling Coordination Program.

1.2 SUMMARY

A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Filters: One set(s) for each air-handling unit.
 - 2. Gaskets: One set(s) for each access door.
 - 3. Fan Belts: One set(s) for each air-handling unit fan.

1.7 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE Compliance:
 - 1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
 - ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - " Procedures," and Section 7 - "Construction and System Start-up."
- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

1.8 COORDINATION

A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period:
 - a. For Compressor: Seven year(s) from date of Substantial Completion.
 - b. For Parts: Five year(s) from date of Substantial Completion.
 - c. For Labor: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

- 1. LG.
- 2. Mitsubishi.
- 3. Multi-Aqua.
- 4. Panasonic.

2.2 INDOOR UNITS (5 TONS OR LESS)

- A. Wall-Mounted, Evaporator-Fan Components:
 - 1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.
 - 2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermalexpansion valve. Comply with ARI 206/110.
 - 3. Fan: Direct drive, centrifugal.
 - 4. Fan Motors:
 - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Division 20 "Common Motor Requirements for Mechanical Equipment."
 - b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
 - c. Enclosure Type: Totally enclosed, fan cooled.
 - d. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
 - e. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
 - f. Mount unit-mounted disconnect switches on interior of unit.
 - 5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
 - 6. Condensate Drain Pans:
 - a. Fabricated with one percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.
 - 1) Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.
 - 2) Depth: A minimum of 1 inch deep.
 - b. Double-wall, stainless-steel sheet with space between walls filled with foam insulation and moisture-tight seal.
 - c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.
 - 1) Minimum Connection Size: NPS 1.
 - d. Pan-Top Surface Coating: Asphaltic waterproofing compound.
 - 7. Air Filtration Section:
 - a. General Requirements for Air Filtration Section:

- 1) Comply with NFPA 90A.
- 2) Minimum Arrestance: According to ASHRAE 52.1 and MERV according to ASHRAE 52.2.
- 3) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.
- b. Extended-Surface, Disposable Panel Filters:
 - 1) Factory-fabricated, dry, extended-surface type.
 - 2) Thickness: 2 inches.
 - 3) Merv according to ASHRAE 52.2: 7.
 - 4) Media: Fibrous material formed into deep-V-shaped pleats with antimicrobial agent and held by self-supporting wire grid.
 - 5) Media-Grid Frame: Galvanized steel.
 - 6) Mounting Frames: Welded, galvanized steel, with gaskets and fasteners; suitable for bolting together into built-up filter banks.
- 8. Accessories (Field Installed)
 - a. Condensate Pump
 - The condensate pump shall remove condensate from the drain pan when gravity drainage cannot be used. Pump shall be designed for quiet operation. Pump shall consist of two parts: an internal reservoir/sensor assembly, and a remote sound-shielded pump assembly. The lift capability of the condensate pump shall be 1 to 10 ft.
 - b. Condensate Overflow Switch
 - 1) A level sensor on the condensate pan shall stop cooling operation if the level in the condensate pan is unacceptable.

2.3 OUTDOOR UNITS (5 TONS OR LESS)

- A. Air-Cooled, Compressor-Condenser Components:
 - 1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
 - 2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
 - a. Compressor Type: Scroll.
 - b. Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
 - c. Refrigerant Charge: R-410A.
 - d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.

- 3. Fan: Aluminum-propeller type, directly connected to motor.
- 4. Motor: Permanently lubricated, with integral thermal-overload protection.
- 5. Low Ambient Kit: Permits operation down to 45 deg F.
- 6. Mounting Base: Polyethylene.

2.4 ACCESSORIES

- A. Control equipment and sequence of operation are specified in Division 23 "Instrumentation and Control for HVAC."
- B. Thermostat: Low voltage with subbase to control compressor and evaporator fan.
- C. Automatic-reset timer to prevent rapid cycling of compressor.
- D. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.
- E. Drain Hose: For condensate.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Install roof-mounted, compressor-condenser components on equipment supports specified in Division 07 "Roof Accessories." Anchor units to supports with removable, cadmium-plated fasteners.
- D. Equipment Mounting:
 - 1. Comply with requirements for vibration isolation devices specified in Division 20 "Vibration Controls."
- E. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Prepare test and inspection reports.
- 3.4 STARTUP SERVICE
 - A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.

3.5 DEMONSTRATION

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

END OF SECTION 23 81 26

SECTION 26 05 05 - SELECTIVE DEMOLITION FOR ELECTRICAL

PART 1 GENERAL

- 1.1 SECTION INCLUDES
 - A. Electrical demolition.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work: As specified in individual sections.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify field measurements and circuiting arrangements are as indicated.
- B. Verify that abandoned wiring and equipment serve only abandoned facilities.
- C. Demolition drawings are based on casual field observation and existing record documents.
- D. Report discrepancies to Architect and Owner before disturbing existing installation.
- E. Beginning of demolition means installer accepts existing conditions.

3.2 PREPARATION

- A. Disconnect electrical systems in walls, floors, and ceilings to be removed.
- B. Coordinate utility service outages with utility company.
- C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.
- D. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.
 - 1. Obtain permission from Owner at least 24 hours before partially or completely disabling system.
 - 2. Make temporary connections to maintain service in areas adjacent to work area.

3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

- A. Perform work for removal and disposal of equipment and materials containing toxic substances regulated under the Federal Toxic Substances Control Act (TSCA) in accordance with applicable federal, state, and local regulations. Applicable equipment and materials include, but are not limited to:
 - 1. PCB- and DEHP-containing lighting ballasts.

- 2. Mercury-containing lamps and tubes, including fluorescent lamps, high intensity discharge (HID), arc lamps, ultra-violet, high pressure sodium, mercury vapor, ignitron tubes, neon, and incandescent.
- B. Remove, relocate, and extend existing installations to accommodate new construction.
- C. Remove abandoned wiring to source of supply.
- D. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
- E. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.
- F. Disconnect and remove abandoned panelboards and distribution equipment.
- G. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
- H. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.
- I. Repair adjacent construction and finishes damaged during demolition and extension work.
- J. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.
- K. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

3.4 CLEANING AND REPAIR

- A. See Section 01 74 19 Construction Waste Management and Disposal for additional requirements.
- B. Clean and repair existing materials and equipment that remain or that are to be reused.

END OF SECTION 26 05 05

SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Single conductor building wire.
- B. Metal-clad cable.
- C. Wiring connectors.
- D. Electrical tape.
- E. Heat shrink tubing.
- F. Oxide inhibiting compound.
- G. Wire pulling lubricant.
- H. Cable ties.
- I. Firestop sleeves.

1.2 RELATED REQUIREMENTS

- A. Section 07 84 00 Firestopping.
- B. Section 26 05 26 Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.
- C. Section 26 05 53 Identification for Electrical Systems: Identification products and requirements.
- D. Section 28 46 00 Fire Detection and Alarm: Fire alarm system conductors and cables.

1.3 REFERENCE STANDARDS

- A. ASTM B3 Standard Specification for Soft or Annealed Copper Wire 2013 (Reapproved 2018).
- B. ASTM B8 Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft 2011 (Reapproved 2017).
- C. ASTM B33 Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes 2010, with Editorial Revision (2020).
- D. ASTM B787/B787M Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation 2004 (Reapproved 2020).
- E. ASTM D3005 Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape 2017.
- F. ASTM D4388 Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes 2020.
- G. NECA 1 Standard for Good Workmanship in Electrical Construction 2015.
- H. NECA 120 Standard for Installing Armored Cable (AC) and Type Metal-Clad (MC) Cable 2018.

- I. NEMA WC 70 Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy 2021.
- J. NETA ATS Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems 2021.
- K. NFPA 70 National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- L. UL 44 Thermoset-Insulated Wires and Cables Current Edition, Including All Revisions.
- M. UL 83 Thermoplastic-Insulated Wires and Cables Current Edition, Including All Revisions.
- N. UL 267 Outline of Investigation for Wire-Pulling Compounds Most Recent Edition, Including All Revisions.
- O. UL 486A-486B Wire Connectors Current Edition, Including All Revisions.
- P. UL 486C Splicing Wire Connectors Current Edition, Including All Revisions.
- Q. UL 486D Sealed Wire Connector Systems Current Edition, Including All Revisions.
- R. UL 510 Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape Current Edition, Including All Revisions.
- S. UL 1569 Metal-Clad Cables Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
 - 2. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
 - 3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

- A. See Section 01 30 00 Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.
- C. Wire Pulling Lubricant: Certification of compatibility with conductors/cables where used with the following insulation/jacket types:
 - 1. Low-density polyethylene (LDPE).

1.6 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 FIELD CONDITIONS

A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F (-10 degrees C), unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Architect and obtain direction before proceeding with work.

PART 2 PRODUCTS

- 2.1 CONDUCTOR AND CABLE APPLICATIONS
 - A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.
 - B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.
 - C. Nonmetallic-sheathed cable is not permitted.
 - D. Armored cable is not permitted.
 - E. Metal-clad cable is permitted only as follows:
 - 1. Where not otherwise restricted, may be used:
 - a. Where concealed above accessible ceilings for final connections from junction boxes to luminaires.
 - 1) Maximum Length: 6 feet (1.8 m).
 - b. Where concealed in hollow stud walls and above accessible ceilings for branch circuits up to 20 A.
 - 1) Exception: Provide single conductor building wire in raceway for circuit homerun from first outlet to panelboard.
 - 2. In addition to other applicable restrictions, may not be used:
 - a. Where exposed to damage.
 - b. For damp, wet, or corrosive locations, unless provided with a PVC jacket listed as suitable for those locations.

2.2 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.
- D. Comply with NEMA WC 70.
- E. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.
- F. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.
- G. Conductors for Grounding and Bonding: Also comply with Section 26 05 26.
- H. Conductor Material:
 - 1. Provide copper conductors only. Aluminum conductors are not acceptable for this project. Conductor sizes indicated are based on copper.

- 2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.
- 3. Tinned Copper Conductors: Comply with ASTM B33.
- I. Minimum Conductor Size:
 - 1. Branch Circuits: 12 AWG.
 - a. Exceptions:
 - 1) 20 A, 120 V circuits longer than 75 feet (23 m): 10 AWG, for voltage drop.
 - 2) 20 A, 120 V circuits longer than 150 feet (46 m): 8 AWG, for voltage drop.
 - 2. Control Circuits: 14 AWG.
- J. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- K. Conductor Color Coding:
 - 1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
 - 2. Color Coding Method: Integrally colored insulation.
 - 3. Color Code:
 - a. 208Y/120 V, 3 Phase, 4 Wire System:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - 4) Neutral/Grounded: White.
 - b. Equipment Ground, All Systems: Green.
 - c. Travelers for 3-Way and 4-Way Switching: Pink.
 - d. For modifications or additions to existing wiring systems, comply with existing color code when existing code complies with NFPA 70 and is approved by the authority having jurisdiction.
 - e. For control circuits, comply with manufacturer's recommended color code.

2.3 SINGLE CONDUCTOR BUILDING WIRE

- A. Description: Single conductor insulated wire.
- B. Conductor Stranding:
 - 1. Feeders and Branch Circuits:
 - a. Size 10 AWG and Smaller: Solid.
 - b. Size 8 AWG and Larger: Stranded.
 - 2. Control Circuits: Stranded.
- C. Insulation Voltage Rating: 600 V.
- D. Insulation:
 - 1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2, except as indicated below.
- 2.4 METAL-CLAD CABLE
 - A. Manufacturers:

- 1. AFC Cable Systems Inc: www.afcweb.com
- 2. Encore Wire Corporation: www.encorewire.com
- 3. Service Wire Co: www.servicewire.com
- 4. Southwire Company: www.southwire.com
- B. Description: NFPA 70, Type MC cable listed and labeled as complying with UL 1569, and listed for use in classified firestop systems to be used.
- C. Conductor Stranding:
 - 1. Size 10 AWG and Smaller: Solid.
 - 2. Size 8 AWG and Larger: Stranded.
- D. Insulation Voltage Rating: 600 V.
- E. Insulation: Type THHN, THHN/THWN, or THHN/THWN-2.
- F. Provide dedicated neutral conductor for each phase conductor where indicated or required.
- G. Grounding: Full-size integral equipment grounding conductor.
- H. Armor: Steel, interlocked tape.
- I. Provide PVC jacket applied over cable armor where indicated or required for environment of installed location.
- 2.5 WIRING CONNECTORS
 - A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.
 - B. Connectors for Grounding and Bonding: Comply with Section 26 05 26.
 - C. Wiring Connectors for Splices and Taps:
 - 1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors.
 - 2. Copper Conductors Size 6 AWG and Larger: Use compression connectors.
 - D. Wiring Connectors for Terminations:
 - 1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
 - 2. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.
 - 3. Provide motor pigtail connectors for connecting motor leads in order to facilitate disconnection.
 - 4. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors where connectors are required.
 - E. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F (105 degrees C) for standard applications and 302 degrees F (150 degrees C) for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.
 - 1. Manufacturers:
 - a. 3M: www.3m.com
 - b. Ideal Industries, Inc: www.idealindustries.com

- c. NSI Industries LLC: www.nsiindustries.com
- F. Mechanical Connectors: Provide bolted type or set-screw type.
 - 1. Manufacturers:
 - a. Burndy LLC: www.burndy.com
 - b. Ilsco: www.ilsco.com
 - c. Thomas & Betts Corporation: www.tnb.com
- G. Compression Connectors: Provide circumferential type or hex type crimp configuration.
 - 1. Manufacturers:
 - a. Burndy LLC: www.burndy.com
 - b. Ilsco: www.ilsco.com

2.6 ACCESSORIES

- A. Electrical Tape:
 - 1. Manufacturers:
 - a. 3M: www.3m.com
 - b. Plymouth Rubber Europa: www.plymouthrubber.com
 - Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil (0.18 mm); resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F (105 degrees C).
 - Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil (0.18 mm); resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F (-18 degrees C) and suitable for continuous temperature environment up to 221 degrees F (105 degrees C).
 - Rubber Splicing Electrical Tape: Ethylene Propylene Rubber (EPR) tape, complying with ASTM D4388; minimum thickness of 30 mil (0.76 mm); suitable for continuous temperature environment up to 194 degrees F (90 degrees C) and short-term 266 degrees F (130 degrees C) overload service.
 - 5. Electrical Filler Tape: Rubber-based insulating moldable putty, minimum thickness of 125 mil (3.2 mm); suitable for continuous temperature environment up to 176 degrees F (80 degrees C).
 - 6. Moisture Sealing Electrical Tape: Insulating mastic compound laminated to flexible, allweather vinyl backing; minimum thickness of 90 mil (2.3 mm).
- B. Heat Shrink Tubing: Heavy-wall, split-resistant, with factory-applied adhesive; rated 600 V; suitable for direct burial applications; listed as complying with UL 486D.
 - 1. Manufacturers:
 - a. 3M: www.3m.com
 - b. Burndy LLC: www.burndy.com
 - c. Thomas & Betts Corporation: www.tnb.com
- C. Oxide Inhibiting Compound: Listed; suitable for use with the conductors or cables to be installed.
 - 1. Manufacturers:

- a. Burndy LLC: www.burndy.com
- b. Ideal Industries, Inc: www.idealindustries.com
- c. Ilsco: www.ilsco.com
- D. Wire Pulling Lubricant:
 - 1. Manufacturers:
 - a. 3M: www.3m.com
 - b. American Polywater Corporation: www.polywater.com
 - c. Ideal Industries, Inc: www.idealindustries.com
 - 2. Listed and labeled as complying with UL 267.
 - 3. Suitable for use with conductors/cables and associated insulation/jackets to be installed.
 - 4. Suitable for use at installation temperature.
- E. Cable Ties: Material and tensile strength rating suitable for application.
 - 1. Manufacturers:
 - a. Burndy LLC: www.burndy.com
- F. Sealing Systems for Roof Penetrations: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for cables and roofing system to be installed; designed to accommodate existing penetrations where applicable.
- G. Firestop Sleeves: Listed; provide as required to preserve fire resistance rating of building elements.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that interior of building has been protected from weather.
- B. Verify that work likely to damage wire and cable has been completed.
- C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.
- D. Verify that field measurements are as indicated.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.3 INSTALLATION

- A. Circuiting Requirements:
 - 1. When circuit destination is indicated without specific routing, determine exact routing required.
 - 2. Arrange circuiting to minimize splices.
 - 3. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and powerlimited circuits in accordance with NFPA 70.

- 4. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are indicated as separate, combining them together in a single raceway is not permitted.
 - a. Provide no more than six current-carrying conductors in a single raceway. Dedicated neutral conductors are considered current-carrying conductors.
 - b. Increase size of conductors as required to account for ampacity derating.
 - c. Size raceways, boxes, etc. to accommodate conductors.
- 5. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among up to three single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.
 - a. Branch circuits fed from ground fault circuit interrupter (GFCI) circuit breakers.
 - b. Branch circuits fed from feed-through protection of GFI receptacles.
 - c. Branch circuits with dimming controls.
- B. Install products in accordance with manufacturer's instructions.
- C. Perform work in accordance with NECA 1 (general workmanship).
- D. Install metal-clad cable (Type MC) in accordance with NECA 120.
- E. Installation in Raceway:
 - 1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
 - 2. Pull all conductors and cables together into raceway at same time.
 - 3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
 - 4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.
- F. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.
- G. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.
 - 1. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conductors and cables to lay on ceiling tiles.
- H. Terminate cables using suitable fittings.
 - 1. Metal-Clad Cable (Type MC):
 - a. Use listed fittings.
 - b. Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.
- I. Install conductors with a minimum of 12 inches (300 mm) of slack at each outlet.
- J. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.
- K. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.

