

Harrison REMC - Addition and Renovation

PROJECT MANUAL



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04/24/2025

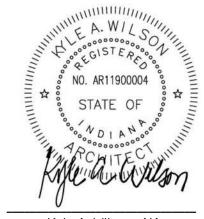
OWNER

Harrison REMC

1165 Old Forest Rd Corydon, IN 47112

PROJECT NUMBER

Architect's Project No. 24-179.000



Kyle A. Wilson, AIA State Registration Number AR11900004

Harrison REMC - Addition and Renovation Harrison REMC

TABLE OF CONTENTS 1 04/24/2025

TABLE OF CONTENTS

COVER & TABLE OF CONTENTS

00 0101 TP Cover Page 00 0110 - TP Table of Contents - Volume 1

DIVISION 00 — PROCUREMENT AND CONTRACTING REQUIREMENTS

- 00 1114 NOTICE TO BIDDERS (Non-Public Works)
- 00 2214 SUPPLEMENTARY INSTRUCTIONS TO BIDDERS (Non-Public Works)
- 00 4203 CONTRACTOR'S BID FORM (Non-PublicWorks)
- 00 4336 SUBCONTRACTOR LIST
- 00 4393 CONTRACTOR'S BID SUBMITTAL CHECKLIST
- 00 5200 AGREEMENT FORM
- 00 5299 ESCROW AGREEMENT
- 00 6113 CONTRACTOR'S BOND FOR CONSTRUCTION
- 00 7200 GENERAL CONDITIONS
- 00 7302 SUPPLEMENTARY GENERAL CONDITIONS (Non-Public Works)
- 00 7316 INSURANCE REQUIREMENTS

DIVISION 01 — GENERAL REQUIREMENTS

- 01 1100 SUMMARY OF WORK SINGLE CONTRACT
- 01 1400 GENERAL CONSTRUCTION REQUIREMENTS
- 01 2116 CONTINGENCY ALLOWANCE
- 01 2300 ALTERNATES
- 01 2973 SCHEDULE OF VALUES
- 01 3100 PROJECT MANAGEMENT AND COORDINATION
- 01 3119 PROJECT MEETINGS
- 01 3200 CONSTRUCTION PROGRESS DOCUMENTATION
- 01 3300 SUBMITTAL PROCEDURES
- 01 4120 STRUCTURAL INSPECTION
- 01 4200 REFERENCES
- 01 4500 QUALITY CONTROL
- 01 5100 TEMPORARY UTILITIES
- 01 5300 TEMPORARY CONSTRUCTION
- 01 6200 PRODUCT OPTIONS AND SUBSTITUTIONS
- 01 6500 PRODUCT DELIVERY AND HANDLING
- 01 7329 CUTTING AND PATCHING
- 01 7423 CLEANING
- 01 7700 CLOSEOUT PROCEDURES
- 01 7800 CLOSEOUT SUBMITTALS
- 01 7846 CLOSEOUT MAINTENANCE MATERIALS

Harrison REMC - Addition and Renovation Harrison REMC

TABLE OF CONTENTS 2 04/24/2025

DIVISION 02 — EXISTING CONDITIONS

02 3000 - SUBSURFACE EXPLORATION

02 3000.01 - Geotech Report

02 4119 - SELECTIVE DEMOLITION

DIVISION 03 — CONCRETE

03 0300 - STRUCTURAL EXCAVATION AND BACKFILL 03 3000 - CAST-IN-PLACE CONCRETE (+MIX FORM)

DIVISION 04 — MASONRY

04 0100 - MASONRY PROTECTION AND CLEANING

04 0513 - MORTAR

04 0519 - MASONRY REINFORCEMENT

04 0523 - MASONRY ACCESSORIES

04 0523.16 - MASONRY EMBEDDED FLASHING

04 2113 - FACE BRICK MASONRY

04 2200 - CONCRETE UNIT MASONRY

04 4301 - LIMESTONE

DIVISION 05 — METALS

05 1000 - STRUCTURAL ANCHORS

05 1200 - STRUCTURAL STEEL FRAMING

05 3100 - STEEL DECKING

05 4000 - COLD FORMED METAL FRAMING - STRUCTURAL

05 4100 - SHEET STEEL SHEAR PANELS

05 4753 - SHOP FABRICATED COLD FORMED STEEL TRUSSES

05 5000 - MISCELLANEOUS METALS

DIVISION 06 — WOOD, PLASTICS, AND COMPOSITES

06 1000 - ROUGH CARPENTRY

06 2000 - FINISH CARPENTRY

06 4000 - ARCHITECTURAL WOODWORK

DIVISION 07 — THERMAL AND MOISTURE PROTECTION

07 2100 - INSULATION

07 2119 - MEDIUM DENSITY CLOSED CELL POLYURETHANE FOAM AIR BARRIER

07 2216.04 - POLYISOCYANURATE ROOF INSULATION

07 2500 - WEATHER BARRIERS

07 4213 - METAL WALL PANELS

07 4293.01 - METAL SOFFIT PANEL

07 6000 - FLASHING, SHEET METAL AND ROOF ACCESSORIES

Harrison REMC - Addition and Renovation Harrison REMC

TABLE OF CONTENTS 3 04/24/2025

07 6113.02 - METAL ROOFING 07 8400 - FIRESTOPPING 07 9200 - JOINT SEALERS

DIVISION 08 — OPENINGS

08 1113 - STEEL DOORS AND FRAMES
08 1416 - FLUSH WOOD DOORS
08 1600 - FRP FLUSH DOORS
08 3113.01 - ACCESS DOORS
08 3613.01 - SECTIONAL OVERHEAD DOORS
08 4113 - ALUMINUM ENTRANCES AND STOREFRONTS
08 5653-1 SECURITY TRANSACTION WINDOW
08 5653-2 BULLET RESISTANT FRAMING SYSTEM
08 5659 - DRIVE-THRU WINDOWS
08 7100 - FINISH HARDWARE
08 7113.01 - AUTOMATIC DOOR OPERATOR
08 8100 - GLASS AND GLAZING
08 8853-1 SECURITY GLAZING

DIVISION 09 — FINISHES

08 9000 - LOUVERS AND VENTS

09 2900.01 - GYPSUM DRYWALL – STEEL STUD CONSTRUCTION
09 3000 - TILE
09 5113 - ACOUSTICAL CEILINGS
09 6519 - RESILIENT TILE FLOORING
09 6800 - CARPETING
09 7216 - WALL PROTECTION
09 9000 - PAINTING
09 9723 - CONCRETE FLOOR COATING

DIVISION 10 — SPECIALTIES

10 1300.02 - INTERIOR SIGNS
10 1416.01 - PLAQUE
10 2113.19 - SOLID PLASTIC TOILET PARTITIONS
10 2613 - WALL AND CORNER GUARDS
10 2641 - BULLET RESISTANT FIBERGLASS PANELS
10 2813 - TOILET ACCESSORIES
10 4400 - FIRE EXTINGUISHERS AND CABINETS
10 5100.01 - LOCKERS
10 7300 - ALUMINUM CANOPIES

DIVISION 11 — EQUIPMENT

11 1300 - LOADING DOCK EQUIPMENT

Harrison REMC - Addition and Renovation Harrison REMC

TABLE OF CONTENTS 4 04/24/2025

11 2216.33 - BULLET RESISTANT DEAL TRAY - RECESSED FLAT BOTTOM

DIVISION 12 — FURNISHINGS

12 2400 - WINDOW SHADES

DIVISION 13 — SPECIAL CONSTRUCTION

13 3419.01 - METAL BUILDING SYSTEMS - STRUCTURAL FRAME 13 3419.02 - PRE-ENGINEERED METAL BUILDING SYSTEM

DIVISION 20 - MECHANICAL

20 0100 - General Provisions

20 0100.1 - Heat Pump - SVC

20 0100.2 - Heat Pump Start-up

20 0200 - Scope

20 0300 - Shop Drawings

20 1100 - Sleeving

20 1200 - Excavation

20 1300 - Pipe

20 1305 - Geothermal

20 1310 - Pipe Treatment

20 2100 - Valves

20 2200 - Insulation

20 2300 - Thermometers

20 2400 - Identifications

20 2500 - Hangers

20 3100 - TAB

DIVISION 21 — FIRE SUPPRESSION

21 0100 - Fire Protection

DIVISION 22 — PLUMBING

22 0100 - Pl. Specialties

22 0200 - Pl.Fixtures

DIVISION 23 — HEATING VENTILATING AND AIR CONDITIONING

23 0100 - Pumps

23 0200 - HVAC.Equipment

23 1100 - GRDs

23 1200 - Sheet.Metal

Harrison REMC - Addition and Renovation Harrison REMC

TABLE OF CONTENTS 5 04/24/2025

DIVISION 25 — INTEGRATED AUTOMATION

25 0100 - Motors 25 0400 - Controls

DIVISION 26 — ELECTRICAL

00 0000	EL E O E D L O A L	
26 0000 -	FI FCTRICAL	INI)+X

26 0010 - GENERAL REQUIREMENTS FOR ELECTRICAL SYSTEMS

26 0500 - COMMON WORK RESULTS FOR ELECTRICAL SYSTEMS

26 0519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

26 0526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

26 0533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

26 0543 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

26 0548 - SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

26 0553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

26 0573 - POWER SYSTEM STUDIES

26 0923 - LIGHTING CONTROL DEVICES

26 2200 - LOW-VOLTAGE TRANSFORMERS

26 2416 - PANELBOARDS

26 2726 - WIRING DEVICES

26 2813 - FUSES

26 2816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

26 2900 - MOTOR CONTROLLERS

26 4100 - FACILITY LIGHTNING PROTECTION

26 4300 - SURGE PROTECTION DEVICES

26 5000 - LIGHTING

DIVISION 27 — COMMUNICATIONS

27 0526 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

27 0528 - PATHWAYS FOR COMMUNICATIONS SYSTEMS

27 0536 - CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

27 4100 - LOW VOLTAGE SYSTEMS

DIVISION 32 — EXTERIOR IMPROVEMENTS

32 3100 - ORNAMENTAL CANTILEVER GATES

32 3119 - STEEL ORNAMENTAL FENCES

32 9200 - LAWNS AND GRASSES

32 9300 - TREES, PLANTS AND GROUND COVER

32 9414 - ALUMINUM MAINTENANCE EDGING

SECTION 00 1114 - NOTICE TO BIDDERS

Notice is hereby given that **electronic proposals** will be received:

Harrison REMC BY:

1165 Old Forest Rd NW Corydon, IN 47112

FOR: Harrison REMC

Addition and Renovation

Corydon, IN

UNTIL: 4PM (EDT)

DATE: Friday, May 16, 2025

VIA: Email to kyle.wilson@towerpinkster.com

The Owner will open all bids privately.

Proposals received after the hour and date set for receiving of proposals, will not be opened.

All work will be awarded under a single General Contract.

Proposals shall be executed on the Proposal Form included in the bid documents. The signed and sealed hard copy bid documents are on file with the Owner and Architect and may be examined by Bidders at the following locations:

TowerPinkster Harrison REMC 1165 Old Forest Rd NW 320 Pearl Street New Albany, IN 47150 Corydon, IN 47112 812-738-4115 812-282-9554 p

Bidding is **BY INVITATION ONLY**.

MANDATORY PRE-BID CONFERENCE Monday, May 5, 2025 DATE: TIME:

1:30PM (EDT)

LOCATION: Harrison REMC 1165 Old Forest Rd NW Corydon, IN 47112

*Mandatory requirement is for General Contractors only.

All bidders will have free access to a complete electronic set of Drawings and Specifications.

All bid documents may be downloaded free of charge in electronic PDF format for viewing, printing and distribution to bidders, sub-bidders, suppliers, and reprographics services at the discretion and responsibility of the General Contractors. Bidders shall complete the Plan Holder List form via www.towerpinkster.com/bid-information. Upon completion of the form, bidders will be re-directed to the Project Page where all bid information may be downloaded. Bidders should bookmark this link and www.towerpinkster.com/bid-information for future access. A list of updated Plan Holders and Addenda will periodically be posted and made available for download.

The Architect retains all copyright to the bid documents, as instruments of their professional service.

NOTICE TO BIDDERS (Non-Public Works) 00 1114 - 2 04/24/2025

Bidders, or any other persons, may not use the PDF files for any other purpose than preparing a bid for this project. Bidders may not distribute bid documents or files to Plan Rooms (either electronic or hard copy format) without the express written permission of the Architect.

For convenience of the bidders, complete electronic files will also be sent to the following reprographic services.

Bidders are responsible for costs of any desired printing of drawings and/or specifications directly from these reprographics services at cost of printing plus any shipping and handling charges.

Zen Reprographics 648 South 8th Street Louisville, KY 40203 502-587.1951p www.zenreproplanroom.com

All questions and requests for substitutions shall be directed to:

TowerPinkster
Kyle Wilson
kyle.wilson@towerpinkster.com

Alec Seaman alec.seaman@towerpinkster.com

Bid Security in the amount of five percent (5%) of the Proposal, including all add alternates must accompany each Proposal in accordance with the Instructions to Bidders.

The Owner reserves the right to accept or reject any bid and to waive any irregularities in bidding. The Base Bid may be held for a period not to exceed Forty-Five (45) days before awarding Contracts. All additive Alternate Bids may be held for a period not to exceed Thirty (30) days after signing of Contract.

Should a successful Bidder withdraw his bid, or fail to execute a satisfactory contract within ten (10) days after notice of acceptance of his bid, the Owner may declare the Bid Security forfeited as liquidated damages, not as penalty.

The successful Bidder shall furnish a Performance Bond and Labor and Materials Payment Bond in an amount equal to one hundred percent (100%) of the Contract Sum with an approved surety company and said bond shall remain in full force and effect for a period of one (1) year after date of final acceptance of the work. The cost of all bonds shall be included in the bid price.

HARRISON REMC April 25, 2025

SECTION 00 22 14 - SUPPLEMENTARY INSTRUCTIONS TO BIDDERS (Non-Public Works)

The following supplements modify the Instructions to Bidders, AIA Document A701 - 2018, entitled "Instructions to Bidders". Where a portion of the Instruction to Bidders is modified or deleted by these Supplementary Instructions, the unaltered portions of the Instructions to Bidders shall remain in effect.