- L. Make wiring connections using specified wiring connectors.
 - 1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
 - 2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
 - 3. Do not remove conductor strands to facilitate insertion into connector.
 - 4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.
 - 5. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
 - 6. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- M. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.
 - 1. Dry Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
 - a. For taped connections, first apply adequate amount of rubber splicing electrical tape or electrical filler tape, followed by outer covering of vinyl insulating electrical tape.
 - 2. Damp Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
 - a. For connections with insulating covers, apply outer covering of moisture sealing electrical tape.
 - b. For taped connections, follow same procedure as for dry locations but apply outer covering of moisture sealing electrical tape.
- N. Insulate ends of spare conductors using vinyl insulating electrical tape.
- O. Field-Applied Color Coding: Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible.
- P. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.
- Q. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

3.4 FIELD QUALITY CONTROL

- A. See Section 01 40 00 Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.3.2. The insulation resistance test is required for all conductors. The resistance test for parallel conductors listed as optional is not required.
- D. Correct deficiencies and replace damaged or defective conductors and cables.

END OF SECTION 26 05 19

SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Grounding and bonding requirements.
- B. Conductors for grounding and bonding.
- C. Connectors for grounding and bonding.

1.2 RELATED REQUIREMENTS

- A. Section 26 05 19 Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.
- B. Section 26 05 53 Identification for Electrical Systems: Identification products and requirements.

1.3 REFERENCE STANDARDS

- A. NECA 1 Standard for Good Workmanship in Electrical Construction 2015.
- B. NETA ATS Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems 2021.
- C. NFPA 70 National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. UL 467 Grounding and Bonding Equipment Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

- A. See Section 01 30 00 Administrative Requirements for submittals procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.

1.6 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.1 GROUNDING AND BONDING REQUIREMENTS

- A. Do not use products for applications other than as permitted by NFPA 70 and product listing.
- B. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.
- C. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- D. Bonding and Equipment Grounding:
 - 1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
 - 2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
 - 3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
 - 4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
 - 5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
 - 6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.

2.2 GROUNDING AND BONDING COMPONENTS

- A. General Requirements:
 - 1. Provide products listed, classified, and labeled as suitable for the purpose intended.
 - 2. Provide products listed and labeled as complying with UL 467 where applicable.
- B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 26 05 26:
 - 1. Use insulated copper conductors unless otherwise indicated.
 - 2. Factory Pre-fabricated Bonding Jumpers: Furnished with factory-installed ferrules; size braided cables to provide equivalent gauge of specified conductors.
- C. Connectors for Grounding and Bonding:
 - 1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
 - 2. Unless otherwise indicated, use mechanical connectors for accessible connections.
 - 3. Manufacturers Mechanical and Compression Connectors:
 - a. Burndy LLC: www.burndy.com
 - b. Harger Lightning & Grounding: www.harger.com
 - c. nVent ERICO: www.nvent.com

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that work likely to damage grounding and bonding system components has been completed.
- B. Verify that field measurements are as indicated.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Make grounding and bonding connections using specified connectors.
 - 1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
 - 2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
 - 3. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
- D. Identify grounding and bonding system components in accordance with Section 26 05 53.

3.3 FIELD QUALITY CONTROL

- A. See Section 01 40 00 Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.13.
- D. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.
- E. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.

END OF SECTION 26 05 26
SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other electrical work.

1.2 RELATED REQUIREMENTS

- A. Section 03 30 00 Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 26 05 33.13 Conduit for Electrical Systems: Additional support and attachment requirements for conduits.
- C. Section 26 05 33.16 Boxes for Electrical Systems: Additional support and attachment requirements for boxes.
- D. Section 26 51 00 Interior Lighting: Additional support and attachment requirements for interior luminaires.
- E. Section 26 56 00 Exterior Lighting: Additional support and attachment requirements for exterior luminaires.

1.3 REFERENCE STANDARDS

- A. ASTM A123/A123M Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.
- B. ASTM A153/A153M Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
- C. ASTM B633 Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel 2019.
- D. MFMA-4 Metal Framing Standards Publication 2004.
- E. NECA 1 Standard for Good Workmanship in Electrical Construction 2015.
- F. NFPA 70 National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes and arrangement of supports and bases with actual equipment and components to be installed.
 - 2. Coordinate work to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at installed locations.
 - 4. Coordinate arrangement of supports with ductwork, piping, equipment and other potential conflicts.

- 5. Notify Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install products on or provide attachment to concrete surfaces until concrete has cured; see Section 03 30 00.

1.5 SUBMITTALS

- A. See Section 01 30 00 Administrative Requirements for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel/strut framing systems, nonpenetrating rooftop supports, and post-installed concrete/masonry anchors.

PART 2 PRODUCTS

2.1 SUPPORT AND ATTACHMENT COMPONENTS

- A. General Requirements:
 - Comply with the following. Where requirements differ, comply with most stringent.
 a. NFPA 70.
 - b. Requirements of authorities having jurisdiction.
 - 2. Provide required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for complete installation of electrical work.
 - 3. Provide products listed, classified, and labeled as suitable for purpose intended, where applicable.
 - 4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for load to be supported with a minimum safety factor of 25%. Include consideration for vibration, equipment operation, and shock loads where applicable.
 - 5. Do not use products for applications other than as permitted by NFPA 70 and product listing.
 - 6. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
 - 7. Steel Components: Use corrosion-resistant materials suitable for environment where installed.
 - a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
 - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
 - c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
 - d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
- B. Conduit and Cable Supports: Straps and clamps suitable for conduit or cable to be supported.
 - 1. Manufacturers:
 - a. Emerson Electric Co; O-Z/Gedney: www.emerson.com

- b. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com
- c. nVent; Caddy: www.nvent.com
- 2. Conduit Straps: One-hole or two-hole type; steel.
- 3. Conduit Clamps: Bolted type unless otherwise indicated.
- C. Outlet Box Supports: Hangers and brackets suitable for boxes to be supported.
 - 1. Manufacturers:
 - a. Emerson Electric Co; O-Z/Gedney: www.emerson.com
 - b. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com
 - c. nVent; Caddy: www.nvent.com
- D. Metal Channel/Strut Framing Systems:
 - 1. Manufacturers:
 - a. ABB: www.electrification.us.abb.com
 - b. Atkore International Inc; Unistrut: www.unistrut.us
 - 2. Description: Factory-fabricated, continuous-slot, metal channel/strut and associated fittings, accessories, and hardware required for field assembly of supports.
 - 3. Comply with MFMA-4.
- E. Hanger Rods: Threaded, zinc-plated steel unless otherwise indicated.
 - 1. Minimum Size, Unless Otherwise Indicated or Required:
 - a. Equipment Supports: 1/2-inch (13 mm) diameter.
 - b. Single Conduit up to 1-inch (27 mm) Trade Size: 1/4-inch (6 mm) diameter.
 - c. Single Conduit Larger than 1-inch (27 mm) Trade Size: 3/8-inch (10 mm) diameter.
 - d. Trapeze Support for Multiple Conduits: 3/8-inch (10 mm) diameter.
 - e. Outlet Boxes: 1/4-inch (6 mm) diameter.
 - f. Luminaires: 1/4-inch (6 mm) diameter.
- F. Nonpenetrating Rooftop Supports for Low-Slope Roofs:
 - 1. Manufacturers:
 - a. Atkore International Inc; Unistrut: www.unistrut.us
 - b. Eaton Corporation: www.eaton.com
 - c. nVent; Caddy: www.nvent.com
 - 2. Description: Steel pedestals with thermoplastic or rubber bases that rest on top of roofing membrane, not requiring attachment to roof structure and not penetrating roofing assembly, with support fixtures as specified.
 - 3. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
 - 4. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
 - 5. Mounting Height: Provide minimum clearance of 6 inches (150 mm) under supported component to top of roofing.
- G. Anchors and Fasteners:
 - 1. Unless otherwise indicated and where not otherwise restricted, use anchor and fastener types indicated for specified applications.
 - 2. Concrete: Use expansion anchors or screw anchors.

- 3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
- 4. Hollow Masonry: Use toggle bolts.
- 5. Hollow Stud Walls: Use toggle bolts.
- 6. Steel: Use beam clamps, machine bolts, or welded threaded studs.
- 7. Sheet Metal: Use sheet metal screws.
- 8. Wood: Use wood screws.
- 9. Plastic and lead anchors are not permitted.
- 10. Powder-actuated fasteners are not permitted.
- 11. Hammer-driven anchors and fasteners are not permitted.
- 12. Preset Concrete Inserts: Continuous metal channel/strut and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
 - a. Manufacturer: Same as manufacturer of metal channel/strut framing system.
 - b. Comply with MFMA-4.
 - c. Channel Material: Use galvanized steel.

PART 3 EXECUTION

- 3.1 EXAMINATION
 - A. Verify that field measurements are as indicated.
 - B. Verify that mounting surfaces are ready to receive support and attachment components.
 - C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install hangers and supports in accordance with NECA 1.
- C. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- G. Equipment Support and Attachment:
 - 1. Use metal, fabricated supports or supports assembled from metal channel/strut to support equipment as required.
 - 2. Use metal channel/strut secured to studs to support equipment surface mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
 - 3. Use metal channel/strut to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
 - 4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- H. Conduit Support and Attachment: See Section 26 05 33.13 for additional requirements.

- I. Box Support and Attachment: See Section 26 05 33.16 for additional requirements.
- J. Interior Luminaire Support and Attachment: See Section 26 51 00 for additional requirements.
- K. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.
- L. Secure fasteners in accordance with manufacturer's recommended torque settings.
- M. Remove temporary supports.
- N. Identify independent electrical component support wires above accessible ceilings, where permitted, with color distinguishable from ceiling support wires in accordance with NFPA 70.
- 3.3 FIELD QUALITY CONTROL
 - A. See Section 01 40 00 Quality Requirements for additional requirements.
 - B. Inspect support and attachment components for damage and defects.
 - C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
 - D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION 26 05 29

SECTION 26 05 33.13 - CONDUIT FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Galvanized steel rigid metal conduit (RMC).
- B. Flexible metal conduit (FMC).
- C. Liquidtight flexible metal conduit (LFMC).
- D. Galvanized steel electrical metallic tubing (EMT).

1.2 RELATED REQUIREMENTS

- A. Section 07 84 00 Firestopping.
- B. Section 26 05 26 Grounding and Bonding for Electrical Systems.
 - 1. Includes additional requirements for fittings for grounding and bonding.
- C. Section 26 05 29 Hangers and Supports for Electrical Systems.

1.3 REFERENCE STANDARDS

- A. ANSI C80.1 American National Standard for Electrical Rigid Steel Conduit (ERSC) 2020.
- B. ANSI C80.3 American National Standard for Electrical Metallic Tubing -- Steel (EMT-S) 2020.
- C. ANSI C80.6 American National Standard for Electrical Intermediate Metal Conduit 2018.
- D. NECA 1 Standard for Good Workmanship in Electrical Construction 2015.
- E. NECA 101 Standard for Installing Steel Conduits (Rigid, IMC, EMT) 2020.
- F. NEMA FB 1 Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable 2014.
- G. NFPA 70 National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. UL 1 Flexible Metal Conduit Current Edition, Including All Revisions.
- I. UL 6 Electrical Rigid Metal Conduit-Steel Current Edition, Including All Revisions.
- J. UL 360 Liquid-Tight Flexible Metal Conduit Current Edition, Including All Revisions.
- K. UL 514B Conduit, Tubing, and Cable Fittings Current Edition, Including All Revisions.
- L. UL 797 Electrical Metallic Tubing-Steel Current Edition, Including All Revisions.
- M. UL 1242 Electrical Intermediate Metal Conduit-Steel Current Edition, Including All Revisions.
- N. UL 2419 Outline of Investigation for Electrically Conductive Corrosion Resistant Compounds Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate minimum sizes of conduits with actual type and quantity of conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
 - 2. Coordinate arrangement of conduits with structural members, ductwork, piping, equipment, and other potential conflicts.
 - 3. Verify exact conduit termination locations required for boxes, enclosures, and equipment.
 - 4. Coordinate work to provide roof penetrations that preserve integrity of roofing system and do not void roof warranty.
 - 5. Notify Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not begin installation of conductors and cables until installation of conduit between termination points is complete.

1.5 SUBMITTALS

- A. See Section 01 30 00 Administrative Requirements for submittals procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.

PART 2 PRODUCTS

2.1 CONDUIT APPLICATIONS

- A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70, manufacturer's instructions, and product listing.
- B. Unless otherwise indicated and where not otherwise restricted, use conduit types indicated for specified applications. Where more than one listed application applies, comply with most restrictive requirements. Where conduit type for particular application is not specified, use galvanized steel rigid metal conduit.
- C. Concealed Within Hollow Stud Walls: Use galvanized steel electrical metallic tubing (EMT).
- D. Concealed Above Accessible Ceilings: Use galvanized steel electrical metallic tubing (EMT).
- E. Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit (RMC).
- F. Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel electrical metallic tubing (EMT).
- G. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit (RMC)
 - 1. Locations subject to physical damage include, but are not limited to:
 - a. Where exposed below 8 feet (2.4 m), except within electrical and communication rooms or closets.
 - b. Elevator pits
- H. Exposed, Exterior, Not Subject to Severe Physical Damage: Use galvanized steel electrical metallic tubing (EMT).

- I. Flexible Connections to Vibrating Equipment:
 - 1. Dry Locations: Use flexible metal conduit (FMC).
 - 2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit (LFMC).
 - 3. Maximum Length: 6 feet (1.8 m) unless otherwise indicated.
 - 4. Vibrating equipment includes, but is not limited to:
 - a. Motors.
- J. Fished in Existing Walls, Where Necessary: Use flexible metal conduit (FMC).

2.2 CONDUIT - GENERAL REQUIREMENTS

- A. Comply with NFPA 70.
- B. Existing Work: Where existing conduits are indicated to be reused, they may be reused only where they comply with specified requirements, are free from corrosion, and integrity is verified by pulling mandrel through them.
- C. Fittings for Grounding and Bonding: See Section 26 05 26 for additional requirements.
- D. Provide conduit, fittings, supports, and accessories required for complete raceway system.
- E. Provide products listed, classified, and labeled as suitable for purpose intended.
- F. Minimum Conduit Size, Unless Otherwise Indicated:
 - 1. Branch Circuits: 3/4-inch (21 mm) trade size.
 - 2. Branch Circuit Homeruns: 3/4-inch (21 mm) trade size.
 - 3. Control Circuits: 1/2-inch (16 mm) trade size.
 - 4. Flexible Connections to Luminaires: 3/8-inch (12 mm) trade size.
- G. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- 2.3 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)
 - A. Manufacturers:
 - 1. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.com
 - 2. Western Tube, a division of Zekelman Industries: www.westerntube.com
 - 3. Wheatland Tube, a division of Zekelman Industries: www.wheatland.com
 - B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.
 - C. Fittings:
 - 1. Manufacturers:
 - a. ABB; T&B: www.electrification.us.abb.com
 - b. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.us
 - c. Bridgeport Fittings Inc: www.bptfittings.com
 - 2. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 6.
 - 3. Material: Use steel or malleable iron.
 - 4. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

2.4 FLEXIBLE METAL CONDUIT (FMC)

- A. Manufacturers:
 - 1. AFC Cable Systems, a division of Atkore International: www.afcweb.com
 - 2. Electri-Flex Company: www.electriflex.com
- B. Description: NFPA 70, Type FMC standard-wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems.
- C. Fittings:
 - 1. Manufacturers:
 - a. ABB; T&B: www.electrification.us.abb.com
 - b. Bridgeport Fittings, LLC: www.bptfittings.com
 - c. Emerson Electric Co; O-Z/Gedney: www.emerson.com
 - 2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 3. Material: Use steel or malleable iron.
 - a. Do not use die cast zinc fittings.

2.5 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

- A. Manufacturers:
 - 1. AFC Cable Systems, a division of Atkore International: www.afcweb.com
 - 2. Electri-Flex Company: www.electriflex.com
- B. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.
- C. Fittings:
 - 1. Manufacturers:
 - a. ABB; T&B: www.electrification.us.abb.com
 - b. Bridgeport Fittings, LLC: www.bptfittings.com
 - c. Emerson Electric Co; O-Z/Gedney: www.emerson.com
 - 2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 3. Material: Use steel or malleable iron.
 - a. Do not use die cast zinc fittings.

2.6 GALVANIZED STEEL ELECTRICAL METALLIC TUBING (EMT)

- A. Manufacturers:
 - 1. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.com
 - 2. Western Tube, a division of Zekelman Industries: www.westerntube.com
 - 3. Wheatland Tube, a division of Zekelman Industries: www.wheatland.com
- B. Description: NFPA 70, Type EMT galvanized steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.
- C. Fittings:

- 1. Manufacturers:
 - a. ABB; T&B: www.electrification.us.abb.com
 - b. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.us
 - c. Emerson Electric Co; O-Z/Gedney: www.emerson.com
- 2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
- 3. Material: Use steel or malleable iron.
- 4. Connectors and Couplings: Use compression/gland or set-screw type.
 - a. Do not use indenter type connectors and couplings.
- 5. Damp or Wet Locations, Where Permitted: Use fittings listed for use in wet locations.