ARTICLE 9 - SUPPLEMENTARY INSTRUCTIONS

- 9.1 Article 3 BIDDING DOCUMENTS, delete the current Paragraph and replace with the following:
 - 3.1.1 All bid documents may be downloaded free of charge in PDF format for viewing, printing and distribution to bidders, sub-bidders and suppliers at the discretion and responsibility of the general contractors. All information is posted on a website identified in the Notice to Bidders or available by contacting the Architect. The Architect retains all copyright to all Bid Documents. Bidders may not use the Bid Documents for any purpose except preparing a bid for this project. Bidders may not distribute Bid Documents to Plan Room services, either electronic or hard copy, without the express written permission of the Architect. Printing of bid documents, including all costs associated therewith, is to be borne by the bidders.
- 9.2 Article 3 BIDDING DOCUMENTS, delete the current Paragraph and replace with the following: 3.1.2 Bid documents are available to sub-bidders in accordance with Paragraph 3.1.1.
- 9.3 Article 3 BIDDING DOCUMENTS, add the following Paragraph:
- 3.1.3 In the event of any discrepancy between electronic versions and any hard copy, printed versions of the files, the hard copy version on file at the Architect's office will govern.
- 9.4 Article 3 BIDDING DOCUMENTS, add the following Paragraph:
 - 3.3.5 When specifications include a list of acceptable manufacturers, it is done for the express purpose of establishing a basis of durability, efficiency, configuration, maintain Owner's maintenance stock, and not for the purpose of limiting competition. These said names establish the products on which the bidder's proposal shall be based for that particular specification item. Proposed substitutions must be submitted in accordance with Specification Section 01630-Product Options and Substitutions.
- 9.5 Article 3 BIDDING DOCUMENTS, delete the current Paragraph and replace with the following:
- 3.4.1 Addenda will be added to the bid documents and made available to all bidders via the website.
- 9.6 Article 3 BIDDING DOCUMENTS, delete Paragraph 3.4.3.
- 9.7 Article 4 BIDDING PROCEDURES, delete Paragraph 4.2 in its entirety, including 4.2.1, 4.2.2 and 4.2.3.
- 9.8 Article 5 CONSIDERATION OF BIDS, delete the current Paragraph and replace with the following:
- 5.1 Bids received may be privately opened or publicly read aloud at the sole discretion of the Owner.
- 9.9 Article 5 CONSIDERATION OF BIDS, delete the current Paragraph and replace with the following:
 - 5.3.1 The Owner shall have the right to accept or reject any and/or all Bids, determined upon any basis. The Owner shall have the right to waive informalities and irregularities in a Bid received and to accept or reject a Bid which, in the Owner's judgment, is in the Owner's best interest. All are at the sole discretion of the Owner.

- 9.10 Article 7 PERFORMANCE BOND AND PAYMENT BOND.
 - Under Section 7.1.1, delete the words "If stipulated in the Bidding Documents, the" and substitute the word "The"
 - Under Section 7.1.1, add the following sentence: "The costs for all Bonds must be included in the bid price." Delete Section 7.1.2 in its entirety.
- 9.11 Electronic submissions of bids are acceptable. Email bids to kyle.wilson@towerpinkster.com
- 9.12 A Wage Scale of minimum wage rates is not required nor has one been established for this project.
- 9.13 Materials supplied for this project may be exempt from Indiana State Sales Tax.

 Bidders shall verify with Owner if Owner holds a current Tax Exempt Certificate.

 Products purchased from sources outside the State of Indiana may require payment of sales tax to particular jurisdiction. All costs for such tax will be the responsibility of the Contractor.

PROJECT NO. 24-179.000 Harrison REMC - Addition and Renovation Harrison REMC

CONTRACTOR'S BID FORM (Non-PublicWorks) 00 4203 - 1 04/24/2025

CONTRACTOR'S BID FORM FOR NON-PUBLIC WORKS:

CONTRACTORS BI	D FOR:	Harrison REMC – Addition and Corydon, IN	Renovation	
Owner:	HARRISON REMC	Oorydon, nv		
Date:				
Bidder (Firm):				
Address:				
City, State, Zip:				
Telephone No.:				
E-Mail Address:				
		proposes to furnish all material a red by TOWERPINKSTER, 320		
	ор остооного р ор о		,	,
BASE BID			Φ.	
Lump Sum			\$	
<u>ADDENDA</u>				
Acknowledges recei	pt of: ddendum No	Datod	No. of Page	ne.
Δ(ddendum No	Dated	No. of Page	es
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7.0	2401144111140	<u></u>		
ALTERNATES	a proposa to furnish a	r to amit all labor and materials r	acceptant to complete war	dr ac required by the
		r to omit all labor and materials n	ecessary to complete wor	k as required by the
-	ovided in the specificat	ions as follows:	¢	
Alternate No. 1: Alternate No. 2A:	,		Φ	
Alternate No. 2B:		Danala	\$	
Alternate No. 3A:	Front Landscapi		\$	
Alternate No. 3A.	Rear Landscapi		Ψ	
Alternate No. 3b.	Кеат Саписсаріі	ıy	Ψ	
<u>ALLOWANCES</u>				
By initialing adjacen	t to amount below, bidd	er acknowledges allowance amo	unt is included in the forgo	ping bid:
Contingency Allow	ance within the Base E	3id per Section 01 2116 \$ 20	00,000.00 initials	
COMPLETION OF V				
Undersigned guarar	itees, if awarded contra () calendar days.	ct, to achieve Substantial Comple	etion for the Phase 1 work	within
Undersigned guaran	tees, if awarded contra	ct, to achieve Substantial Comple	etion for the Phase 2 work	within
Undersigned guaran	() calendar days.	ct, to achieve Substantial Comple	ation for the Phase 3 work	within
	ilees, ii awarded contra () calendar days.	oi, io acilieve Substantiai Compi	SHOTH OF LITE IS HASE O WOLK	. VVIU IIII

PROJECT NO. 24-179.000 Harrison REMC - Addition and Renovation Harrison REMC

CONTRACTOR'S BID FORM (Non-PublicWorks) 00 4203 - 2 04/24/2025

Addenda	a, and have reviev	ved the jobsite to si		cuments, including all Drawings ves with the existing conditions , 20	
	(Name of Organ	nization)			
BY					
	(Title of Person	Signing)			
	ND AFFIRMATIO		that the facts and informat	ion contained in the foregoing l	oid is true and correc
•			day of	0 0	Jiu is tiue and correc
	(Name of Organ	aination)			
	(Name of Orgai	nization)			
BY					
	(Title of Person	Signing)			
	WLEDGEMENT				
STATE (<u> </u>		
		c, personally appea	ared the above-named	(Name of Person Sig	and ning)
			regoing document are true day of	and correct.	9)
				Notary Publi	<u>c</u>
•	•				
County of	of Residence:				

SECTION 00 4336 - SUBCONTRACTOR LIST

1.01 PROJECT MANUAL

A. All requirements of the Project Manual shall apply to this Section.

1.02 SCOPE

- A. Successful Bidder for each Contract shall submit his complete Subcontractors List for all trades and divisions of work.
- B. After submission of this List and after approval by the Architect/Engineer and Owner, it shall not be changed without written approval by the Owner and Architect/Engineer.
- C. Refer to Section 00 4393 Contractor's Bid Submittal Checklist for requirements as to time of submission.

1.03 FORM

Provide in Contractor's own format to include the following information:

- A. Description of work or trade.
- B. Company Name.
- C. Company Address.
- D. Company Phone.
- E. Contact Person.
- F. E-mail Address.
- G. MBE/WBE Status.

SECTION 00 4393 - CONTRACTOR'S BID SUBMITTAL CHECKLIST

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDED

- A. Section Includes:
 - 1. Submittals required at time of bid.
 - 2. Submittals required following bid.

1.2 BID SUBMITTALS

- A. The following items are to be submitted by all bidders for all contracts at the time of bidding:
 - 1. Proposal Form
 - 2. Bid Security
- B. Submit electronically via email per Section 00 1114 Notice To Bidders.

1.3 POST-BID SUBMITTALS

The following items are to be submitted by each successful bidder for all contracts within seventy-two (72) hours following the time of bidding:

- 1. Schedule of Values
- 2. Subcontractor List
- B. The following items are to be submitted prior to execution of the Owner-Contractor Agreement:
 - 1. Performance Bond
 - 2. Labor & Material Payment Bond
 - 3. Certificate of Insurance
 - Signed Escrow Agreement
- C. Submit all above items to Architect for review and approval.

SECTION 00 5200 - AGREEMENT FORM

- 1.01 PROJECT MANUAL
 - A. All requirements of the Project Manual shall apply to this Section.
- 1.02 <u>SCOPE</u>
 - A. The agreement shall be AIA Document A101 2017, entitled "Standard Form of Agreement Between Owner and Contractor".
 - 1. Where the basis of payment is a stipulated sum.
 - 2. Copy of this form is bound herewith.
 - B. This form, when fully executed, becomes a part of the successful Bidder's Contract Documents.

SECTION 00 5299 - ESCROW AGREEMENT

- 1.01 PROJECT MANUAL
 - A. All requirements of the Project Manual shall apply to this Section.

1.02 <u>SCOPE</u>

- A. All funds retained by the Owner from approved certificates for payment shall be placed in Escrow per **Indiana** Statutes.
 - 1. Escrow Agreement Form shall be provided by the Escrow Agent and shall be acceptable to both the Owner and the Contractor.
 - 2. Escrow Agreement, when executed shall become a part of the Contract Documents.
 - 3. All escrowed funds shall be deposited in a financial institute as agreed upon by both parties to the Contract.

SECTION 00 6113 - CONTRACTOR'S BOND FOR CONSTRUCTION

1.01 PROJECT MANUAL

All requirements of the Project Manual shall apply to this Section.

1.02 SCOPE

- A. The Performance Bond and Labor and Material Payment Bond shall be AIA Document A312 2010, comprised of two sections entitled "Performance Bond" and "Payment Bond".
 - 1. Bonds shall be executed by an acceptable Surety Company licensed to do business in the State of Indiana.
 - 2. A copy of this form is bound herewith.
- B. Bonds shall be executed in an amount equal to one hundred percent (100%) of the contract amount in favor of the Owner conditioned on the full and faithful performance of the contract and full payment of all obligations arising there under.
- C. This form when fully executed becomes a part of the successful bidder's Contract Documents.

SECTION 00 7200 - GENERAL CONDITIONS

1.1 PROJECT MANUAL

All requirements of the Project Manual shall apply to this Section.

1.2 <u>SCOPE</u>

- A. The General Conditions shall be AIA Document A201 2017, entitled "General Conditions of the Contract for Construction".
 - 1. A copy of which is bound herewith.

SECTION 00 7302 - SUPPLEMENTARY GENERAL CONDITIONS (Non-Public Works)

Unless otherwise provided in these Supplemental Conditions, all work shall be governed by the terms of AIA Document A201 - 2007, entitled "General Conditions of the Contract for Construction". The following Supplemental Conditions, modify, delete from and add to AIA A201. Where an Article Paragraph, Subparagraph or Clause of AIA A201 is modified, deleted from or added to by these Supplemental Conditions, the unaltered provisions of that Article, Paragraph, Subparagraph or Clause shall remain in full force and effect. To the extent that there is any conflict or ambiguity between AIA A201 and these Supplemental Conditions, then these Supplemental Conditions shall control.

ARTICLE 1 - GENERAL PROVISIONS

1.1.1 THE CONTRACT DOCUMENTS

Add the following:

1. Proposal Form.

1.1.5 THE DRAWINGS

Add the following Paragraphs:

- 1.1.5.1 The Drawings are a graphic representation intended to convey the design intent of the Project. They are a 2-dimensional representation of a 3-dimensional Project, and they do not provide a detail for every construction condition of the project. The Drawings are a small scale representation of complex construction assemblies and components, and not every element of the Project can be indicated in these small scale representations. The Drawings are not an instruction manual, nor are they assembly instructions. They are meant for use by experienced, competent construction professionals with the ability to read, interpret, co-ordinate, interpolate and infer information from them. The Drawings do not indicate every component and assembly necessary to construct the Project. It is the Contractor's responsibility to provide all components and assemblies necessary to provide a safe, complete and finished Project, which is reasonably fit for its intended purpose, whether or not such components and assemblies are detailed on the Drawings.
- 1.1.5.2 In general, all drawings are diagrammatic and schematic, and cannot indicate every offset, fitting, and accessory, nor can they indicate the field coordination work required to avoid all conflict with other trades. Contractor shall check drawings, shop drawings, and actual equipment of other trades to verify spaces available and make reasonable modifications, as directed, without extra cost to Owner; maintain headroom and other requirements in all areas; and where such requirements appear inadequate, notify Architect/Engineer before proceeding.

SUPPLEMENTARY GENERAL CONDITIONS (Non-Public Works) 00 7302 - 2 04/24/2025

1.2 CORRELATION AND INTENT OF THE CONTRACT DOCUMENTS

Add the following sentence to Paragraph 1.2.1:

It is the Contractor's responsibility to provide all work necessary for a complete and finished Project of first class quality. The Contractor will work skillfully, carefully and will perform in all respects in a workmanlike manner.

Add the following Paragraphs 1.2.2.1 and 1.2.3.1:

- 1.2.2.1 The Drawings are not intended to define the scope of work among various trades, sub-contractors, material suppliers and vendors. The sheet numbering system is for the convenience of the Architect and the Architect's consultants only and is not intended to define a sub-contractor's or material supplier's scope of work. Information is detailed, described and located at various locations throughout the Drawings. No consideration will be given to requests for change orders which relate to a failure of the Contractor, or the Contractor's sub-contractors and suppliers to obtain and review a complete set of Contract Documents during bidding, nor to maintain a complete set of Contract Documents during construction. Where bidding is separated into a number of different prime contracts, this paragraph applies to each of the separate prime contracts.
- 1.2.3.1 In the event of conflicts or discrepancies among the Contract Documents, interpretations will be based on the following priorities.
 - 1. The Agreement
 - 2. Addenda, with those of later date having precedence over those of earlier date.
 - 3. The Supplementary Conditions.
 - 4. The General Conditions of the Contract for Construction.
 - 5. Drawings and Specifications.