2.7 ACCESSORIES

- A. Conduit Joint Compound: Corrosion-resistant, electrically conductive compound listed as complying with UL 2419; suitable for use with conduit to be installed.
- B. Pull Strings: Use nylon or polyester tape with average breaking strength of not less than 1,250 lbf (5.6 kN).
- C. Foam Conduit Sealant:
 - 1. Removable, two-part, closed-cell foam, specifically designed for sealing conduit openings against water, moisture, gases, and dust.
 - 2. Suitable for use with conductors/cables and associated insulation/jackets to be installed.
 - 3. Rated to hold minimum of 10 ft (3.0 m) water head pressure.
- D. Sealing Systems for Roof Penetrations: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for conduits and roofing system to be installed; designed to accommodate existing penetrations where applicable.
- E. Firestop Sleeves: Listed; provide as required to preserve fire resistance rating of building elements.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive conduits.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install conduit in accordance with NECA 1.
- C. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.
- D. Conduit Routing:
 - 1. Unless dimensioned, conduit routing indicated is diagrammatic.

- 2. When conduit destination is indicated without specific routing, determine exact routing required.
- 3. Conceal conduits unless specifically indicated to be exposed.
- 4. Conduits in the following areas may be exposed, unless otherwise indicated:
 - a. Electrical rooms.
 - b. Mechanical equipment rooms.
 - c. Within joists in areas with no ceiling.
 - d. Elevator Pit and Shaft.
- 5. Unless otherwise approved, do not route exposed conduits:
 - a. Across floors.
 - b. Across top of parapet walls.
- 6. Arrange conduit to maintain adequate headroom, clearances, and access.
- 7. Arrange conduit to provide no more than equivalent of four 90-degree bends between pull points.
- 8. Arrange conduit to provide no more than 150 feet (46 m) between pull points.
- 9. Route conduits above water and drain piping where possible.
- 10. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
- 11. Maintain minimum clearance of 6 inches (150 mm) between conduits and piping for other systems.
- 12. Maintain minimum clearance of 12 inches (300 mm) between conduits and hot surfaces. This includes, but is not limited to:
 - a. Heaters.
 - b. Hot water piping.
 - c. Flues.
- 13. Group parallel conduits in same area on common rack.
- E. Conduit Support:
 - 1. Secure and support conduits in accordance with NFPA 70 using suitable supports and methods approved by authorities having jurisdiction; see Section 26 05 29.
 - 2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
 - 3. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
 - 4. Use conduit strap to support single surface-mounted conduit.
 - a. Use clamp back spacer with conduit strap for damp and wet locations to provide space between conduit and mounting surface.
 - 5. Use metal channel/strut with accessory conduit clamps to support multiple parallel surface-mounted conduits.
 - 6. Use conduit clamp to support single conduit from beam clamp or threaded rod.
 - 7. Use trapeze hangers assembled from threaded rods and metal channel/strut with accessory conduit clamps to support multiple parallel suspended conduits.
 - 8. Use nonpenetrating rooftop supports to support conduits routed across rooftops, where approved.
 - 9. Use of spring steel conduit clips for support of conduits is not permitted.

- 10. Use of wire for support of conduits is not permitted.
- 11. Where conduit support intervals specified in NFPA 70 and NECA standards differ, comply with most stringent requirements.
- F. Connections and Terminations:
 - 1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
 - 2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
 - 3. Use suitable adapters where required to transition from one type of conduit to another.
 - 4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
 - 5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
 - 6. Provide insulating bushings, insulated throats, or listed metal fittings with smooth, rounded edges at conduit terminations to protect conductors.
 - 7. Secure joints and connections to provide mechanical strength and electrical continuity.
- G. Penetrations:
 - 1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
 - 2. Make penetrations perpendicular to surfaces unless otherwise indicated.
 - 3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
 - 4. Conceal bends for conduit risers emerging above ground.
 - 5. Provide suitable sealing system where conduits penetrate exterior wall below grade.
 - 6. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
 - 7. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty.
 - 8. Install firestopping to preserve fire resistance rating of partitions and other elements; see Section 07 84 00.
- H. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
 - 1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
 - 2. Where conduits are subject to earth movement by settlement or frost.
- I. Conduit Sealing:
 - 1. Use foam conduit sealant to prevent entry of moisture and gases. This includes, but is not limited to:
 - a. Where conduits enter building from outside.
 - b. Where conduits may transport moisture to contact live parts.

- 2. Where conduits cross barriers between areas of potential substantial temperature differential, use foam conduit sealant at accessible point near penetration to prevent condensation. This includes, but is not limited to:
 - a. Where conduits pass from outdoors into conditioned interior spaces.
 - b. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.
- J. Provide pull string in each empty conduit and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches (300 mm) at each end.
- K. Provide grounding and bonding; see Section 26 05 26.

3.3 FIELD QUALITY CONTROL

- A. See Section 01 40 00 Quality Requirements for additional requirements.
- B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- C. Correct deficiencies and replace damaged or defective conduits.

3.4 CLEANING

- A. Clean interior of conduits to remove moisture and foreign matter.
- 3.5 PROTECTION
 - A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

END OF SECTION 26 05 33.13

SECTION 26 05 33.16 - BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Outlet and device boxes up to 100 cubic inches (1,650 cu cm), including those used as junction and pull boxes.
- B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches (1,650 cu cm).
- 1.2 RELATED REQUIREMENTS
 - A. Section 08 31 00 Access Doors and Panels: Panels for maintaining access to concealed boxes.
 - B. Section 26 05 29 Hangers and Supports for Electrical Systems.
 - C. Section 26 05 33.13 Conduit for Electrical Systems:
 - 1. Conduit bodies and other fittings.
 - 2. Additional requirements for locating boxes to limit conduit length and/or number of bends between pulling points.
 - D. Section 26 27 26 Wiring Devices:
 - 1. Wall plates.
 - 2. Additional requirements for locating boxes for wiring devices.

1.3 REFERENCE STANDARDS

- A. NECA 1 Standard for Good Workmanship in Electrical Construction 2015.
- B. NECA 130 Standard for Installing and Maintaining Wiring Devices 2016.
- C. NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.
- D. NEMA FB 1 Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable 2014.
- E. NEMA OS 1 Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports 2013 (Reaffirmed 2020).
- F. NFPA 70 National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. UL 50 Enclosures for Electrical Equipment, Non-Environmental Considerations Current Edition, Including All Revisions.
- H. UL 50E Enclosures for Electrical Equipment, Environmental Considerations Current Edition, Including All Revisions.
- I. UL 508A Industrial Control Panels Current Edition, Including All Revisions.
- J. UL 514A Metallic Outlet Boxes Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
 - 4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
 - 5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
 - 6. Coordinate the work with other trades to preserve insulation integrity.
 - 7. Coordinate the work with other trades to provide walls suitable for installation of flushmounted boxes where indicated.
 - 8. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

- A. See Section 01 30 00 Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for cabinets and enclosures, boxes for hazardous (classified) locations, floor boxes, and underground boxes/enclosures.

PART 2 PRODUCTS

2.1 BOXES

- A. General Requirements:
 - 1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
 - 2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
 - 3. Provide products listed, classified, and labeled as suitable for the purpose intended.
 - 4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
 - 5. Provide grounding terminals within boxes where equipment grounding conductors terminate.
- B. Outlet and Device Boxes Up to 100 cubic inches (1,650 cu cm), Including Those Used as Junction and Pull Boxes:
 - 1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
 - 2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.

- 3. Use cast iron boxes or cast aluminum boxes where exposed galvanized steel rigid metal conduit is used.
- 4. Use suitable concrete type boxes where flush-mounted in concrete.
- 5. Use suitable masonry type boxes where flush-mounted in masonry walls.
- 6. Use raised covers suitable for the type of wall construction and device configuration where required.
- 7. Use shallow boxes where required by the type of wall construction.
- 8. Do not use "through-wall" boxes designed for access from both sides of wall.
- 9. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
- 10. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
- 11. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
- 12. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.
- 13. Minimum Box Size, Unless Otherwise Indicated:
 - a. Wiring Devices (Other Than Communications Systems Outlets): 4 inch square by 1-1/2 inch deep (100 by 38 mm) trade size.
 - b. Communications Systems Outlets: 4 inch square by 2-1/8 inch (100 by 54 mm) trade size.
 - c. Ceiling Outlets: 4 inch octagonal or square by 1-1/2 inch deep (100 by 38 mm) trade size.
- 14. Wall Plates: Comply with Section 26 27 26.
- 15. Manufacturers:
 - a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com
 - b. Hubbell Incorporated; RACO Products: www.hubbell-rtb.com
 - c. Thomas & Betts Corporation: www.tnb.com
- C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches (1,650 cu cm):
 - 1. Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
 - 2. NEMA 250 Environment Type, Unless Otherwise Indicated:
 - a. Indoor Clean, Dry Locations: Type 1, painted steel.
 - b. Outdoor Locations: Type 3R, painted steel.
 - 3. Junction and Pull Boxes Larger Than 100 cubic inches (1,650 cu cm):
 - a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
 - b. Boxes 6 square feet (0.56 sq m) and Larger: Provide sectionalized screw-cover or hinged-cover enclosures.
 - 4. Finish for Painted Steel Enclosures: Manufacturer's standard grey unless otherwise indicated.
 - 5. Manufacturers:
 - a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com

- b. Hoffman, a brand of Pentair Technical Products: www.hoffmanonline.com
- c. Hubbell Incorporated; Wiegmann Products: www.hubbell-wiegmann.com

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive boxes.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install boxes in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide separate boxes for emergency power and normal power systems.
- E. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.
- F. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.
- G. Unless otherwise indicated, boxes may be surface-mounted where exposed conduits are indicated or permitted.
- H. Box Locations:
 - 1. Locate boxes to be accessible. Provide access panels in accordance with Section 08 31 00 as required where approved by the Architect.
 - 2. Unless dimensioned, box locations indicated are approximate.
 - Locate boxes as required for devices installed under other sections or by others.
 a. Switches, Receptacles, and Other Wiring Devices: Comply with Section 26 27 26.
 - 4. Locate boxes so that wall plates do not span different building finishes.
 - 5. Locate boxes so that wall plates do not cross masonry joints.
 - 6. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.
 - 7. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches (150 mm) horizontal separation unless otherwise indicated.
 - 8. Fire Resistance Rated Walls: Install flush-mounted boxes such that the required fire resistance will not be reduced.
 - a. Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches (610 mm) separation where wall is constructed with individual noncommunicating stud cavities or protect both boxes with listed putty pads.
 - b. Do not install flush-mounted boxes with area larger than 16 square inches (0.0103 sq m) or such that the total aggregate area of openings exceeds 100 square inches (0.0645 sq m) for any 100 square feet (9.29 sq m) of wall area.

- 9. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 26 05 33.13.
- 10. Locate junction and pull boxes in the following areas, unless otherwise indicated or approved by the Architect:
 - a. Concealed above accessible suspended ceilings.
 - b. Within joists in areas with no ceiling.
 - c. Electrical rooms.
 - d. Mechanical equipment rooms.
- I. Box Supports:
 - 1. Secure and support boxes in accordance with NFPA 70 and Section 26 05 29 using suitable supports and methods approved by the authority having jurisdiction.
 - 2. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.
 - 3. Installation Above Suspended Ceilings: Do not provide support from ceiling grid or ceiling support system.
- J. Install boxes plumb and level.
- K. Flush-Mounted Boxes:
 - 1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch (6 mm) or does not project beyond finished surface.
 - 2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.
 - 3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch (3 mm) at the edge of the box.
- L. Install boxes as required to preserve insulation integrity.
- M. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- N. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.
- O. Close unused box openings.
- P. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.
- Q. Provide grounding and bonding in accordance with Section 26 05 26.

3.3 CLEANING

A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

3.4 PROTECTION

A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

END OF SECTION 26 05 33.16

SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Electrical identification requirements.
- B. Identification nameplates and labels.
- C. Wire and cable markers.
- D. Voltage markers.
- E. Warning signs and labels.

1.2 RELATED REQUIREMENTS

- A. Section 09 91 13 Exterior Painting.
- B. Section 09 91 23 Interior Painting.
- C. Section 26 05 19 Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.
- D. Section 26 05 73 Power System Studies: Arc flash hazard warning labels.
- E. Section 26 27 26 Wiring Devices Lutron: Device and wallplate finishes; factory pre-marked wallplates.

1.3 REFERENCE STANDARDS

- A. UL 969 Marking and Labeling Systems Current Edition, Including All Revisions.
- 1.4 ADMINISTRATIVE REQUIREMENTS
 - A. Coordination:
 - 1. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.
 - B. Sequencing:
 - 1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.
 - 2. Do not install identification products until final surface finishes and painting are complete.

1.5 SUBMITTALS

- A. See Section 01 30 00 Administrative Requirements for submittals procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.

1.6 FIELD CONDITIONS

A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

PART 2 PRODUCTS

2.1 IDENTIFICATION REQUIREMENTS

- A. Identification for Equipment:
 - 1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
 - a. Panelboards:
 - 1) Identify ampere rating.
 - 2) Identify voltage and phase.
 - 3) Identify power source and circuit number. Include location when not within sight of equipment.
 - 4) Identify main overcurrent protective device. Use identification label for panelboards with a door. For power distribution panelboards without a door, use identification nameplate.
 - 5) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces using pencil.
 - 6) For power panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
 - b. Enclosed switches, circuit breakers, and motor controllers:
 - 1) Identify voltage and phase.
 - 2) Identify power source and circuit number. Include location when not within sight of equipment.
 - 3) Identify load(s) served. Include location when not within sight of equipment.
 - 2. Use identification nameplate to identify disconnect location for equipment with remote disconnecting means.
 - 3. Use identification label on inside of door at each fused switch to identify required NEMA fuse class and size.
 - 4. Use identification label to identify overcurrent protective devices for branch circuits serving fire alarm circuits. Identify with text "FIRE ALARM CIRCUIT".
 - 5. Arc Flash Hazard Warning Labels: Comply with Section 26 05 73.
- B. Identification for Conductors and Cables:
 - 1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 05 19.
 - 2. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.
 - 3. Use wire and cable markers to identify circuit number or other designation indicated for power, control, and instrumentation conductors and cables at the following locations:
 - a. At each source and load connection.
 - b. Within boxes when more than one circuit is present.

- c. Within equipment enclosures when conductors and cables enter or leave the enclosure.
- 4. Use wire and cable markers to identify connected grounding electrode system components for grounding electrode conductors.
- C. Identification for Raceways:
 - 1. Use voltage markers to identify highest voltage present for accessible conduits at maximum intervals of 20 feet (6.1 m).
 - 2. Use voltage markers, color-coded bands, or factory-painted conduits to identify systems other than normal power system for accessible conduits.
 - a. Maximum Intervals: 20 feet (6.1 m).
 - b. Color-Coded Bands: Use field-painting or vinyl color coding electrical tape to mark bands 3 inches (76 mm) wide.
 - 1) Field-Painting: Comply with Section 09 91 23 and 099113.
 - 2) Vinyl Color Coding Electrical Tape: Comply with Section 26 05 19.
 - c. Color Code:
 - 1) Emergency Power System: Red.
 - 2) Fire Alarm System: Red.
 - 3. Use identification labels or plastic marker tags to identify spare conduits at each end. Identify purpose and termination location.
 - 4. Use voltage markers to identify highest voltage present for wireways at maximum intervals of 20 feet (6.1 m).
- D. Identification for Boxes:
 - 1. Use voltage markers to identify highest voltage present.
 - 2. Use voltage markers or color coded boxes to identify systems other than normal power system.
 - a. Color-Coded Boxes: Field-painted in accordance with Section 09 91 23 and 099113 per the same color code used for raceways.
 - 1) Fire Alarm System: Red.
 - b. For exposed boxes in public areas, do not color code.
 - 3. Use identification labels to identify circuits enclosed.
 - a. For exposed boxes in public areas, use only identification labels.
- E. Identification for Devices:
 - 1. Wiring Device and Wallplate Finishes: Comply with Section 26 27 26.
 - 2. Use identification label to identify fire alarm system devices.
 - 3. Use identification label or engraved wallplate to identify serving branch circuit for all receptacles.
 - a. For receptacles in public areas or in areas as directed by Architect, provide identification on inside surface of wallplate.
 - 4. Use identification label or engraved wallplate to identify load controlled for wall-mounted control devices controlling loads that are not visible from the control location and for multiple wall-mounted control devices installed at one location.
- F. Identification for Luminaires:

1. Use permanent red dot on luminaire frame to identify luminaires connected to emergency power system.

2.2 IDENTIFICATION NAMEPLATES AND LABELS

- A. Identification Nameplates:
 - 1. Materials:
 - a. Indoor Clean, Dry Locations: Use plastic nameplates.
 - b. Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.
 - Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically nonconductive phenolic with beveled edges; minimum thickness of 1/16 inch (1.6 mm); engraved text.
 - a. Exception: Provide minimum thickness of 1/8 inch (3 mm) when any dimension is greater than 4 inches (100 mm).
 - 3. Stainless Steel Nameplates: Minimum thickness of 1/32 inch (0.8 mm); engraved or laseretched text.
 - 4. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch (0.8 mm); engraved or laser-etched text.
 - 5. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch (25 mm) high; Four, located at corners for larger sizes.
- B. Identification Labels:
 - 1. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
 - a. Use only for indoor locations.
 - 2. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.
- C. Format for Equipment Identification:
 - 1. Minimum Size: 1 inch (25 mm) by 2.5 inches (64 mm).
 - 2. Legend:
 - a. System designation where applicable:
 - 1) Emergency Power System: Identify with text "EMERGENCY".
 - 2) Fire Alarm System: Identify with text "FIRE ALARM".
 - b. Equipment designation or other approved description.
 - 3. Text: All capitalized unless otherwise indicated.
 - 4. Minimum Text Height:
 - a. System Designation: 1 inch (25 mm).
 - b. Equipment Designation: 1/2 inch (13 mm).
 - 5. Color:
 - a. Normal Power System: White text on black background.
 - b. Emergency Power System: White text on red background.
 - c. Fire Alarm System: White text on red background.
- D. Format for General Information and Operating Instructions:

- 1. Minimum Size: 1 inch (25 mm) by 2.5 inches (64 mm).
- 2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
- 3. Text: All capitalized unless otherwise indicated.
- 4. Minimum Text Height: 1/4 inch (6 mm).
- 5. Color: Black text on white background unless otherwise indicated.
- E. Format for Caution and Warning Messages:
 - 1. Minimum Size: 2 inches (51 mm) by 4 inches (100 mm).
 - 2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
 - 3. Text: All capitalized unless otherwise indicated.
 - 4. Minimum Text Height: 1/2 inch (13 mm).
 - 5. Color: Black text on yellow background unless otherwise indicated.
- F. Format for Receptacle Identification:
 - 1. Minimum Size: 3/8 inch (10 mm) by 1.5 inches (38 mm).
 - 2. Legend: Power source and circuit number or other designation indicated.
 - 3. Text: All capitalized unless otherwise indicated.
 - 4. Minimum Text Height: 3/16 inch (5 mm).
 - 5. Color: Black text on clear background.
- G. Format for Control Device Identification:
 - 1. Minimum Size: 3/8 inch (10 mm) by 1.5 inches (38 mm).
 - 2. Legend: Load controlled or other designation indicated.
 - 3. Text: All capitalized unless otherwise indicated.
 - 4. Minimum Text Height: 3/16 inch (5 mm).
 - 5. Color: Black text on clear background.
- H. Format for Fire Alarm Device Identification:
 - 1. Minimum Size: 3/8 inch (10 mm) by 1.5 inches (38 mm).
 - 2. Legend: Designation indicated and device zone or address.
 - 3. Text: All capitalized unless otherwise indicated.
 - 4. Minimum Text Height: 3/16 inch (5 mm).
 - 5. Color: Red text on white background.