In the case of an inconsistency between Drawings and Specifications or within either Document not clarified by addendum, the better quality or greater quantity of Work shall be provided in accordance with the Architect's interpretation. The Contractor has a duty to inquire about possible ambiguities and inconsistencies which are patent or obvious during the bidding process, and will not receive additional compensation or be excused from resulting difficulties in performance for failure to point out any inconsistencies after that point. In the case of disregard by the Contractor of such inconsistencies and ambiguities, the Architect may require the Contractor to remove and correct work which has been installed at no additional cost to the Owner.

ARTICLE 2 - OWNER

- 2.2 INFORMATION AND SERVICES REQUIRED OF THE OWNER
- 2.2.2 DELETE Subparagraph 2.2.2 in its entirety.
- 2.2.3 DELETE Subparagraph 2.2.3 in its entirety and replace with the following:

Neither the Owner nor the Architect shall be liable for inaccuracies or omissions contained in any surveys for the site of the Project, nor shall any inaccuracies or omissions in such items relieve the Contractor of its responsibility to perform the Work in accordance with the Contract Documents.

2.2.5 Replace Subparagraph 2.2.5 with the following:

The Contractor will be provided free of charge all bid documents in PDF format. Printing of all bid documents, including all costs associated therewith, is to be borne by the Contractor for use by and distribution to all their bidders, sub-bidders and suppliers at the discretion and responsibility of the Contractor. All bid documents will be made available as identified in the Notice To Bidders.

ARTICLE 3 - CONTRACTOR

- 3.3 SUPERVISION AND CONSTRUCTION PROCEDURES
- 3.3.4 ADD the following new Subparagraph:

The Contractor shall maintain total control of and shall be fully responsible for the Contractor's employees, agents, representatives, workers, Subcontractors, sub-subcontractors and other such persons or entities, and shall remove from the Site any such persons or entities not in compliance with the Contract Documents as interpreted by the Architect or the Owner. The Contractor shall assure harmonious labor relations at and adjacent to the Site so as to prevent any delays, disruption or interference to the Work. The Contractor shall prevent strikes, sympathy strikes, slowdowns, work interruption, jurisdictional disputes or other labor disputes resulting for any reason whatsoever, from the acts or failure to act, of the employees of the Contractor or any of its Subcontractors material suppliers, or other such persons or entities. The Contractor agrees that it will bind and require all of its Subcontractors, material suppliers and other such persons or entities to agree to all of the provisions of this subparagraph. If the Contractor or any of its Subcontractors, material suppliers or other such persons or entities fail to fulfill any of the covenants set forth in the Subparagraph, the Contractor will be deemed to be in default and substantial violation of the Contract Documents.

SUPPLEMENTARY GENERAL CONDITIONS (Non-Public Works) 00 7302 - 4 04/24/2025

1.5.1 WARRANTY

Add the following new Subparagraphs 3.5.2, 3.5.3, 3.5.4, 3.5.5, 3.5.6, 3.5.7, 3.5.8 and 3.5.9.

- 3.5.2 For a period of one (1) year from the date of Substantial Completion, the Contractor warrants as provided in Subparagraph 3.5.1 and further warrants to the Owner, and the Architect that (a) all movable or adjustable work shall remain in working order, including hardware, doors, windows, apparatus, machinery, mechanical and electrical equipment and (b) the Contractor's portion of the Work shall be waterproof and weatherproof in every respect.
- 3.5.3 In addition to all the Contractor warranties and obligations to correct defective Work provided by law or as set forth in any of the Contract Documents, the Contractor agrees, upon notice from the Owner or the Architect, to pay for, and if requested, correct, repair, restore and cure any damage or injury, whenever the same shall occur or appear, resulting from any defects, omissions or failure in workmanship or materials, and indemnify, hold harmless, and defend the Owner against any and all claims, losses, costs, damages and expenses, including attorneys' fees, suffered by the Owner as a result of such damage or injury, whenever such damage or injury shall occur or appear.
- 3.5.4 The commencement and terms of the guarantees and warranties required by the Contract Documents shall not in any manner be affected by any delay in the commencement, progress or completion of the Work, regardless of the cause therefore.
- 3.5.5 The foregoing guarantees and warranties shall not shorten any longer warranty or liability period provided for by law or in the Contract Documents or otherwise received from the Contractor or any Subcontractor, material supplier or manufacturer, nor supersede the terms of any special warranty given by the Contractor, nor shorten any period of the Contractor's legal liability for defective Work, but shall be in addition thereto.
- 3.5.6 Notwithstanding anything to the contrary contained herein with respect to warranties, it is understood and agreed that the foregoing warranties and guarantees shall not affect, limit or impair the Owner's right against the Contractor with regard to latent defects in the Work which do not appear within the applicable warranty period and which could not, by the exercise of reasonable care and due diligence, be ascertained or discovered by the Owner within such warranty period. The Contractor shall be correct and cure any such latent defects which are reported to the Contractor by the Owner in writing within ninety (90) days after such latent defect first appears or could, by the exercise of reasonable care and due diligence, be ascertained or discovered by the Owner.
- 3.5.7 Neither the acceptance of any of the Work by the Owner, in whole or in part, nor any payment, either partial or final, by the Owner to the Contractor, shall constitute a waiver by the Owner of any claims against the Contractor for defects in the Work, whether latent or apparent, and no such payment or acceptance of the Work by the Owner shall release or discharge the Contractor of the Contractor's surety, if any, from any such claims for breach of such warranties.
- 3.5.8 Upon completion of the Work, the Contractor shall furnish the Owner with all written warranties, guarantees, operating manuals, all shop drawings and submittals used in the project relative to equipment installed, and if requested by the Architect, a complete set of reproducible drawings with all field changes noted on them relating to the improvements constructed.

SUPPLEMENTARY GENERAL CONDITIONS (Non-Public Works) 00 7302 - 5 04/24/2025

- 3.5.9 If required by the Owner or the Architect, the Contractor shall deliver to the Owner a signed affidavit stating that the Work has been constructed in accordance with the Contract Documents. If such affidavit is required, final payment or a final certificate for payment shall not be tendered until such affidavit has been delivered to the Owner.
- 3.6 TAXES
- 3.6.1 ADD the following new Subparagraph:

Material and properties purchased by contracts with the Owner that become a permanent part of the structure or facilities constructed may be exempt from the Indiana Gross Retail Tax (Sales Tax). Contractor and Bidders shall verify with Owner if Owner holds a current Tax Exempt Certificate. The Contractor shall obtain a copy of the Owner's exemption certificate and then issue copies of this certificate to his suppliers when acquiring materials and properties for use on the Project. The Contractor shall enforce this exemption clause for their purchases and for those of their Subcontractors.

3.8 ALLOWANCES

Refer to Section 01220 - Contingency Allowance for further provisions on this subject.

3.12 SHOP DRAWINGS, PROJECT DATA AND SAMPLES

Refer to Section 01330 - Submittal Procedures for further provisions on this subject.

3.13 USE OF SITE

ADD the following new Subparagraphs 3.13.1 and 3.13.2:

- 3.13.1 If the Owner requires the contractor to relocate materials or equipment which have been stored on the Site or within the Project, the Contractor shall relocate such materials or equipment at no additional cost to the Owner.
- 3.13.2 The Contractor is solely responsible for its Site access. The Contractor shall keep all roads, walks, ramps and other areas on and adjacent to the Site in good working order and condition and free from obstructions which might present a hazard to or interference with traffic or the public. When construction operations necessitate the closing of traffic lanes, the Contractor shall be responsible for arranging such closings in advance with the authorities having jurisdiction, the Owner, and adjacent property Owners. The Contractor shall provide adequate barricades, signs and other devices for traffic guides and public safety. Contractor shall maintain all adjacent streets to that Project in a clean condition and shall clean all dirt and mud from the Project and from such adjacent street on a daily basis.
- 3.14 CUTTING AND PATCHING

Refer to Section 01732 - Cutting and Patching for further provisions on this subject.

SUPPLEMENTARY GENERAL CONDITIONS (Non-Public Works) 00 7302 - 6 04/24/2025

3.15 CLEANING UP

Refer to Section 01740 - Cleaning for further provisions on this subject.

ARTICLE 6 - CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

6.2 MUTUAL RESPONSIBILITY

ADD the following new Subparagraphs 6.2.6 and 6.2.7:

- 6.2.6 No Contractor, other Contractor, or Subcontractor, shall be entitled or permitted to sue or make a claim against the Owner or the Architect on account of any delay, disruption or acceleration or damage related thereto. If, however, the Owner or the Architect is sued or receives a claim from a Contractor or other Contractor on account of any alleged delay, disruption, interference or acceleration or damage related thereto caused, or alleged to be caused, in whole or in part, by the Contractor, the Contractor shall defend and indemnify the Owner and the Architect therefore, and reimburse them for their attorney's fees, costs and expenses.
- 6.2.7 Inasmuch as the completion of the Project within the Contract Time is dependent upon the close and active cooperation of all those engaged therein, it shall be expressly understood and agreed that the Contractor shall lay out and install its Work at such time or times and in such manner as not to delay, interfere, or disrupt the Work of others.

ARTICLE 7 - CHANGES IN THE WORK

7.1 GENERAL

Add the following new Subparagraphs 7.1.4 and 7.1.5:

7.1.4 Consultants to Architect or Owner:

- 1. Consultants to Architect or Owner shall have NO authority to modify Contract requirements in the Scope of Work or Contract Time.
- 2. Consultants to Architect or Owner shall have no direct communication with Contractor or subcontractors, suppliers and vendors to Contractor without the express consent of the Architect.
- 3. Any direct communication authorized by the Architect shall be for clarifications of the Work only and shall not act to authorize any changes in the Scope of Work, Contract Sum or Contract Time.
- 7.1.5 The overhead, profit and commission percentages included in a Change Order or Construction Change Directive must not exceed the maximums given at the end of this paragraph, and will be considered to include, but not be limited to, insurance (other than Workman's Compensation Insurance, FICA, Medicare and FUTA), bonds, small tools, incidental job burdens, supervisory expense, project management expense, clerical expense, preparatory expense and general office expense. Workmen's Compensation Insurance, and employment taxes under FICA, Medicare and FUTA are to be itemized separately and no percentage for overhead, profit and commission will be allowed on them. The

percentages for overhead, profit and commission will be negotiated and may vary according to the nature, extent and complexity of the work involved, but not to exceed the maximum percentages shown. Not more than three percentages will be allowed regardless of the number of tiers of sub-contractors; that is, the markup on work subcontracted by a subcontractor will be limited to one overhead percentage and one profit percentage in addition to the prime contractor's commission percentage. On proposals covering both increases and decreases in the amount of the contract, the overhead, profit, and where applicable, commission, will be computed on the net change only. On proposals for decreases in the amount of the contract, the overhead and profit shall be added to the decrease in direct cost:

Description	Overhead	Profit	Commission
To Contractor on work performed by other than	0%	0%	10%
his/her own forces			
To Contractor for that portion of work performed with	10%	10%	0%
by his/her own forces			
To Sub-contractor for that portion of work	10%	10%	0%
performed by his/her own forces			

7.3 CONSTRUCTION CHANGE DIRECTIVES

Add the following new Subparagraph to 7.3.7.6:

7.3.7.6 Amount for overhead and profit as set forth in this Agreement shall be in accordance with the schedule set forth in Article 7.1.5.

ARTICLE 8 - TIME

8.2 PROGRESS AND COMPLETION

ADD the following Subparagraphs 8.2.4, 8.2.5 and 8.2.6:

- 8.2.4 Whenever it may be useful or necessary for the Owner to do so, the Owner may take possession of the Project or parts thereof at any time that it is determined by the Architect that the Work has been completed to a point where the Owner may occupy or use said Project, or parts thereof, without interference, delay or disruption to the continued execution of the work. The Owner may at such time install furnishings and equipment as it sees fit or may at its discretion hire other Contractors for this purpose. Such use or occupation shall not relieve the Contractor or these warranty obligations as provided in the Contract Documents nor shorten their commencement dates.
- 8.2.5 Except as otherwise provided herein, substantial completion of work shall be within the number of calendar days stated by the Contractor on the Proposal Form and shall become a contract obligation. The time for completion of the work shall be extended for the period of any excusable delay, which term shall include

SUPPLEMENTARY GENERAL CONDITIONS (Non-Public Works) 00 7302 - 8 04/24/2025

only those delays directly caused by any of the reasons enumerated in the following subparagraph 8.3.2 and 8.3.3.

- 8.2.6 Completion shall be understood to be substantially complete for the Owner's beneficial occupancy, with only minor Punch List" items yet to be completed and items such as balancing of heating system, etc., which cannot be completed due to climatic conditions.
- 8.3 DELAYS AND EXTENSIONS OF TIME

DELETE Subparagraph 8.3.1 in its entirety and substitute the following:

8.3.1 If the Work is delayed, disrupted, interfered with our constructively accelerated (hereinafter and collectively referred to as "Hinderance" or "Hindrances") at any time by any act or neglect of the Owner, the Architect, other Contractors or Subcontractors, or any of their employees, or by changes ordered in the Work, fire, unusual delay in transportation, unavoidable casualties, or other cause beyond the Contractor's control as elsewhere provided in the Contract Documents, then the Contract Time shall be increased by Change Order for such reasonable time as the Architect may determine.

DELETE Subparagraph 8.3.3 in its entirety and substitute the following:

8.3.3 Whether or not any Hinderance shall be the basis for an increase in the Contract Time, the Contractor shall have no claim against the Owner or the Architect for an increase in the Contract Sum, nor a claim against the Owner or the Architect for a payment or allowance of any kind for damage, loss or expense resulting from any Hinderance. As between the Contractor and the Owner, except for acts constituting intentional or grossly unreasonable interference by the Owner or the Architect with the Contractor's performance of the Work when such acts continue after the Contractor's written notice to the Owner of such interference or disruption, the Contractor shall assume the risk of all Hindrances arising from any and all causes whatsoever, including without limitation, those due to any act or omission of the Owner or the Architect, except only to the extent that an increase to the Contract Time may be due to the Contractor as expressly provided for in this Subparagraph. The Contractor shall bear all costs, expenses and liabilities in connection with Hindrances and all costs, expenses and liabilities of any nature whatsoever, whether or not provided for in the Contract Documents, shall conclusively be deemed to have been within the contemplation of the parties. The only remedy available to the Contractor shall be an increase in the Contract Time.