2.3 WIRE AND CABLE MARKERS

- A. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.
- B. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.
- C. Legend: Power source and circuit number or other designation indicated.
- D. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.
- E. Minimum Text Height: 1/8 inch (3 mm).

F. Color: Black text on white background unless otherwise indicated.

2.4 VOLTAGE MARKERS

- A. Markers for Conduits: Use factory pre-printed self-adhesive vinyl, self-adhesive vinyl cloth, or vinyl snap-around type markers.
- B. Markers for Boxes and Equipment Enclosures: Use factory pre-printed self-adhesive vinyl or self-adhesive vinyl cloth type markers.
- C. Minimum Size:
 - 1. Markers for Equipment: 1 1/8 by 4 1/2 inches (29 by 110 mm).
 - 2. Markers for Conduits: As recommended by manufacturer for conduit size to be identified.
 - 3. Markers for Pull Boxes: 1 1/8 by 4 1/2 inches (29 by 110 mm).
 - 4. Markers for Junction Boxes: 1/2 by 2 1/4 inches (13 by 57 mm).
- D. Legend:
 - 1. Markers for Voltage Identification: Highest voltage present.
 - 2. Markers for System Identification:
- E. Color: Black text on orange background unless otherwise indicated.

2.5 WARNING SIGNS AND LABELS

- A. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.
- B. Warning Signs:
 - 1. Materials:
 - a. Indoor Dry, Clean Locations: Use factory pre-printed rigid plastic or self-adhesive vinyl signs.
 - b. Outdoor Locations: Use factory pre-printed rigid aluminum signs.
 - 2. Rigid Signs: Provide four mounting holes at corners for mechanical fasteners.
 - 3. Minimum Size: 7 by 10 inches (178 by 254 mm) unless otherwise indicated.
- C. Warning Labels:
 - 1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or selfadhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.
 - a. Do not use labels designed to be completed using handwritten text.
 - 2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.
 - 3. Minimum Size: 2 by 4 inches (51 mm by 102 mm) unless otherwise indicated.

PART 3 EXECUTION

3.1 PREPARATION

A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
 - 1. Surface-Mounted Equipment: Enclosure front.
 - 2. Flush-Mounted Equipment: Inside of equipment door.
 - 3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
 - 4. Elevated Equipment: Legible from the floor or working platform.
 - 5. Branch Devices: Adjacent to device.
 - 6. Interior Components: Legible from the point of access.
 - 7. Conduits: Legible from the floor.
 - 8. Boxes: Outside face of cover.
 - 9. Conductors and Cables: Legible from the point of access.
 - 10. Devices: Outside face of cover.
- C. Install identification products centered, level, and parallel with lines of item being identified.
- D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using self-adhesive backing or epoxy cement.
- E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.
- F. Secure rigid signs using stainless steel screws.
- G. Mark all handwritten text, where permitted, to be neat and legible.
- 3.3 FIELD QUALITY CONTROL
 - A. See Section 01 40 00 Quality Requirements, for additional requirements.
 - B. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

END OF SECTION 26 05 53

SECTION 26 05 73 - POWER SYSTEM STUDIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Short-circuit study.
- B. Protective device coordination study.
- C. Arc flash and shock risk assessment.
 - 1. Includes arc flash hazard warning labels.
- D. Criteria for the selection and adjustment of equipment and associated protective devices not specified in this section, as determined by studies to be performed.

1.2 RELATED REQUIREMENTS

- A. Section 26 05 53 Identification for Electrical Systems: Additional requirements for arc flash hazard warning labels.
- B. Section 26 24 16 Panelboards.
- C. Section 26 28 13 Fuses.
- D. Section 26 28 16.16 Enclosed Switches.
- 1.3 REFERENCE STANDARDS
 - A. ANSI Z535.4 American National Standard for Product Safety Signs and Labels 2011 (Reaffirmed 2017).
 - B. IEEE 141 IEEE Recommended Practice for Electrical Power Distribution for Industrial Plants 1993 (Reaffirmed 1999).
 - C. IEEE 242 IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems 2001, with Errata (2003).
 - D. IEEE 399 IEEE Recommended Practice for Industrial and Commercial Power Systems Analysis 1997.
 - E. IEEE 551 IEEE Recommended Practice for Calculating Short-Circuit Currents in Industrial and Commercial Power Systems 2006.
 - F. IEEE 1584 IEEE Guide for Performing Arc-Flash Hazard Calculations 2018, with Errata (2019).
 - G. NEMA MG 1 Motors and Generators 2021.
 - H. NETA ATS Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems 2021.
 - I. NFPA 70 National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
 - J. NFPA 70E Standard for Electrical Safety in the Workplace 2021.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work to provide equipment and associated protective devices complying with criteria for selection and adjustment, as determined by studies to be performed.
 - 2. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Submit study reports prior to or concurrent with product submittals.
 - 2. Do not order equipment until matching study reports and product submittals have both been evaluated by Architect.
 - 3. Verify naming convention for equipment identification prior to creation of final drawings, reports, and arc flash hazard warning labels (where applicable).
- C. Scheduling:
 - 1. Arrange access to existing facility for data collection with Owner.
 - 2. Where work of this section involves interruption of existing electrical service, arrange service interruption with Owner.

1.5 SUBMITTALS

- A. See Section 01 30 00 Administrative Requirements, for submittal procedures.
- B. Study preparer's qualifications.
- C. Study reports, stamped or sealed and signed by study preparer.
- D. Product Data: In addition to submittal requirements specified in other sections, include manufacturer's standard catalog pages and data sheets for equipment and protective devices indicating information relevant to studies.
 - 1. Include characteristic time-current trip curves for protective devices.
 - 2. Include impedance data for engine generators.
 - 3. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
 - 4. Identify modifications made in accordance with studies that:
 - a. Can be made at no additional cost to Owner.
 - b. As submitted will involve a change to the contract sum.
- E. Arc Flash Hazard Warning Label Samples: One of each type and legend specified.
- F. Certification that field adjustable protective devices have been set in accordance with requirements of studies.
- G. Project Record Documents: Revise studies as required to reflect as-built conditions.
 - 1. Include hard copies with operation and maintenance data submittals.
 - 2. Include computer software files used to prepare studies with file name(s) cross-referenced to specific pieces of equipment and systems.

1.6 POWER SYSTEM STUDIES

A. Scope of Studies:

- 1. Perform analysis of new electrical distribution system components as indicated on drawings.
- 2. Except where study descriptions below indicate exclusions, analyze system at each bus from primary protective devices of utility source down to each piece of equipment involved, including parts of system affecting calculations being performed (e.g. fault current contribution from motors).
- 3. Include in analysis alternate sources and operating modes (including known future configurations) to determine worst case conditions.
 - a. Known Operating Modes:
 - 1) Utility as source.
- B. General Study Requirements:
 - 1. Comply with NFPA 70.
 - 2. Perform studies utilizing computer software complying with specified requirements; manual calculations are not permitted.
- C. Data Collection:
 - 1. Compile information on project-specific characteristics of actual installed equipment, protective devices, feeders, etc. as necessary to develop single-line diagram of electrical distribution system and associated input data for use in system modeling.
 - a. Utility Source Data: Include primary voltage, maximum and minimum three-phase and line-to-ground fault currents, impedance, X/R ratio, and primary protective device information.
 - 1) Obtain up-to-date information from Utility Company.
 - 2) Utility Company: As indicated on drawings.
 - b. Generators: Include manufacturer/model, kW and voltage ratings, and impedance.
 - c. Motors: Include manufacturer/model, type (e.g. induction, synchronous), horsepower rating, voltage rating, full load amps, and locked rotor current or NEMA MG 1 code letter designation.
 - d. Transformers: Include primary and secondary voltage ratings, kVA rating, winding configuration, percent impedance, and X/R ratio.
 - e. Protective Devices:
 - Circuit Breakers: Include manufacturer/model, type (e.g. thermal magnetic, electronic trip), frame size, trip rating, voltage rating, interrupting rating, available field-adjustable trip response settings, and features (e.g. zone selective interlocking).
 - 2) Fuses: Include manufacturer/model, type/class (e.g. Class J), size/rating, and speed (e.g. time delay, fast acting).
 - f. Protective Relays: Include manufacturer/model, type, settings, current/potential transformer ratio, and associated protective device.
 - g. Conductors: Include feeder size, material (e.g. copper, aluminum), insulation type, voltage rating, number per phase, raceway type, and actual length.
 - 2. Existing Installations:
 - a. Collect data on existing electrical distribution system necessary for completion of studies, including field verification of available existing data (e.g. construction documents, previous studies). Include actual settings for field-adjustable devices.
- D. Short-Circuit Study:

- 1. Comply with IEEE 551 and applicable portions of IEEE 141, IEEE 242, and IEEE 399.
- 2. For purposes of determining equipment short circuit current ratings, consider conditions that may result in maximum available fault current, including but not limited to:
 - a. Maximum utility fault currents.
 - b. Maximum motor contribution.
 - c. Known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).
- 3. For each bus location, calculate the maximum available three-phase bolted symmetrical and asymmetrical fault currents. For grounded systems, also calculate the maximum available line-to-ground bolted fault currents.
- E. Protective Device Coordination Study:
 - 1. Comply with applicable portions of IEEE 242 and IEEE 399.
 - 2. Analyze alternate scenarios considering known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).
 - Analyze protective devices and associated settings for suitable margins between timecurrent curves to provide adequate protection for equipment and conductors while achieving full selective coordination.
- F. Arc Flash and Shock Risk Assessment:
 - 1. Comply with NFPA 70E.
 - 2. Perform incident energy and arc flash boundary calculations in accordance with IEEE 1584 (as referenced in NFPA 70E Annex D), where applicable.
 - 3. Analyze alternate scenarios considering conditions that may result in maximum incident energy, including but not limited to:
 - a. Maximum and minimum utility fault currents.
 - b. Maximum and minimum motor contribution.
 - c. Known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).
- G. Study Reports:
 - 1. General Requirements:
 - a. Identify date of study and study preparer.
 - b. Identify study methodology and software product(s) used.
 - c. Identify scope of studies, assumptions made, implications of possible alternate scenarios, and any exclusions from studies.
 - d. Identify base used for per unit values.
 - e. Include single-line diagram and associated input data used for studies; identify buses on single-line diagram as referenced in reports, and indicate bus voltage.
 - f. Include conclusions and recommendations.
 - 2. Short-Circuit Study:
 - a. For each scenario, identify at each bus location:
 - 1) Calculated maximum available symmetrical and asymmetrical fault currents (both three-phase and line-to-ground where applicable).
 - 2) Fault point X/R ratio.
 - 3) Associated equipment short circuit current ratings.

- b. Identify locations where the available fault current exceeds the equipment short circuit current rating, along with recommendations.
- 3. Protective Device Coordination Study:
 - a. For each scenario, include time-current coordination curves plotted on log-log scale graphs.
 - b. For each graph include (where applicable):
 - 1) Partial single-line diagram identifying the portion of the system illustrated.
 - 2) Protective Devices: Time-current curves with applicable tolerance bands for each protective device in series back to the source, plotted up to the maximum available fault current at the associated bus.
 - 3) Conductors: Damage curves.
 - 4) Transformers: Inrush points and damage curves.
 - 5) Generators: Full load current, overload curves, decrement curves, and short circuit withstand points.
 - 6) Motors: Full load current, starting curves, and damage curves.
 - 7) Capacitors: Full load current and damage curves.
 - c. For each protective device, identify fixed and adjustable characteristics with available ranges and recommended settings.
 - 1) Circuit Breakers: Include long time pickup and delay, short time pickup and delay, and instantaneous pickup.
 - 2) Include ground fault pickup and delay.
 - 3) Include fuse ratings.
 - 4) Protective Relays: Include current/potential transformer ratios, tap, time dial, and instantaneous pickup.
 - d. Identify cases where either full selective coordination or adequate protection is not achieved, along with recommendations.
- 4. Arc Flash and Shock Risk Assessment:
 - a. For the worst case for each scenario, identify at each bus location:
 - 1) Calculated incident energy and associated working distance.
 - 2) Calculated arc flash boundary.
 - 3) Bolted fault current.
 - 4) Arcing fault current.
 - 5) Clearing time.
 - 6) Arc gap distance.
 - b. For purposes of producing arc flash hazard warning labels, summarize the maximum incident energy and associated data reflecting the worst case condition of all scenarios at each bus location.
 - c. Include recommendations for reducing the incident energy at locations where the calculated maximum incident energy exceeds 8 calories per sq cm.

1.7 QUALITY ASSURANCE

- A. Study Preparer Qualifications: Professional electrical engineer licensed in the State in which the Project is located and with minimum five years experience in preparation of studies of similar type and complexity using specified computer software.
 - 1. Study preparer may be employed by manufacturer of electrical distribution equipment.

- B. Computer Software for Study Preparation: Use the latest edition of commercially available software utilizing specified methodologies.
 - 1. Products:
 - a. ETAP/Operation Technology, Inc: www.etap.com/#sle.
 - b. SKM Systems Analysis, Inc: www.skm.com/#sle.

PART 2 PRODUCTS

2.1 ARC FLASH HAZARD WARNING LABELS

- A. Provide warning labels complying with ANSI Z535.4 to identify arc flash hazards for each work location analyzed by the arc flash and shock risk assessment.
 - 1. Materials: Comply with Section 26 05 53.
 - 2. Legend: Provide custom legend in accordance with NFPA 70E based on equipmentspecific data as determined by arc flash and shock risk assessment.
 - a. Include the following information:
 - 1) Arc flash boundary.
 - 2) Available incident energy and corresponding working distance.
 - 3) Site-specific PPE (personnel protective equipment) requirements.
 - 4) Nominal system voltage.
 - 5) Limited approach boundary.
 - 6) Restricted approach boundary.
 - 7) Equipment identification.
 - 8) Study preparer, report reference, and date calculations were performed.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install arc flash warning labels in accordance with Section 26 05 53.
- 3.2 FIELD QUALITY CONTROL
 - A. See Section 01 40 00 Quality Requirements, for additional requirements.
 - B. Inspect and test in accordance with NETA ATS, except Section 4.
 - C. Adjust equipment and protective devices for compliance with studies and recommended settings.
 - D. Notify Architect of any conflicts with or deviations from studies. Obtain direction before proceeding.

3.3 CLOSEOUT ACTIVITIES

- A. See Section 01 78 00 Closeout Submittals, for closeout submittals.
- B. See Section 01 79 00 Demonstration and Training, for additional requirements.
- C. Training: Include as part of the base bid training for Owner's personnel on electrical safety pertaining to arc flash and shock hazards.

1. Use site-specific arc flash and shock risk assessment report as training reference, supplemented with additional training materials as required.

END OF SECTION 26 05 73

SECTION 26 05 83 - WIRING CONNECTIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Electrical connections to equipment.

1.2 RELATED REQUIREMENTS

- A. Section 26 05 19 Low-Voltage Electrical Power Conductors and Cables.
- B. Section 26 05 33.13 Conduit for Electrical Systems.
- C. Section 26 05 33.16 Boxes for Electrical Systems.
- D. Section 26 27 26 Wiring Devices.
- E. Section 26 28 16.16 Enclosed Switches.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
 - 2. Determine connection locations and requirements.
- B. Sequencing:
 - 1. Install rough-in of electrical connections before installation of equipment is required.
 - 2. Make electrical connections before required start-up of equipment.

PART 2 PRODUCTS

- 2.1 MATERIALS
 - A. Disconnect Switches: As specified in Section 26 28 16.16 and in individual equipment sections.
 - B. Wiring Devices: As specified in Section 26 27 26.
 - C. Flexible Conduit: As specified in Section 26 05 33.13.
 - D. Wire and Cable: As specified in Section 26 05 19.
 - E. Boxes: As specified in Section 26 05 33.16.

PART 3 EXECUTION

- 3.1 EXAMINATION
 - A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.2 ELECTRICAL CONNECTIONS

- A. Make electrical connections in accordance with equipment manufacturer's instructions.
- B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.
- C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.
- D. Provide receptacle outlet to accommodate connection with attachment plug.
- E. Provide cord and cap where field-supplied attachment plug is required.
- F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
- G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.
- H. Install terminal block jumpers to complete equipment wiring requirements.
- I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

END OF SECTION 26 05 83

SECTION 26 09 23 - LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Occupancy sensors.

1.2 RELATED REQUIREMENTS

- A. Section 26 05 29 Hangers and Supports for Electrical Systems
- B. Section 26 05 33.16 Boxes for Electrical Systems.
- C. Section 26 27 26 Wiring Devices: Devices for manual control of lighting, including wall switches, wall dimmers, and fan speed controllers.
 - 1. Includes finish requirements for wall controls specified in this section.
 - 2. Includes accessory receptacles, switches, dimmers and wall plates, to match lighting controls specified in this section.

1.3 REFERENCE STANDARDS

- A. NECA 1 Standard for Good Workmanship in Electrical Construction 2015.
- B. NECA 130 Standard for Installing and Maintaining Wiring Devices 2016.
- C. NEMA 410 Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Disharge Ballasts 2020.
- D. NFPA 70 National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the placement of lighting control devices with millwork, furniture, equipment, etc. installed under other sections or by others.
 - 2. Coordinate the placement of wall switch occupancy sensors with actual installed door swings.
 - 3. Coordinate the placement of occupancy sensors with millwork, furniture, equipment or other potential obstructions to motion detection coverage installed under other sections or by others.
 - 4. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.
- B. Sequencing:
 - 1. Do not install lighting control devices until final surface finishes and painting are complete.
1.5 SUBMITTALS

- A. See Section 01 30 00 Administrative Requirements, for submittal procedures.
- B. Product Data: Include ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
 - 1. Occupancy Sensors: Include detailed motion detection coverage range diagrams.
- C. Shop Drawings:
 - 1. Occupancy Sensors: Provide lighting plan indicating location, model number, and orientation of each occupancy sensor and associated system component.
- D. Field Quality Control Reports.
- E. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 Product Requirements, for additional provisions.
- G. Project Record Documents: Record actual installed locations and settings for lighting control devices.
- 1.6 QUALITY ASSURANCE
 - A. Comply with requirements of NFPA 70.
 - B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
 - C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 WARRANTY

- A. See Section 01 78 00 Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer warranty for all occupancy sensors.

PART 2 PRODUCTS

2.1 LIGHTING CONTROL DEVICES - GENERAL REQUIREMENTS

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless specifically indicated to be excluded, provide all required conduit, wiring, connectors, hardware, components, accessories, etc. as required for a complete operating system.
- C. Products for Switching of Electronic Ballasts/Drivers: Tested and rated to be suitable for peak inrush currents specified in NEMA 410.

2.2 OCCUPANCY SENSORS

A. Manufacturers:

- 1. Hubbell Incorporated: www.hubbell.com
- 2. Sensor Switch Inc: www.sensorswitch.com
- 3. WattStopper: www.wattstopper.com
- 4. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.
- B. All Occupancy Sensors:
 - 1. Description: Factory-assembled commercial specification grade devices for indoor use capable of sensing both major motion, such as walking, and minor motion, such as small desktop level movements, according to published coverage areas, for automatic control of load indicated.
 - 2. Sensor Technology:
 - a. Passive Infrared/Ultrasonic Dual Technology Occupancy Sensors: Designed to detect occupancy using a combination of both passive infrared and ultrasonic technologies.
 - 3. Provide LED to visually indicate motion detection with separate color LEDs for each sensor type in dual technology units.
 - 4. Operation: Unless otherwise indicated, occupancy sensor to turn load on when occupant presence is detected and to turn load off when no occupant presence is detected during an adjustable turn-off delay time interval.
 - 5. Dual Technology Occupancy Sensors: Field configurable turn-on and hold-on activation with settings for activation by either or both sensing technologies.
 - 6. Passive Infrared Lens Field of View: Field customizable by addition of factory masking material, adjustment of integral blinders, or similar means to block motion detection in selected areas.
 - 7. Turn-Off Delay: Field adjustable, with time delay settings up to 30 minutes.
 - 8. Sensitivity: Field adjustable.
 - 9. Adaptive Technology: Field selectable; capable of self-adjusting sensitivity and time delay according to conditions.
 - 10. Compatibility (Non-Dimming Sensors): Suitable for controlling incandescent lighting, low-voltage lighting with electronic and magnetic transformers, fluorescent lighting with electronic and magnetic ballasts, and fractional motor loads, with no minimum load requirements.
 - 11. Load Rating for Line Voltage Occupancy Sensors: As required to control the load indicated on drawings.
 - 12. Isolated Relay for Low Voltage Occupancy Sensors: SPDT dry contacts, ratings as required for interface with system indicated.
- C. Wall Switch Occupancy Sensors:
 - 1. All Wall Switch Occupancy Sensors:
 - a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with a field of view of 180 degrees, integrated manual control capability, and no leakage current to load in off mode.
 - b. Unless otherwise indicated or required to control the load indicated on drawings, provide line voltage units with self-contained relay.

- c. Where indicated, provide two-circuit units for control of two separate lighting loads, with separate manual controls and separately programmable operation for each load.
- d. Operation: Field selectable to operate either as occupancy sensor (automatic on/off) or as vacancy sensor (manual-on/automatic off).
- e. Manual-Off Override Control: When used to turn off load while in automatic-on mode, unit to revert back to automatic mode after no occupant presence is detected during the delayed-off time interval.
- f. Finish: Match finishes specified for wiring devices in Section 26 27 26, unless otherwise indicated.
- g. Finish: Grey.
- 2. Passive Infrared (PIR) Wall Switch Occupancy Sensors: Capable of detecting motion within an area of 900 square feet (83.6 sq m).
- 3. Passive Infrared/Ultrasonic Dual Technology Wall Switch Occupancy Sensors: Capable of detecting motion within an area of 900 square feet (83.6 sq m).
- D. Ceiling Mounted Occupancy Sensors:
 - 1. All Ceiling Mounted Occupancy Sensors:
 - a. Description: Low profile occupancy sensors designed for ceiling installation.
 - b. Unless otherwise indicated or required to control the load indicated on drawings, provide low voltage units, for use with separate compatible accessory power packs.
 - c. Provide field selectable setting for disabling LED motion detector visual indicator.
 - d. Occupancy sensor to be field selectable as either manual-on/automatic-off or automatic on/off.
 - e. Finish: White unless otherwise indicated.
 - 2. Passive Infrared (PIR) Ceiling Mounted Occupancy Sensors:
 - a. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet (41.8 square meters) at a mounting height of 9 feet (2.7 m), with a field of view of 360 degrees.
 - b. Extended Range Sensors: Capable of detecting motion within an area of 1,200 square feet (111.5 sq m) at a mounting height of 9 feet (2.7 m), with a field of view of 360 degrees.
 - 3. Passive Infrared/Ultrasonic Dual Technology Ceiling Mounted Occupancy Sensors:
 - a. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet (41.8 sq m) at a mounting height of 9 feet (2.7 m), with a field of view of 360 degrees.
 - Extended Range Sensors: Capable of detecting motion within an area of 1,200 square feet (111.5 sq m) at a mounting height of 9 feet (2.7 m), with a field of view of 360 degrees.
- E. Power Packs for Low Voltage Occupancy Sensors:
 - 1. Description: Plenum rated, self-contained low voltage class 2 transformer and relay compatible with specified low voltage occupancy sensors for switching of line voltage loads.
 - 2. Provide quantity and configuration of power and slave packs with all associated wiring and accessories as required to control the load indicated on drawings.
 - 3. Input Supply Voltage: Dual rated for 120/277 V ac.

4. Load Rating: As required to control the load indicated on drawings.

PART 3 EXECUTION

- 3.1 EXAMINATION
 - A. Verify that field measurements are as indicated.
 - B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
 - C. Verify that openings for outlet boxes are neatly cut and will be completely covered by devices or wall plates.
 - D. Verify that final surface finishes are complete, including painting.
 - E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to lighting control devices.
 - F. Verify that the service voltage and ratings of lighting control devices are appropriate for the service voltage and load requirements at the location to be installed.
 - G. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

- A. Install lighting control devices in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
- B. Coordinate locations of outlet boxes provided under Section 26 05 33.16 as required for installation of lighting control devices provided under this section.
 - 1. Orient outlet boxes for vertical installation of lighting control devices unless otherwise indicated.
 - 2. Locate wall switch occupancy sensors on strike side of door with edge of wall plate 3 inches (80 mm) from edge of door frame. Where locations are indicated otherwise, notify Architect to obtain direction prior to proceeding with work.
- C. Install lighting control devices in accordance with manufacturer's instructions.
- D. Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- E. Install lighting control devices plumb and level, and held securely in place.
- F. Where required and not furnished with lighting control device, provide wall plate in accordance with Section 26 27 26.
- G. Provide required supports in accordance with Section 26 05 29.
- H. Where applicable, install lighting control devices and associated wall plates to fit completely flush to mounting surface with no gaps and rough opening completely covered without strain on

wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.

- I. Occupancy Sensor Locations:
 - 1. Location Adjustments: Locations indicated are diagrammatic and only intended to indicate which rooms or areas require devices. Provide quantity and locations as required for complete coverage of respective room or area based on manufacturer's recommendations for installed devices.
 - 2. Locate ultrasonic and dual technology passive infrared/ultrasonic occupancy sensors a minimum of 4 feet (1.2 m) from air supply ducts or other sources of heavy air flow and as per manufacturer's recommendations, in order to minimize false triggers.
- J. Unless otherwise indicated, install power packs for lighting control devices above accessible ceiling or above access panel in inaccessible ceiling near the sensor location.
- K. Unless otherwise indicated, install switches on load side of power packs so that switch does not turn off power pack.

3.4 FIELD QUALITY CONTROL

- A. See Section 01 40 00 Quality Requirements, for additional requirements.
- B. Inspect each lighting control device for damage and defects.
- C. Test occupancy sensors to verify proper operation, including time delays and ambient light thresholds where applicable. Verify optimal coverage for entire room or area. Record test results in written report to be included with submittals.
- D. Correct wiring deficiencies and replace damaged or defective lighting control devices.

3.5 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.
- B. Adjust occupancy sensor settings to minimize undesired activations while optimizing energy savings, and to achieve desired function as indicated or as directed by Architect.
- C. Where indicated or as directed by Architect, install factory masking material or adjust integral blinders on passive infrared (PIR) and dual technology occupancy sensor lenses to block undesired motion detection.

3.6 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.7 CLOSEOUT ACTIVITIES

- A. Demonstration: Demonstrate proper operation of lighting control devices to Architect, and correct deficiencies or make adjustments as directed.
- B. Training: Train Owner's personnel on operation, adjustment, programming, and maintenance of lighting control devices.

1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.

END OF SECTION 26 09 23

SECTION 26 24 16 - PANELBOARDS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Power distribution panelboards.
- B. Lighting and appliance panelboards.
- C. Overcurrent protective devices for panelboards.

1.2 RELATED REQUIREMENTS

- A. Section 26 05 26 Grounding and Bonding for Electrical Systems.
- B. Section 26 05 29 Hangers and Supports for Electrical Systems.
- C. Section 26 05 53 Identification for Electrical Systems: Identification products and requirements.
- D. Section 26 05 73 Power System Studies: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.
- E. Section 26 43 00 Surge Protective Devices.

1.3 REFERENCE STANDARDS

- A. FS W-C-375 Circuit Breakers, Molded Case; Branch Circuit and Service 2013e, with Amendment (2017).
- B. NECA 1 Standard for Good Workmanship in Electrical Construction 2015.
- C. NECA 407 Standard for Installing and Maintaining Panelboards 2015.
- D. NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.
- E. NEMA PB 1 Panelboards 2011.
- F. NEMA PB 1.1 General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less 2013.
- G. NETA ATS Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems 2021.
- H. NFPA 70 National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. UL 50 Enclosures for Electrical Equipment, Non-Environmental Considerations Current Edition, Including All Revisions.
- J. UL 50E Enclosures for Electrical Equipment, Environmental Considerations Current Edition, Including All Revisions.
- K. UL 67 Panelboards Current Edition, Including All Revisions.
- L. UL 489 Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures Current Edition, Including All Revisions.
- M. UL 943 Ground-Fault Circuit-Interrupters Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 3. Coordinate the work with other trades to provide walls suitable for installation of flushmounted panelboards where indicated.
 - 4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
 - 5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

- A. See Section 01 30 00 Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.
 - 1. Include characteristic trip curves for each type and rating of overcurrent protective device upon request.
- C. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
 - 1. Include dimensioned plan and elevation views of panelboards and adjacent equipment with all required clearances indicated.
 - 2. Include wiring diagrams showing all factory and field connections.
 - 3. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 Product Requirements, for additional provisions.
 - 2. Panelboard Keys: Two of each different key.

1.6 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions and NECA 407.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

1.8 FIELD CONDITIONS

- A. Maintain ambient temperature within the following limits during and after installation of panelboards:
 - 1. Panelboards Containing Circuit Breakers: Between 23 degrees F (-5 degrees C) and 104 degrees F (40 degrees C).

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. ABB/GE: www.electrification.us.abb.com
- B. Eaton Corporation: www.eaton.com
- C. Schneider Electric; Square D Products: www.schneider-electric.us
- D. Source Limitations: Furnish panelboards and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.2 PANELBOARDS - GENERAL REQUIREMENTS

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 - 1. Altitude: Less than 6,600 feet (2,000 m).
 - 2. Ambient Temperature:
 - a. Panelboards Containing Circuit Breakers: Between 23 degrees F (-5 degrees C) and 104 degrees F (40 degrees C).
- C. Short Circuit Current Rating:
 - 1. Provide panelboards with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
- D. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.
- E. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.
- F. Bussing: Sized in accordance with UL 67 temperature rise requirements.
 - 1. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.

- 2. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
- G. Conductor Terminations: Suitable for use with the conductors to be installed.
- H. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
 - 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1.
 - 2. Boxes: Galvanized steel unless otherwise indicated.
 - a. Provide wiring gutters sized to accommodate the conductors to be installed.
 - b. Increase gutter space as required where sub-feed lugs, feed-through lugs, gutter taps, or oversized lugs are provided.
 - 3. Fronts:
 - a. Fronts for Surface-Mounted Enclosures: Same dimensions as boxes.
 - b. Fronts for Flush-Mounted Enclosures: Overlap boxes on all sides to conceal rough opening.
 - c. Finish for Painted Steel Fronts: Manufacturer's standard grey unless otherwise indicated.
 - 4. Lockable Doors: All locks keyed alike unless otherwise indicated.
- I. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.
- J. Surge Protective Devices: Where factory-installed, internally mounted surge protective devices are provided in accordance with Section 26 43 00, list and label panelboards as a complete assembly including surge protective device.
- K. Load centers are not acceptable.
- L. Provide the following features and accessories where indicated or where required to complete installation:
 - 1. Feed-through lugs.
 - 2. Sub-feed lugs.

2.3 POWER DISTRIBUTION PANELBOARDS

- A. Description: Panelboards complying with NEMA PB 1, power and feeder distribution type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.
- B. Conductor Terminations:
 - 1. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - 2. Main and Neutral Lug Type: Mechanical.
- C. Bussing:
 - 1. Phase and Neutral Bus Material: Aluminum.
 - 2. Ground Bus Material: Aluminum.
- D. Circuit Breakers:
 - 1. Provide bolt-on type.

E. Enclosures:

- 1. Provide surface-mounted enclosures unless otherwise indicated.
- 2. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
- 3. Provide clear plastic circuit directory holder mounted on inside of door.
- 2.4 LIGHTING AND APPLIANCE PANELBOARDS
 - A. Description: Panelboards complying with NEMA PB 1, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.
 - B. Conductor Terminations:
 - 1. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - 2. Main and Neutral Lug Type: Mechanical.
 - C. Bussing:
 - 1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
 - 2. Phase and Neutral Bus Material: Aluminum.
 - 3. Ground Bus Material: Aluminum.
 - D. Circuit Breakers: Thermal magnetic bolt-on type unless otherwise indicated.
 - E. Enclosures:
 - 1. Provide surface-mounted or flush-mounted enclosures as indicated.
 - 2. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
 - 3. Provide clear plastic circuit directory holder mounted on inside of door.