ADD the following new Subparagraphs 8.3.4, 8.3.5 and 8.3.6:

- 8.3.4 The Owner's exercise of any of its rights under the Contract Documents, including but not limited to its rights regarding changes in the Work, regardless of extent or number of such changes, performance of separate Work or carrying of the Work by the Owner or the Architect, directing overtime or changes in the sequence of the Work, withholding payment or otherwise exercising its rights hereunder, or exercising any of its remedies of suspension of the Work or requirements of correction or re-execution of any defective Work shall not, under any circumstances, be construed as intentional interference or disruption with the Work.
 - 8.3.5 No increase in the Contract Time shall be granted for any Hindrance resulting from unsuitable ground conditions, inadequate forces, the failure of the Contractor to place orders for equipment or materials sufficiently in advance to insure their delivery when needed, or any Hindrance resulting from interruptions

SUPPLEMENTARY GENERAL CONDITIONS (Non-Public Works) 00 7302 - 9 04/24/2025

to or suspensions of the Work so as to enable others to perform their Work, other than as specifically provided elsewhere in the Contract Documents.

8.3.6 If the Contractor causes a Hindrance to the Work so as to cause any damage to the Owner or any damages for which the Owner may become liable, the Contractor shall be liable therefore and the Owner may withhold from any amount yet due the Contractor the amount reasonably required to compensate the Owner for such damages, if the amount of compensation exceeds the amount yet paid to the Contractor, the Contractor shall pay the difference to the Owner immediately upon demand.

ARTICLE 9 - PAYMENTS AND COMPLETION

9.2 SCHEDULE OF VALUES

Add the following new Subparagraph 9.2.2:

9.2.2 Contractor shall obtain written concurrence in such schedule of values from the Surety furnishing any Performance Bond and Labor and Materials Payment Bond. Copy of written concurrence by the Surety shall be submitted by the time of written submission.

9.3 APPLICATIONS FOR PAYMENT

ADD the following new Subparagraphs: 9.3.1.3, 9.3.1.4, 9.3.1.5, and 9.3.1.6:

- 9.3.1.3 The Owner will pay ninety-five percent (95%) of the amount due the Contractor on Account of progress payments for the entire period of the Contract.
- 9.3.1.4 A subcontractor shall be paid ninety-five percent (95%) of the earned sum by the Contractor for the entire period of the Contract.
 - 9.3.1.5 The Owner, Contractor and the Architect/Engineer shall cooperate to the end that retentions shall be paid promptly when all conditions of the Contract have been met.
 - 9.3.1.6 Applications for payment, subsequent to the first application, shall be accompanied by Waivers of Lien from the Contractor and all major subcontractors, suppliers, and vendors.

ADD the following at the end of Subparagraph 9.3.3:

- 9.3.3 This provision shall not be construed as relieving the Contractor from the sole responsibility and expense for the care and protection of materials and Work upon which payments have been made or the restoration of any stolen, destroyed or damaged Work, or as a waiver of the right of the Owner to require the fulfillment of all of the terms of the Contract Documents.
- 9.5 DECISIONS TO WITHHOLD CERTIFICATION

ADD the following new Subparagraph 9.5.4:

- 9.5.4 If any claim or lien is made or filed with or against the Owner, the Architect, the Project, or the Contract Sum by any persons or entity claiming that the Contractor or and Subcontractor or other person for whom the Contractor is responsible has failed to make payment for labor, services, materials, equipment, taxes or other items or obligations furnished or incurred for or in connection with the Work, or if at any time there shall be any evidence of such non-payment or of any claim or lien which is chargeable to the Contractor, or if the Contractor or any Subcontractor or other person or entity for whom the Contractor is responsible caused damage to the Work or to any other Work on the project, or if the Contractor fails to perform or is otherwise in default under any of the terms or provisions of the Contract Documents, the Owner shall have the right to retain from any payment then due or thereafter to become due an amount which it deems sufficient to (1) satisfy, discharge and/or defend against such claim or lien or any action which may be brought or judgment which may be recovered thereon, (2) make good any such non-payment, damage, failure or default, and (3) compensate the Owner and the Architect for any and all losses, liabilities, damages, cost and expenses, including legal fees and costs, which may be sustained or incurred by either or both of them in connection therewith. The Owner shall have the right to apply and charge against the Contractor so much of the amount retained as may be required for the foregoing purposes. If the amount retained is insufficient therefore, the Contractor shall be liable for the difference and shall pay the difference to the Owner.
- 9.6 PROGRESS PAYMENTS

DELETE Subparagraph 9.6.6 in its entirety and replace with the following:

- 9.6.6 No recommendation or certification of a progress payment, any progress payment, final payment, or any partial or entire use or occupancy of the Project by the Owner, shall constitute acceptance of any Work not in accordance with the Contract Documents.
- 9.9 PARTIAL OCCUPANCY OR USE
- 9.9.1 DELETE the phrase "when such portion is designated by separate agreement with the Contractor" in line 2; DELETE the last two sentences in Subparagraph 9.9.1.
- 9.10 FINAL COMPLETION AND FINAL PAYMENT
- 9.10.1 ADD the following sentence at the end of the Subparagraph:

"Provided, however, that final payment shall not be due and payable until sixty-one (61) days after the Work has been completed and the Contract fully performed".

9.10.4 ADD the following at the end of Subparagraph 9.10.4:

"Final payment constituting the unpaid balance of the Contract Sum shall be paid to the Contractor in full, no less than sixty-one (61 days) following the date of substantial completion. If at any of that time there are any remaining uncompleted items, an amount equal to two hundred percent (200%) of the value of each

SUPPLEMENTARY GENERAL CONDITIONS (Non-Public Works) 00 7302 - 11 04/24/2025

item as determined by the Architect shall be withheld until said items are completed and a Final Certificate of Payment is issued by the Architect".

DELETE Subparagraph 9.10.5 in its entirety and replace with the following:

9.10.5 The Contractor's obligation to perform the Work and complete the Project in accordance with the Contract Documents shall be absolute. Neither approval of any progress or final payment, nor the issuance of a Certificate of Substantial Completion, nor any payment by the Owner to the Contractor under the Contract Documents, nor any use or occupancy of the Project or any part thereof by the Owner, nor any act of acceptance by the Owner shall constitute an acceptance of Work not in accordance with the Contract Documents, nor does it constitute a waiver of any claims that arise from: (1) liens, claims, security interests or encumbrances arising out of the contract or settled; or (2) terms of any warranties in favor of the Owner that are provided pursuant to the Contract Documents or otherwise.

ARTICLE 10 - PROTECTION OF PERSONS AND PROPERTY

DELETE Subparagraph 10.1.1 in its entirety and replace with the following:

- 10.1.1 The Contractor shall be solely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work and in connection with the Contractor's performance of any work other than the Work.
- 10.2 SAFETY OF PERSONS AND PROPERTY
- 10.2.1 REPLACE the words "reasonable" with the phrase "all necessary" in both instances in line 1.