2.5 OVERCURRENT PROTECTIVE DEVICES

- A. Molded Case Circuit Breakers:
 - 1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
 - 2. Interrupting Capacity:
 - a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
 - 1) 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.
 - b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
 - 3. Conductor Terminations:
 - a. Provide mechanical lugs unless otherwise indicated.
 - b. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.

- 4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
 - a. Provide field-adjustable magnetic instantaneous trip setting for circuit breaker frame sizes 225 amperes and larger.
- 5. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
- 6. Provide the following circuit breaker types where indicated:
 - a. Ground Fault Circuit Interrupter (GFCI) Circuit Breakers: Listed as complying with UL 943, class A for protection of personnel.
 - b. Ground Fault Equipment Protection Circuit Breakers: Designed to trip at 30 mA for protection of equipment.
- 7. Do not use tandem circuit breakers.
- 8. Do not use handle ties in lieu of multi-pole circuit breakers.
- 9. Provide multi-pole circuit breakers for multi-wire branch circuits as required by NFPA 70.
- 10. Provide the following features and accessories where indicated or where required to complete installation:
 - a. Handle Pad-Lock Provision: For locking circuit breaker handle in OFF position.

2.6 SOURCE QUALITY CONTROL

A. Factory test panelboards according to NEMA PB 1.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive panelboards.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Install panelboards in accordance with NECA 407 and NEMA PB 1.1.
- D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- E. Provide required support and attachment in accordance with Section 26 05 29.
- F. Install panelboards plumb.
- G. Install flush-mounted panelboards so that trims fit completely flush to wall with no gaps and rough opening completely covered.
- H. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches (2000 mm) above the floor or working platform.

- I. Provide minimum of six spare 1 inch (27 mm) trade size conduits out of each flush-mounted panelboard stubbed into accessible space above ceiling and below floor.
- J. Provide grounding and bonding in accordance with Section 26 05 26.
- K. Install all field-installed branch devices, components, and accessories.
- L. Set field-adjustable circuit breaker tripping function settings as determined by overcurrent protective device coordination study performed according to Section 26 05 73.
- M. Provide filler plates to cover unused spaces in panelboards.
- N. Provide circuit breaker lock-on devices to prevent unauthorized personnel from de-energizing essential loads where indicated. Also provide for the following:
 - 1. Emergency and night lighting circuits.
 - 2. Fire detection and alarm circuits.
 - 3. Intrusion detection and access control system circuits.
 - 4. Video surveillance system circuits.
- O. Identify panelboards in accordance with Section 26 05 53.

3.3 FIELD QUALITY CONTROL

- A. See Section 01 40 00 Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers. Tests listed as optional are not required.
- D. Test GFCI circuit breakers to verify proper operation.
- E. Correct deficiencies and replace damaged or defective panelboards or associated components.
- 3.4 ADJUSTING
 - A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.
 - B. Adjust alignment of panelboard fronts.
 - C. Load Balancing: For each panelboard, rearrange circuits such that the difference between each measured steady state phase load does not exceed 20 percent and adjust circuit directories accordingly. Maintain proper phasing for multi-wire branch circuits.
- 3.5 CLEANING
 - A. Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.
 - B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 26 24 16

SECTION 26 27 26 - WIRING DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Wall switches.
- B. Receptacles.
- C. Wall plates.

1.2 RELATED REQUIREMENTS

- A. Section 26 05 33.16 Boxes for Electrical Systems.
- B. Section 26 05 53 Identification for Electrical Systems: Identification products and requirements.

1.3 REFERENCE STANDARDS

- A. FS W-C-596 Connector, Electrical, Power, General Specification for 2014h, with Amendments (2017).
- B. FS W-S-896 Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification) 2014g, with Amendment (2017).
- C. NECA 1 Standard for Good Workmanship in Electrical Construction 2015.
- D. NECA 130 Standard for Installing and Maintaining Wiring Devices 2016.
- E. NEMA WD 1 General Color Requirements for Wiring Devices 1999 (Reaffirmed 2020).
- F. NEMA WD 6 Wiring Devices Dimensional Specifications 2021.
- G. NFPA 70 National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. UL 20 General-Use Snap Switches Current Edition, Including All Revisions.
- I. UL 498 Attachment Plugs and Receptacles Current Edition, Including All Revisions.
- J. UL 514D Cover Plates for Flush-Mounted Wiring Devices Current Edition, Including All Revisions.
- K. UL 943 Ground-Fault Circuit-Interrupters Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.
 - 2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.
 - 3. Coordinate the placement of outlet boxes for wall switches with actual installed door swings.

- 4. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.
- 5. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.
- B. Sequencing:
 - 1. Do not install wiring devices until final surface finishes and painting are complete.

1.5 SUBMITTALS

- A. See Section 01 30 00 Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.

1.6 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Products: Listed, classified, and labeled as suitable for the purpose intended.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND PROTECTION

A. Store in a clean, dry space in original manufacturer's packaging until ready for installation.

PART 2 PRODUCTS

- 2.1 WIRING DEVICE APPLICATIONS
 - A. Provide wiring devices suitable for intended use and with ratings adequate for load served.
 - B. For single receptacles installed on an individual branch circuit, provide receptacle with ampere rating not less than that of the branch circuit.
 - C. Provide weather resistant GFCI receptacles with specified weatherproof covers for receptacles installed outdoors or in damp or wet locations.
 - D. Provide GFCI protection for receptacles installed within 6 feet (1.8 m) of sinks.
 - E. Provide GFCI protection for receptacles serving electric drinking fountains.

2.2 WIRING DEVICE FINISHES

- A. Provide wiring device finishes as described below unless otherwise indicated.
- B. Wiring Devices Installed in Finished Spaces: Gray with gray nylon wall plate.
- C. Wiring Devices Installed in Unfinished Spaces: Gray with galvanized steel wall plate.
- D. Wiring Devices Installed in Wet or Damp Locations: White with specified weatherproof cover.

2.3 WALL SWITCHES

- A. Manufacturers:
 - 1. Hubbell Incorporated: www.hubbell.com
 - 2. Leviton Manufacturing Company, Inc: www.leviton.com
 - 3. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us
- B. Wall Switches General Requirements: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20 and where applicable, FS W-S-896; types as indicated on the drawings.
 - 1. Wiring Provisions: Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.
- C. Standard Wall Switches: Industrial specification grade, 20 A, 120/277 V with standard toggle type switch actuator and maintained contacts; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

2.4 RECEPTACLES

- A. Manufacturers:
 - 1. Hubbell Incorporated: www.hubbell.com
 - 2. Leviton Manufacturing Company, Inc: www.leviton.com
 - 3. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us
 - 4. Source Limitations: Where wall controls are furnished as part of lighting control system, provide accessory matching receptacles and wallplates by the same manufacturer in locations indicated.
- B. Receptacles General Requirements: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498, and where applicable, FS W-C-596; types as indicated on the drawings.
 - 1. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.
 - 2. NEMA configurations specified are according to NEMA WD 6.
- C. Convenience Receptacles:
 - 1. Standard Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R; single or duplex as indicated on the drawings.
 - 2. Weather Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as weather resistant type complying with UL 498 Supplement SD suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.
- D. GFCI Receptacles:
 - 1. GFCI Receptacles General Requirements: Self-testing, with feed-through protection and light to indicate ground fault tripped condition and loss of protection; listed as complying with UL 943, class A.
 - a. Provide test and reset buttons of same color as device.
 - 2. Standard GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style.

3. Weather Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as weather resistant type complying with UL 498 Supplement SD suitable for installation in damp or wet locations.

2.5 WALL PLATES

- A. Manufacturers:
 - 1. Hubbell Incorporated: www.hubbell-wiring.com
 - 2. Leviton Manufacturing Company, Inc: www.leviton.com
 - 3. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us
 - 4. Source Limitations: Where wall controls are furnished as part of lighting control system, provide accessory matching receptacles and wallplates by the same manufacturer in locations indicated.
- B. Wall Plates: Comply with UL 514D.
 - 1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.
 - 2. Size: Standard.
 - 3. Screws: Metal with slotted heads finished to match wall plate finish.
- C. Nylon Wall Plates: Smooth finish, high-impact thermoplastic.
- D. Stainless Steel Wall Plates: Brushed satin finish, Type 302 stainless steel.
- E. Galvanized Steel Wall Plates: Rounded corners and edges, with corrosion resistant screws.
- F. Weatherproof Covers for Damp Locations: Gasketed, cast aluminum, with self-closing hinged cover and corrosion-resistant screws; listed as suitable for use in wet locations with cover closed.
- G. Weatherproof Covers for Wet Locations: Gasketed, cast aluminum, with hinged lockable cover and corrosion-resistant screws; listed as suitable for use in wet locations while in use with attachment plugs connected and identified as extra-duty type.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
- C. Verify that wall openings are neatly cut and will be completely covered by wall plates.
- D. Verify that final surface finishes are complete, including painting.
- E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.
- F. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
- B. Coordinate locations of outlet boxes provided under Section 26 05 33.16 as required for installation of wiring devices provided under this section.
 - 1. Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.
 - 2. Where multiple receptacles, wall switches, or wall dimmers are installed at the same location and at the same mounting height, gang devices together under a common wall plate.
 - 3. Locate wall switches on strike side of door with edge of wall plate 3 inches (80 mm) from edge of door frame. Where locations are indicated otherwise, notify Architect to obtain direction prior to proceeding with work.
 - 4. Locate receptacles for electric drinking fountains concealed behind drinking fountain according to manufacturer's instructions.
- C. Install wiring devices in accordance with manufacturer's instructions.
- D. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- E. Where required, connect wiring devices using pigtails not less than 6 inches (150 mm) long. Do not connect more than one conductor to wiring device terminals.
- F. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.
- G. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- H. Provide GFCI receptacles with integral GFCI protection at each location indicated. Do not use feed-through wiring to protect downstream devices.
- I. Install wiring devices plumb and level with mounting yoke held rigidly in place.
- J. Install wall switches with OFF position down.
- K. Install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left.
- L. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.
- M. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.
- N. Identify wiring devices in accordance with Section 26 05 53.
- 3.4 FIELD QUALITY CONTROL
 - A. See Section 01 40 00 Quality Requirements, for additional requirements.
 - B. Inspect each wiring device for damage and defects.

- C. Operate each wall switch, wall dimmer, and fan speed controller with circuit energized to verify proper operation.
- D. Test each receptacle to verify operation and proper polarity.
- E. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.
- F. Correct wiring deficiencies and replace damaged or defective wiring devices.

3.5 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.
- 3.6 CLEANING
 - A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION 26 27 26

SECTION 26 28 13 - FUSES

PART 1 GENERAL

- 1.1 SECTION INCLUDES
 - A. Fuses.

1.2 RELATED REQUIREMENTS

- A. Section 26 05 53 Identification for Electrical Systems: Identification products and requirements.
- B. Section 26 05 73 Power System Studies: Additional criteria for the selection of protective devices specified in this section.
- C. Section 26 28 16.16 Enclosed Switches: Fusible switches.

1.3 REFERENCE STANDARDS

- A. NEMA FU 1 Low Voltage Cartridge Fuses 2012.
- B. NFPA 70 National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. UL 248-1 Low-Voltage Fuses Part 1: General Requirements Current Edition, Including All Revisions.
- D. UL 248-12 Low-Voltage Fuses Part 12: Class R Fuses Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate fuse clips furnished in equipment provided under other sections for compatibility with indicated fuses.
 - a. Fusible Enclosed Switches: See Section 26 28 16.16.
 - 2. Coordinate fuse requirements according to manufacturer's recommendations and nameplate data for actual equipment to be installed.
 - 3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

- A. See Section 01 30 00 Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard data sheets including voltage and current ratings, interrupting ratings, time-current curves, and current limitation curves.
- C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 Product Requirements, for additional provisions.
 - 2. Extra Fuses: One set(s) of three for each type and size installed.

3. Fuse Pullers: One set(s) compatible with each type and size installed.

1.6 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Bussmann, a division of Eaton Corporation: www.cooperindustries.com
- B. Littelfuse, Inc: www.littelfuse.com
- C. Mersen: ep-us.mersen.com

2.2 APPLICATIONS

- A. Service Entrance:
 - 1. Fusible Switches up to 600 Amperes: Class RK1, time-delay.
- B. General Purpose Branch Circuits: Class RK1, time-delay.
- C. Individual Motor Branch Circuits: Class RK1, time-delay.

2.3 FUSES

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless specifically indicated to be excluded, provide fuses for all fusible equipment as required for a complete operating system.
- C. Provide fuses of the same type, rating, and manufacturer within the same switch.
- D. Comply with UL 248-1.
- E. Unless otherwise indicated, provide cartridge type fuses complying with NEMA FU 1, Class and ratings as indicated.
- F. Voltage Rating: Suitable for circuit voltage.
- G. Class R Fuses: Comply with UL 248-12.
- H. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.
- I. Provide the following accessories where indicated or where required to complete installation:
 - 1. Fuseholders: Compatible with indicated fuses.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that fuse ratings are consistent with circuit voltage and manufacturer's recommendations and nameplate data for equipment.
- B. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Do not install fuses until circuits are ready to be energized.
- B. Install fuses with label oriented such that manufacturer, type, and size are easily read.
- C. Identify spare fuse cabinet in accordance with Section 26 05 53.

END OF SECTION 26 28 13

SECTION 26 28 16.16 - ENCLOSED SWITCHES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Enclosed safety switches.

1.2 RELATED REQUIREMENTS

- A. Section 26 05 26 Grounding and Bonding for Electrical Systems.
- B. Section 26 05 29 Hangers and Supports for Electrical Systems.
- C. Section 26 05 53 Identification for Electrical Systems: Identification products and requirements.
- D. Section 26 05 73 Power System Studies: Additional criteria for the selection of equipment and associated protective devices specified in this section.
- E. Section 26 28 13 Fuses.

1.3 REFERENCE STANDARDS

- A. NECA 1 Standard for Good Workmanship in Electrical Construction 2015.
- B. NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.
- C. NEMA KS 1 Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum) 2013.
- D. NETA ATS Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems 2021.
- E. NFPA 70 National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. UL 50 Enclosures for Electrical Equipment, Non-Environmental Considerations Current Edition, Including All Revisions.
- G. UL 50E Enclosures for Electrical Equipment, Environmental Considerations Current Edition, Including All Revisions.
- H. UL 98 Enclosed and Dead-Front Switches Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.

4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

- A. See Section 01 30 00 Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.
- C. Shop Drawings: Indicate outline and support point dimensions, voltage and current ratings, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
 - 1. Include dimensioned plan and elevation views of enclosed switches and adjacent equipment with all required clearances indicated.
 - 2. Include wiring diagrams showing all factory and field connections.
- D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

1.6 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.
- 1.7 DELIVERY, STORAGE, AND HANDLING
 - A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
 - B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed switch internal components, enclosure, and finish.

1.8 FIELD CONDITIONS

A. Maintain ambient temperature between -22 degrees F (-30 degrees C) and 104 degrees F (40 degrees C) during and after installation of enclosed switches.

PART 2 PRODUCTS

- 2.1 MANUFACTURERS
 - A. ABB/GE: www.electrification.us.abb.com
 - B. Eaton Corporation: www.eaton.com
 - C. Schneider Electric; Square D Products: www.schneider-electric.us
 - D. Source Limitations: Furnish enclosed switches and associated components produced by a single manufacturer and obtained from a single supplier.

2.2 ENCLOSED SAFETY SWITCHES

- A. Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated on the drawings.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 - 1. Altitude: Less than 6,600 feet (2,000 m).
 - 2. Ambient Temperature: Between -22 degrees F (-30 degrees C) and 104 degrees F (40 degrees C).
- D. Horsepower Rating: Suitable for connected load.
- E. Voltage Rating: Suitable for circuit voltage.
- F. Short Circuit Current Rating:
 - 1. Provide enclosed safety switches, when protected by the fuses or supply side overcurrent protective devices to be installed, with listed short circuit current rating not less than the available fault current at the installed location as determined by short circuit study performed in accordance with Section 26 05 73.
 - 2. Minimum Ratings:
 - a. Heavy Duty Single Throw Switches Protected by Class R, Class J, Class L, or Class T Fuses: 200,000 rms symmetrical amperes.
- G. Provide with switch blade contact position that is visible when the cover is open.
- H. Conductor Terminations: Suitable for use with the conductors to be installed.
- I. Provide insulated, groundable fully rated solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.
- J. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.
- K. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
 - 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1.
 - 2. Finish for Painted Steel Enclosures: Manufacturer's standard, factory applied grey unless otherwise indicated.
- L. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.
- M. Heavy Duty Switches:
 - 1. Comply with NEMA KS 1.
 - 2. Conductor Terminations:
 - a. Provide mechanical lugs unless otherwise indicated.
 - b. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - 3. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.

a. Provide means for locking handle in the ON position where indicated.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings of the enclosed switches are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive enclosed safety switches.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide required support and attachment in accordance with Section 26 05 29.
- E. Install enclosed switches plumb.
- F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches (2000 mm) above the floor or working platform.
- G. Provide grounding and bonding in accordance with Section 26 05 26.
- H. Provide fuses complying with Section 26 28 13 for fusible switches as indicated or as required by equipment manufacturer's recommendations.
- I. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- J. Identify enclosed switches in accordance with Section 26 05 53.

3.3 FIELD QUALITY CONTROL

- A. See Section 01 40 00 Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.
- D. Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.
- 3.4 ADJUSTING
 - A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.5 CLEANING

A. Clean dirt and debris from switch enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 26 28 16.16

SECTION 26 51 00 - INTERIOR LIGHTING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Interior luminaires.
- B. Emergency lighting units.
- C. Ballasts and drivers.
- D. LED emergency power supply units.

1.2 RELATED REQUIREMENTS

- A. Section 26 05 29 Hangers and Supports for Electrical Systems.
- B. Section 26 05 33.16 Boxes for Electrical Systems.

1.3 REFERENCE STANDARDS

- A. IES LM-79 Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products 2019.
- B. IES LM-80 Approved Method: Measuring Maintenance of Light Output Characteristics of Solid-State Light Sources 2021.
- C. NECA 1 Standard for Good Workmanship in Electrical Construction 2015.
- D. NECA/IESNA 500 Standard for Installing Indoor Lighting Systems 2006.
- E. NECA/IESNA 502 Standard for Installing Industrial Lighting Systems 1999 (Reaffirmed 2006).
- F. NEMA 410 Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Disharge Ballasts 2020.
- G. NEMA LE 4 Recessed Luminaires, Ceiling Compatibility 2012 (Reaffirmed 2018).
- H. NFPA 70 National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. NFPA 101 Life Safety Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. UL 924 Emergency Lighting and Power Equipment Current Edition, Including All Revisions.
- K. UL 1598 Luminaires Current Edition, Including All Revisions.
- L. UL 8750 Light Emitting Diode (LED) Equipment for Use in Lighting Products Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the installation of luminaires with mounting surfaces installed under other sections or by others. Coordinate the work with placement of supports, anchors, etc.

required for mounting. Coordinate compatibility of luminaires and associated trims with mounting surfaces at installed locations.

- 2. Coordinate the placement of luminaires with structural members, ductwork, piping, equipment, diffusers, fire suppression system components, and other potential conflicts installed under other sections or by others.
- 3. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.
- 1.5 SUBMITTALS
 - A. See Section 01 30 00 Administrative Requirements, for submittal procedures.
 - B. Shop Drawings:
 - 1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
 - 2. Provide photometric calculations where luminaires are proposed for substitution upon request.
 - C. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.
 - 1. LED Luminaires:
 - a. Include estimated useful life, calculated based on IES LM-80 test data.
 - b. Include IES LM-79 test report upon request.
 - 2. LED Emergency Power Supply Unit: Include list of compatible LED configurations and associated lumen output.
 - D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
 - E. Operation and Maintenance Data: Instructions for each product including information on replacement parts.
 - F. Project Record Documents: Record actual connections and locations of luminaires and any associated remote components.

1.6 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.
- 1.7 DELIVERY, STORAGE, AND PROTECTION
 - A. Receive, handle, and store products according to NECA/IESNA 500 (commercial lighting), NECA/IESNA 502 (industrial lighting), and manufacturer's written instructions.

- B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.
- 1.8 FIELD CONDITIONS
 - A. Maintain field conditions within manufacturer's required service conditions during and after installation.
- 1.9 WARRANTY
 - A. See Section 01 78 00 Closeout Submittals, for additional warranty requirements.
 - B. Provide 3-year manufacturer warranty for LED luminaires, including drivers.
 - C. Provide 5-year pro-rata warranty for batteries for emergency lighting units.
 - D. Provide 10-year pro-rata warranty for batteries for self-powered exit signs.
 - E. Provide 3-year full warranty for LED emergency power supply units.

PART 2 PRODUCTS

- 2.1 LUMINAIRE TYPES
 - A. Furnish products as indicated in luminaire schedule included on the drawings.
 - B. Substitutions: Not permitted.

2.2 LUMINAIRES

- A. Manufacturers: As noted on the lighting fixture schedule
- B. Provide products that comply with requirements of NFPA 70.
- C. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- D. Provide products listed, classified, and labeled as suitable for the purpose intended.
- E. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
- F. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.
- G. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
- H. Recessed Luminaires:
 - 1. Ceiling Compatibility: Comply with NEMA LE 4.
- I. LED Luminaires:
 - 1. Components: UL 8750 recognized or listed as applicable.
 - 2. Tested in accordance with IES LM-79 and IES LM-80.
 - 3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.

2.3 EMERGENCY LIGHTING UNITS

- A. Description: Emergency lighting units complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
- B. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.
- C. Battery:
 - 1. Sealed maintenance-free lead calcium unless otherwise indicated.
 - 2. Size battery to supply all connected lamps, including emergency remote heads where indicated.
- D. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.
- E. Provide low-voltage disconnect to prevent battery damage from deep discharge.
- F. Self-Diagnostics: Provide units that self-monitor functionality and automatically perform testing required by NFPA 101 where indicated; provide indicator light(s) to report test and diagnostic status.
- G. Accessories:
 - 1. Where indicated, provide emergency remote heads that are compatible with the emergency lighting unit they are connected to and suitable for the installed location.

2.4 BALLASTS AND DRIVERS

- A. Manufacturers:
 - 1. Manufacturer Limitations: Where possible, for each type of luminaire provide ballasts produced by a single manufacturer.
 - 2. Where a specific manufacturer or model is indicated elsewhere in the luminaire schedule or on the drawings, substitutions are not permitted unless explicitly indicated.
- B. Ballasts/Drivers General Requirements:
 - 1. Provide ballasts containing no polychlorinated biphenyls (PCBs).
 - 2. Minimum Efficiency/Efficacy: Provide ballasts complying with all current applicable federal and state ballast efficiency/efficacy standards.
 - 3. Electronic Ballasts/Drivers: Inrush currents not exceeding peak currents specified in NEMA 410.

2.5 LED POWER SUPPLY UNITS

- A. Manufacturers:
 - 1. Iota Engineering, LLC: www.iotaengineering.com
 - 2. Lithonia Lighting: www.lithonia.com
 - 3. Philips Emergency Lighting/Bodine: www.bodine.com
 - 4. Manufacturer Limitations: Where possible, for each type of luminaire provide fluorescent emergency power supply units produced by a single manufacturer.

- B. Description: Self-contained LED emergency power supply units suitable for use with indicated luminaires, complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
- C. Compatibility:
 - 1. Drivers: Compatible with drivers specified for the individual fixtures
- D. Operation: Upon interruption of normal power source, solid-state control automatically switches connected lamp(s) to the fluorescent emergency power supply for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.
- E. Battery: Sealed maintenance-free high-temperature nickel cadmium unless otherwise indicated.
- F. Emergency Illumination Output: Provide full output of fixture indicated in the luminair schedule
- G. Diagnostics: Provide accessible and visible multi-chromatic combination test switch/indicator light to display charge, test, and diagnostic status and to manually activate emergency operation.
- H. Self-Diagnostics: Provide units that self-monitor functionality and automatically perform testing required by NFPA 101 where indicated; provide indicator light(s) to report test and diagnostic status and field selectable audible alert.
- I. Operating Temperature: From 32 degrees F (0 degrees C) to 122 degrees F (50 degrees C) unless otherwise indicated or required for the installed location.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.
- C. Verify that suitable support frames are installed where required.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

- A. Coordinate locations of outlet boxes provided under Section 26 05 33.16 as required for installation of luminaires provided under this section.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Install products in accordance with manufacturer's instructions.

- D. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting) and NECA 502 (industrial lighting).
- E. Provide required support and attachment in accordance with Section 26 05 29.
- F. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- G. Suspended Ceiling Mounted Luminaires:
 - 1. Do not use ceiling tiles to bear weight of luminaires.
 - 2. Do not use ceiling support system to bear weight of luminaires unless ceiling support system is certified as suitable to do so.
 - 3. Secure surface-mounted and recessed luminaires to building structure.
 - 4. Secure pendant-mounted luminaires to building structure.
 - 5. Secure lay-in luminaires to ceiling support channels using listed safety clips at four corners.
 - In addition to ceiling support wires, provide two galvanized steel safety wire(s), minimum 12 gauge, connected from opposing corners of each recessed luminaire to building structure.
 - 7. See appropriate Division 9 section where suspended grid ceiling is specified for additional requirements.
- H. Recessed Luminaires:
 - 1. Install trims tight to mounting surface with no visible light leakage.
- I. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.
- J. Install accessories furnished with each luminaire.
- K. Bond products and metal accessories to branch circuit equipment grounding conductor.
- L. Emergency Lighting Units:
 - 1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.
 - 2. Install lock-on device on branch circuit breaker serving units.
- M. LED Emergency Power Supply Units:
 - 1. For field-installed units, install inside luminaire unless otherwise indicated. Where installation inside luminaire is not possible, install on top of luminaire.
 - 2. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal ballast(s) in luminaire. Bypass local switches, contactors, or other lighting controls.

3.4 FIELD QUALITY CONTROL

- A. See Section 01 40 00 Quality Requirements, for additional requirements.
- B. Inspect each product for damage and defects.
- C. Operate each luminaire after installation and connection to verify proper operation.
- D. Test self-powered exit signs, emergency lighting units, and fluorescent emergency power supply units to verify proper operation upon loss of normal power supply.

E. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect.

3.5 ADJUSTING

- A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect. Secure locking fittings in place.
- B. Aim and position adjustable emergency lighting unit lamps to achieve optimum illumination of egress path as required or as directed by Architect or authority having jurisdiction.

3.6 CLEANING

A. Clean surfaces according to NECA 500 (commercial lighting), NECA 502 (industrial lighting), and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.7 CLOSEOUT ACTIVITIES

- A. See Section 01 78 00 Closeout Submittals, for closeout submittals.
- B. Demonstration: Demonstrate proper operation of luminaires to Architect, and correct deficiencies or make adjustments as directed.

3.8 PROTECTION

A. Protect installed luminaires from subsequent construction operations.

END OF SECTION 26 51 00

SECTION 28 46 00 - FIRE DETECTION AND ALARM

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fire alarm system design and installation, including all components, wiring, and conduit.
- B. Transmitters for communication with supervising station.
- C. Replace existing fire alarm system components, wiring, and conduit indicated.

1.2 RELATED REQUIREMENTS

A. Section 14 24 00 - Hydraulic Elevators: Elevator systems monitored and controlled by fire alarm system.

1.3 REFERENCE STANDARDS

- A. 36 CFR 1191 Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines current edition.
- B. ADA Standards 2010 ADA Standards for Accessible Design 2010.
- C. IEEE C62.41.2 IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits 2002 (Corrigendum 2012).
- D. NFPA 70 National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. NFPA 72 National Fire Alarm and Signaling Code Most Recent Edition Cited by Referring Code or Reference Standard.
- F. NFPA 101 Life Safety Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 SUBMITTALS

- A. See Section 01 30 00 Administrative Requirements, for submittal procedures.
- B. Drawings must be prepared using AutoCAD Release Latest Release.
- C. Evidence of designer qualifications.
- D. Design Documents: Submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, riser diagrams, and description of operation:
 - 1. Copy (if any) of list of data required by authority having jurisdiction.
 - 2. NFPA 72 "Record of Completion", filled out to the extent known at the time.
 - 3. Clear and concise description of operation, with input/output matrix similar to that shown in NFPA 72 Appendix A-7-5-2.2(9), and complete listing of software required.
 - 4. System zone boundaries and interfaces to fire safety systems.
 - 5. Location of all components, circuits, and raceways; mark components with identifiers used in control unit programming.

- 6. Circuit layouts; number, size, and type of raceways and conductors; conduit fill calculations; spare capacity calculations; notification appliance circuit voltage drop calculations.
- 7. List of all devices on each signaling line circuit, with spare capacity indicated.
- 8. Manufacturer's detailed data sheet for each component, including wiring diagrams, installation instructions, and circuit length limitations.
- 9. Description of power supplies; if secondary power is by battery include calculations demonstrating adequate battery power.
- 10. Certification by either the manufacturer of the control unit or by the manufacturer of each other component that the components are compatible with the control unit.
- 11. Certification by the manufacturer of the control unit that the system design complies with Contract Documents.
- 12. Certification by Contractor that the system design complies with Contract Documents.
- 13. Do not show existing components to be removed.
- E. Evidence of installer qualifications.
- F. Evidence of instructor qualifications; training lesson plan outline.
- G. Inspection and Test Reports:
 - 1. Submit inspection and test plan prior to closeout demonstration.
 - 2. Submit documentation of satisfactory inspections and tests.
 - 3. Submit NFPA 72 "Inspection and Test Form," filled out.
- H. Operating and Maintenance Data: See Section 01 78 00 for additional requirements; revise and resubmit until acceptable; have one set available during closeout demonstration:
 - 1. Complete set of specified design documents, as approved by authority having jurisdiction.
 - 2. Additional printed set of project record documents and closeout documents, bound or filed in same manuals.
 - 3. Contact information for firm that will be providing contract maintenance and trouble callback service.
 - 4. List of recommended spare parts, tools, and instruments for testing.
 - 5. Replacement parts list with current prices, and source of supply.
 - 6. Detailed troubleshooting guide and large scale input/output matrix.
 - 7. Preventive maintenance, inspection, and testing schedule complying with NFPA 72; provide printed copy and computer format acceptable to Owner.
 - 8. Detailed but easy to read explanation of procedures to be taken by non-technical administrative personnel in the event of system trouble, when routine testing is being conducted, for fire drills, and when entering into contracts for remodeling.
- I. Project Record Documents: See Section 01 78 00 for additional requirements; have one set available during closeout demonstration:
 - 1. Complete set of floor plans showing actual installed locations of components, conduit, and zones.
 - 2. "As installed" wiring and schematic diagrams, with final terminal identifications.
 - 3. "As programmed" operating sequences, including control events by device, updated input/output chart, and voice messages by event.
- J. Closeout Documents:
- 1. Certification by manufacturer that the system has been installed in compliance with manufacturer's installation requirements, is complete, and is in satisfactory operating condition.
- 2. NFPA 72 "Record of Completion", filled out completely and signed by installer and authorized representative of authority having jurisdiction.

1.5 QUALITY ASSURANCE

- A. Designer Qualifications: NICET Level III or IV (3 or 4) certified fire alarm technician or registered fire protection engineer, employed by fire alarm control panel manufacturer, Contractor, or installer, with experience designing fire alarm systems in the jurisdictional area of the authorities having jurisdiction.
- B. Installer Qualifications: Firm with minimum 3 years documented experience installing fire alarm systems of the specified type and providing contract maintenance service as a regular part of their business.
 - 1. Authorized representative of control unit manufacturer; submit manufacturer's certification that installer is authorized; include name and title of manufacturer's representative making certification.
 - 2. Installer Personnel: At least 2 years of experience installing fire alarm systems.
 - 3. Supervisor: NICET level III or IV (3 or 4) certified fire alarm technician; furnish name and address.
- C. Instructor Qualifications: Experienced in technical instruction, understanding fire alarm theory, and able to provide the required training; trained by fire alarm control unit manufacturer.
- 1.6 WARRANTY
 - A. Provide installer's warranty that the installation is free from defects and will remain so for 1 year after date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

2.2 FIRE ALARM SYSTEM

- A. Fire Alarm System: Provide modifications and extensions to the existing automatic fire detection and alarm system:
 - 1. Provide all components necessary, regardless of whether shown in Contract Documents or not.
 - 2. Protected Premises: Entire building shown on drawings.
 - 3. Comply with the following; where requirements conflict, order of precedence of requirements is as listed:
 - a. ADA Standards.
 - b. The requirements of the local authority having jurisdiction .
 - c. Applicable local codes.
 - d. Contract Documents (drawings and specifications).
 - e. NFPA 101.

- f. NFPA 72; where the word "should" is used consider that provision mandatory; where conflicts between requirements require deviation from NFPA 72, identify deviations clearly on design documents.
- 4. Evacuation Alarm: Single smoke zone; general evacuation of entire premises.
- 5. Fire Alarm Control Unit: Existing
- B. Supervising Stations and Fire Department Connections:
 - 1. Remote Supervising Station: Existing proprietary station operated by Owner.
 - 2. Means of Transmission to Remote Supervising Station: Digital alarm communicator transmitter (DACT), 2 telephone lines.
- C. Circuits:
 - 1. Initiating Device Circuits (IDC): Class B, Style A.
 - 2. Signaling Line Circuits (SLC) Within Single Building: Class B, Style 0.5.
 - 3. Notification Appliance Circuits (NAC): Class B, Style W.
- D. Spare Capacity:
 - 1. Initiating Device Circuits: Minimum 25 percent spare capacity.
 - 2. Notification Appliance Circuits: Minimum 25 percent spare capacity.
 - 3. Fire Alarm Control Units: Capable of handling all circuits utilized to capacity without requiring additional components other than plug-in control modules.
- E. Power Sources:
 - 1. Primary: Dedicated branch circuits of the facility power distribution system.
 - 2. Secondary: Storage batteries.
 - 3. Capacity: Sufficient to operate entire system for period specified by NFPA 72.
 - 4. Each Computer System: Provide uninterruptible power supply (UPS).

2.3 EXISTING COMPONENTS

- A. Existing Fire Alarm System: Remove existing components indicated and incorporate remaining components into new system, under warranty as if they were new; do not take existing portions of system out of service until new portions are fully operational, tested, and connected to existing system.
- B. Clearly label components that are "Not In Service."
- C. Remove unused existing components and materials from site and dispose of properly.

2.4 FIRE SAFETY SYSTEMS INTERFACES

- A. Supervision: Provide supervisory signals in accordance with NFPA 72 for the following:
 - 1. Elevator shut-down control circuits.
- B. Alarm: Provide alarm initiation in accordance with NFPA 72 for the following:
 - 1. Elevator lobby, elevator hoistway, and elevator machine room smoke detectors.
- C. Elevators:
 - 1. Elevator lobby, hoistway, and machine room smoke detectors: Elevator recall for fire fighters' service.

2.5 COMPONENTS

- A. General:
 - 1. Provide flush mounted units where installed in finish areas; in unfinished areas, surface mounted unit are acceptable.
 - 2. Provide legible, permanent labels for each control device, using identification used in operation and maintenance data.
- B. Initiating Devices:
 - 1. Addressable Systems:
 - a. Addressable Devices: Individually identifiable by addressable fire alarm control unit.
 - b. Provide suitable addressable interface modules as indicated or as required for connection to conventional (non-addressable) devices and other components that provide a dry closure output.
 - 2. Smoke Detectors: Photoelectric.
- C. Notification Appliances:
 - 1. Combination Horn/Strobe: Candela rating as indicated on the drawings.
 - 2. Strobes: Candela rating as indicated on the drawings.
- D. Circuit Conductors: Copper; provide 200 feet (60 m) extra; color code and label.
- E. Surge Protection: In accordance with IEEE C62.41.2 category B combination waveform and NFPA 70; except for optical fiber conductors.
- F. Locks and Keys: Deliver keys to Owner.
- G. Instruction Charts: Printed instruction chart for operators, showing steps to be taken when a signal is received (normal, alarm, supervisory, and trouble); easily readable from normal operator's station.
 - 1. Frame: Stainless steel or aluminum with polycarbonate or glass cover.
 - 2. Provide one for each control unit where operations are to be performed.
 - 3. Obtain approval of Owner prior to mounting; mount in location acceptable to Owner.
 - 4. Provide extra copy with operation and maintenance data submittal.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with applicable codes, NFPA 72, NFPA 70, and Contract Documents.
- B. Conceal all wiring, conduit, boxes, and supports where installed in finished areas.
- C. Obtain Owner's approval of locations of devices, before installation.
- D. Install instruction cards and labels.

3.2 INSPECTION AND TESTING FOR COMPLETION

- A. Notify Owner 7 days prior to beginning completion inspections and tests.
- B. Notify authorities having jurisdiction and comply with their requirements for scheduling inspections and tests and for observation by their personnel.

- C. Provide the services of the installer's supervisor or person with equivalent qualifications to supervise inspection and testing, correction, and adjustments.
- D. Prepare for testing by ensuring that all work is complete and correct; perform preliminary tests as required.
- E. Provide all tools, software, and supplies required to accomplish inspection and testing.
- F. Perform inspection and testing in accordance with NFPA 72 and requirements of local authorities; document each inspection and test.
- G. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.

3.3 OWNER PERSONNEL INSTRUCTION

- A. Provide the following instruction to designated Owner personnel:
 - 1. Hands-On Instruction: On-site, using operational system.
 - 2. Classroom Instruction: Owner furnished classroom, on-site or at other local facility.
- B. Administrative: One-hour session(s) covering issues necessary for non-technical administrative staff; classroom:
 - 1. Initial Training: 1 session pre-closeout.
- C. Basic Operation: One-hour sessions for attendant personnel, security officers, and engineering staff; combination of classroom and hands-on:
 - 1. Initial Training: 1 session pre-closeout.
- D. Furnish the services of instructors and teaching aids; have copies of operation and maintenance data available during instruction.

3.4 CLOSEOUT

- A. Closeout Demonstration: Demonstrate proper operation of all functions to Owner.
 - 1. Be prepared to conduct any of the required tests.
 - 2. Have at least one copy of operation and maintenance data, preliminary copy of project record drawings, input/output matrix, and operator instruction chart(s) available during demonstration.
 - 3. Have authorized technical representative of control unit manufacturer present during demonstration.
 - 4. Demonstration may be combined with inspection and testing required by authority having jurisdiction; notify authority having jurisdiction in time to schedule demonstration.
 - 5. Repeat demonstration until successful.

END OF SECTION 28 46 00

SECTION 31 23 00 - FOUNDATION EXCAVATING AND BACKFILLING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Foundation, excavating, and backfilling within five feet of the building perimeter. Work shall include, but not be limited to, the following items:
 - 1. Removal of all unacceptable soil.
 - 2. Furnish and install acceptable fill.
 - 3. Prepare subgrade for footings and slab on grade.
- B. The following items are not a part of this specification:
 - 1. Utility trenching and related backfilling outside the building footprint.
 - 2. Subgrade for exterior walks and paving.
- C. Structural notes indicated on the drawings regarding foundation excavating and backfilling shall be considered part of this specification.

1.2 RELATED WORK

- A. Pertinent Sections of Division 01.
- B. Pertinent Sections of Division 31.

1.3 REFERENCES

- A. Codes and Standards: Comply with the provisions of the following codes, specifications and standards, except where more stringent requirements are shown or specified. Where any provisions of other pertinent codes and standards conflict with this specification, the more stringent provision shall govern.
 - 1. ASTM C136 Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - 2. ASTM D698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort.
 - 3. ASTM D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using the Modified Effort.
 - 4. ASTM D2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
 - 5. ASTM D2940 Standard Specification for Graded Aggregate Material for Bases or Subbases for Highways or Airports.
 - 6. ASTM D4253 Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
 - 7. ASTM D4254 Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
 - 8. ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

- 9. ASTM D6938 Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
- 10. Insert Department of Transportation (InsertDOT): InsertDOT Standard Specifications for Road and Bridge Construction.

1.4 TESTING

- A. Minimum testing frequency and locations:
 - 1. Laboratory Testing:
 - a. Granular fill: One representative gradation test for each type of material.
 - b. Cohesive soils: One representative set of Atterberg limits and moisture density test for each type of material used.
 - c. Non-cohesive soils: One representative moisture density test for each type of material used.
 - 2. Field Testing:
 - a. The Special Inspector shall determine the location of testing.
 - b. Testing of final utility trench backfill shall begin at a depth of 2 feet above the top of the pipe.
 - c. In-place field density test and moisture content tests shall be performed as follows:
 - 1) Fills not within the influence of building foundations and slab on grade: Per civil specifications.
 - 2) For fills within the influence of building foundations and slab on grade, the following criteria shall apply: One test for each 8-inch vertical lift of compacted fill placed per 2,500 square feet of fill area (minimum of two tests per lift per structure for areas smaller than 5,000 square feet).
 - d. Additional testing may be required by the Special Inspector if noncompliance or a change in conditions occurs.
 - e. If a test fails, the Contractor shall rework the material, recompact and retest as necessary until specific compaction is achieved in all areas of the trench. All costs associated with this work, including retesting, shall be the responsibility of the Contractor.

1.5 SUBMITTALS

A. Material Test Reports: Provide the Owner and Architect with the on-site material test reports from the Special Inspection Agency indicating the interpreting test results for compliance with this specification.

1.6 PROTECTION

A. Contractor shall provide for design, permits and installation of all cribbing, bracing, shoring and other methods required to safely retain earth banks and excavations.

- B. Notify the Architect immediately and discontinue work in affected area if adjacent existing footings are encountered during excavation. Underpin other adjacent structures that may be damaged by excavation work, including service utilities and pipe chases.
- C. Notify the Architect of unexpected subsurface conditions and discontinue work in affected areas until notification to resume.
- D. Protect benchmarks, existing structures, fences, sidewalks, paving, curbing, etc., from excavation equipment and vehicular traffic.
- E. Maintain and protect above and below grade utilities that are to remain.
- F. Provide temporary heating or protective insulating materials to protect subgrades and foundations soils against freezing temperatures or frost during cold weather conditions.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Provide borrow soil materials when sufficient acceptable soil materials are not available from excavations.
- B. Acceptable soils shall comply with the following:
 - 1. Meet ASTM D2487 soil classification groups GW, GP, GM, SW, SP, SM or a combination of these group symbols.
 - 2. Be free of rock or gravel larger than 3 inches in any dimension.
 - 3. Be free of debris, waste, frozen materials, vegetation and other deleterious materials.
 - 4. Have a liquid limit less than 45 and a plasticity index less than 20.
 - 5. Be approved by the Special Inspection Agency.
- C. Unacceptable soils shall be defined as following:
 - 1. ASTM D2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH, PT or a combination of these group symbols.
 - 2. Unacceptable soils also to include acceptable soils not maintained within 2 percent of optimum moisture content at time of compaction.
- D. Free-Draining Granular Fill: Free-draining granular fill shall comply with the following:
 - 1. Be a naturally or artificially graded mixture of natural or crushed gravel, crushed stone.
 - 2. Be clean and free of fines.
 - 3. Comply with ASTM D2940.
 - 4. Be uniformly graded as follows:

Coarse Aggregate Gradations							
Sieve Size - Percent Passing							
Grade No.	1-1/2"	1"	3/4"	1/2"	3/8"	No. 4	
CA7	100	95 ± 5	-	45 ± 15	-	5 max	

5. Be approved by the Special Inspection Agency.

E. Engineered Fill and Utility Base Course shall comply with the following:

- 1. Be a naturally or artificially graded mixture of natural or crushed gravel, crushed stone, natural or crushed sand...
- 2. Comply with ASTM D2940.
- 3. Be uniformly graded as follows:

Coarse Aggregate Gradations							
Sieve Size - Percent Passing							
Grade No.	1-1/2"	1"	1/2"	No. 4	No. 16	No. 200	
CA6	100 to 90	95 ± 5	75 ± 15	43 ± 13	25 ± 15	8 ± 4	

Coarse Aggregate Gradations							
Sieve Size - Percent Passing							
Grade No.	1-1/2"	1"	1/2"	No. 4	No. 30	No. 200	
IN#53	100	90 ± 10	67 ± 13	47 ± 13	21 ± 9	7 ± 3	

- 4. Be approved by the Special Inspection Agency.
- F. Material Applications: Provide and install material meeting with the above requirements as follows:
 - 1. General fill: Acceptable soils.
 - 2. Backfill against basement and retaining walls for 2 feet directly adjacent to wall: Free-draining granular fill.
 - 3. Backfill at over-excavated areas beneath footings: Engineered fill.
 - 4. Sub-grade layer beneath slabs-on-grade: Refer to drawings.
- G. Spoil material displaced by drilled pier installation is unacceptable as fill material and shall be disposed of offsite.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Identify and verify required lines, levels, contours, and benchmark elevations for the work are as indicated.
- B. Protect plant life, lawns, other features, and vegetation to remain as a portion of the final landscaping.
- C. Free groundwater is not expected during excavation. Contractor shall provide for de-watering of excavations from surface water, ground water or seepage. Where ground water occurs during excavation, special procedures shall be implemented as recommended by the Geotechnical Engineer of Record.
- D. Identify known underground utility locations with stakes and flags.

3.2 EXCAVATION

- A. All excavations shall be safely and properly backfilled.
- B. All abandoned footings, utilities and other structures that interfere with new construction shall be removed.
- C. All unacceptable material and organic material shall be removed from below all proposed slabs-on-grade and the exposed natural soil shall be proof rolled and the compaction verified by the soils testing firm prior to placing fill. Proof-roll with a loaded tandem dump truck, loaded ready-mix truck, roller, or equivalent weight vehicle. Materials exhibiting weakness, such as those exhibiting rutting or pumping, shall be removed, and replaced with acceptable compacted fill material.
- D. Do not excavate within the 45-degree bearing splay of any adjacent foundations.
- E. Remove lumped subsoil, boulders and rock up to 1/3 cubic yard (measured by volume). Provide Owner with unit price per cubic yard for obstructions larger than 1/3 cubic yard.
- F. Outside 45-degree bearing splay of foundations, correct areas over excavated with aggregate at no additional cost to the Owner.
- G. Within the 45-degree bearing splay of foundations, correct areas over excavated with 2000 psi concrete fill at no additional cost to the Owner. Notify the Architect prior to performing such work.
- H. Hand trim final excavation to remove all loose material.
- I. Contractor shall form all dams and perform other work necessary for keeping the excavation clear of water during the progress of the work and, at Contractor's expense, shall pump or otherwise remove all surface and perched water which accumulates in the excavations. Perched water that cannot be de-watered in 48 hours of continuous pumping at a minimum rate of 60 gpm in dry weather shall be considered ground water.
- J. If de-watering is required to lower the static level of the ground water, it will be paid for by the Owner on a unit price basis per hour as extra compensation.
- K. Stockpile excavated material in the area designated and remove excess material not being used, from the site.

3.3 BACKFILLING

- A. Verify foundation perimeter drainage system is complete and has been inspected prior to backfilling against foundation walls.
- B. Support pipe and conduit during placement and compaction of bedding fill.
- C. Systematically backfill to allow necessary time for natural settlement. Do not backfill over porous, wet, spongy, or frozen subgrade surfaces.
- D. Backfill areas to contours and elevations with unfrozen materials.

- E. Unless noted otherwise on the drawings, make grade changes gradual.
- F. Unless noted otherwise on the drawings, slope grade away from the building a minimum of 2 inches in 10 feet.
- G. Contractor shall procure the approval of the subgrade from the Special Inspection Agency prior to the start of any filling or bedding operations.
- H. Place a minimum width of 24 inches of free-draining granular fill against all basement and retaining walls for the full height of the wall.
- I. Do not begin any backfill operations against any concrete walls until the concrete has achieved its specified strength.
- J. Do not backfill against below grade walls without necessary bracing to support the walls or until supporting slab or framing is installed and has been anchored to the wall per the drawings.
- K. Place and mechanically compact granular fill in continuous layers not to exceed 6 inches compacted depth.
- L. Employ a placement method that does not disturb or damage adjacent utilities, vapor barriers, foundation perimeter drainage and foundation waterproofing.
- M. All surplus fill materials are to be removed from the site.
- N. Fill material stockpiles shall be free of unacceptable soil materials.
- O. After work is complete, remove all excess stockpile material and repair stockpile area to its original condition.

3.4 COMPACTION

- A. Compact all fill that will support building footings or floor slabs to 95 percent of the maximum dry density in accordance with ASTM D1557ASTM D698. For relative cohesionless fill materials, where the percent passing the #200 sieve is less than 10 and the moisture density curve indicates only slight sensitivity to changing moisture content, compaction requirements should be changed to 75 percent relative density in accordance with ASTM D4253 and ASTM D4254.
- B. Compact all fills that support paving and landscape per civil specifications.

3.5 FOUNDATIONS

- A. Each footing excavation should be cleared of all obstructions and other organic or deleterious materials.
- B. Localized areas of unstable or unacceptable material may be discovered during the stripping and excavation operation and may require over-excavation and backfilling. The Special Inspection Agency shall be present during the proof rolling to evaluate any localized areas and make recommendations regarding over-excavation, backfilling and recompaction of these areas. Fill placement and compaction shall be inspected and tested by the Special Inspection Agency.

- C. Footing elevations shown on the drawings designate a minimum depth of footing where an appropriate soil bearing pressure is expected. Footings, piers and/or walls shall be lowered or extended as required to reach soil meeting the design bearing pressure. This work shall be performed per the recommendations of the Special Inspection Agency.
- D. All footing excavations shall be recompacted by hand-operated, vibratory compaction equipment, except where compaction will degrade the integrity of subgrade soils. In these instances, bottom of footing excavations should be hand-trimmed to remove loosened material.
- E. All excavation and recompacted surfaces shall be inspected and tested to a depth of 2.0 feet below the excavated elevation by the Special Inspection Agency. Additional field density tests should be performed for each one foot of fill material placed. Any areas not in compliance with the compaction requirements should be corrected and re-tested prior to placement of fill material.
- F. For foundation areas where over excavation is performed, place and mechanically compact Engineered fill material in continuous layers not to exceed 6 inches compacted depth.

3.6 SLAB-ON-GRADE

- A. All disturbed areas after the clearing and stripping operation should be proof-rolled and recompacted with a heavy vibratory drum roller (approved by the Special Inspection Agency) in the static mode. The compactor should make a minimum of 10 passes, with a minimum of one foot overlap of each pass. The compactor speed should be less than 0.2 MPH.
- B. The Special Inspection Agency shall monitor proof-rolling and compaction operations. This area should then be tested for compaction to a depth of 2.0 feet below the compacted surface prior to the placement of any structural fill material.
- C. Refer to drawings for required sub-grade preparation beneath slabs-on-grade.

3.7 UTILITY TRENCH BACKFILL (AT SLAB-ON-GRADE LOCATIONS)

- A. Excavate and backfill utility trenches under wall footings as shown on the drawings.
- B. Place utility base course on subgrades free of mud, frost, snow, or ice.
- C. Place and compact utility base course on trench bottoms and where indicated.
- D. Lay underground utilities on 6" sand bedding, which meets the acceptable criteria of Section 2.1B.
- E. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- F. After connection joints are made, any misalignment can be corrected by tamping the sand around the utilities.
- G. Place and compact initial backfill of acceptable sand to a height of 6 inches over the utility pipe or conduit in 6 inch layers meeting specified compaction requirements.

- H. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of piping or conduit.
- I. Place and compact final backfill using acceptable soil to final subgrade elevation meeting specified compaction requirements.
- J. Backfill voids with acceptable soil while installing and removing shoring and bracing.
- K. Special Inspection Agency shall monitor and test compacted backfill to verify final compaction meets the specified requirement.
- 3.8 TOLERANCES
 - A. Top surface of backfilling under paved areas: Plus or minus 1/2 inch from required elevation.
 - B. Top surface of general backfilling: Plus or minus 1 inch from required elevation.

END OF SECTION