ADD the following to Subparagraph 10.2.1:

- .4 Protect excavation, trenches, buildings and grounds from all water damage. Furnish necessary equipment to provide this protection during the term of the Contract. Construct and maintain necessary temporary drainage to keep excavations free of water.
- .5 Provide protection of the Work against wind, storms, cold and heat. At the end of each day, cover new Work which may be damaged:
- .6 Provide adequately-engineered shoring and bracing required for safety and for the proper execution of the Work and have same removed when the Work is completed; and
- .7 Protect, maintain and restore benchmarks, monuments and other reference points affected by the Work. If benchmarks, monuments or other reference points are displaced or destroyed, points shall be re-established and markers reset under the supervision of a licensed surveyor, who shall furnish certificates of its work.

10.2.5 INSERT the work "solely" after the word "loss" in the clause which reads "except damage or loss attributable to acts or omissions of the Owner or Architect...".

ADD the following new Subparagraphs 10.2.9, 10.2.10 and 10.2.11:

- 10.2.9 "The Project is designed to be self-supporting and stable after the Work is fully completed. Except as otherwise provided, it is solely the Contractor's responsibility to determine erection procedures and sequences, and to insure the safety of the Project and its component parts during erection. This includes, but is not limited to, the addition or modification of whatever temporary bracing, guys or tie downs may be necessary. Such material shall be removed after completion of the Work".
- 10.2.10 The Contractor shall conform with the United States Department of Labor and the State Division of Labor Occupational Safety and Health Administration regulations.
- 10.2.11 The Contractor shall have the Hazard Communication Program in effect with all their personnel working on the project. All Material Data sheets should be current as required by law.

ARTICLE 11 - INSURANCE AND BONDS

11.1 CONTRACTOR'S INSURANCE AND BONDS

- 11.1.1 ADD the following at the end of the subparagraph:
- .1 The form of such bonds shall be acceptable to Owner and in compliance with **Indiana** Statute:
- .2 The Bonds shall remain in effect for a period of not less than one (1) year following the date of Substantial Completion and/or time required to resolve any items of incomplete Work and the payment to any owed amounts, whichever time period extends the longer.
- .3 The amount of the Performance Bond and the Labor and Material Bond shall each be 100% of the Contract Sum; and
- .4 The Contractor shall require the attorney in fact who executes the required bonds on behalf of the surety to affix thereto a certified and current copy of his power of attorney indicating the momentary limit of such power.
- .5 The required insurance shall be written for not less than the limits stated in the Owner's Instructions to the Architect (AIA Document G612, Part B) as included in the Project Manual or as required by law, whichever is greater and with the Owner, Architect, Consultants, and Engineers or their assigned names as "Additional Insureds" "Primary" on the insurance policy. Coverages shall be maintained

SUPPLEMENTARY GENERAL CONDITIONS (Non-Public Works) 00 7302 - 13 04/24/2025

without interruptions from date of commencement, of the work, until date of final payment and termination of any coverage required to be maintained after final payment.

Add the following new Subparagraph 11.1.5 and 11.1.6:

- 11.1.5 The Contractor shall furnish one copy of Certificate of Insurance and Bonds required of each copy of the agreement, which shall specifically set forth evidence of all coverages required. Furnish Owner copies of any endorsements subsequently issued amending coverage limits.
- 11.1.6 The Contractor shall keep the surety informed of the progress of the Work, changes in the Work, requests for release of retainage, request for final payment and any other information required by the surety.
- 11.2 OWNER'S INSURANCE
- 11.2.1.1 Any errors and omissions insurance maintained by the Architect or the Architect's Consultants shall not serve to exclude the Architect or Architect's Consultant from the mutual waiver of rights outlined in paragraph 11.3.7. The waiver of rights is given in exchange for property insurance covering the work.
 - 11.2.2 Change the second sentence to include after sub-subcontractors: "...and Architects and Engineers of Record".

ARTICLE 13 - MISCELLANEOUS PROVISIONS

- 13.2 SUCCESSORS AND ASSIGNS
- 13.2.1 DELETE the last two sentences of this Subparagraph.

 ADD the following as the last two sentences of the Subparagraph:

"Contractor shall not assign the Contract or any portion thereof without the written consent of Owner. Owner is entitled to assign the Contract or any portion thereof".

- 13.2.2 DELETE this Subparagraph in its entirety.
- 13.5 TESTS AND INSPECTIONS

ADD the following new Subparagraph 13.5.7:

13.5.7 Neither the observations of the Architect, its administration of the Contract Documents, nor inspections tests or approvals by persons other than the Contractor shall relieve the Contractor from its obligation to perform the Work in accordance with the Contract Documents.

ADD the following new Paragraph 13.8:

There shall be no firearms allowed on the project site or anywhere within the project property. Exceptions would be made for law enforcement officials, security forces required elsewhere by these Specifications, or per other requirements or allowances specifically made by the Owner.

ADD the following new Paragraph 13.9:

There shall be no smoking or tobacco use allowed within the buildings, on the project site or anywhere within the project property. Violators shall be removed from the project immediately.

Any construction materials in contact with or exposure to such tobacco products shall be removed and replaced with new, at the Contractor's expense.

ARTICLE 14 - TERMINATION OR SUSPENSION OF THE CONTRACT

14.1 TERMINATION BY THE CONTRACTOR

DELETE Subparagraph 14.1.1 in its entirety and replace with the following:

14.1.1 If the Work is stopped for a period of sixty (60) days under an order of any court or other public authority having jurisdiction, or as a result of any act of government such as a declaration of a national emergency making material unavailable, through no act or failure to act of the Contractor or a Subcontractor or their agents or employees or any other persons performing any of the Work under a contract with the Contractor, and the Owner has not otherwise suspended, delayed, disrupted or interrupted the Work in accordance with the Subparagraph, then the Contractor may, upon fourteen (14) days' written notice to the Owner, terminate the Contract, and recover from the Owner payment for all Work executed to date. Recovery by the

Contractor of lost anticipated profit and overhead and other consequential and incidental damages is hereby specifically excluded.

14.1.3 DELETE all words following the words "payment for" and ADD the following after "payment for":

"all work executed to date. Recovery by the Contractor of last anticipated profit and overhead and other consequential and incidental damages is hereby excluded."

ADD the following new Subparagraph 14.1.5:

- 14.1.5 "The Owner shall not be liable to the Contractor for the Owner's failure to perform its obligations set forth herein if such performance is prevented or interrupted by war (including the consequences thereof), fire, tornado, hurricane, windstorms, labor problems, fuel or transportation shortages, civil unrest, governmental action, or any other natural or economic disaster or cause which is reasonably beyond the control of the Owner ("Force Majeure"). If the estimated duration of the Force Majeure is one year or more, the Contractor shall have the option to terminate this Contract upon thirty (30) days' written notice. In the event that the estimated duration of the Force Majeure is less than one year, the Contract Time shall be increased by the same length of time as the Force Majeure persisted."
- 14.3 SUSPENSION BY THE OWNER FOR CONVENIENCE
- 14.3.1 DELETE this Subparagraph in its entirety.
- 14.3.2 DELETE this Subparagraph in its entirety.
- 14.4 TERMINATION BY THE OWNER FOR CONVENIENCE
- 14.4.3 DELETE the words "and cost incurred by reason of such termination" and REPLACE with "reimbursable costs actually incurred."

DELETE the words "reasonable overhead and profit on" in the second line and REPLACE with "and an amount representing six percent (6%) of the amount of the work not executed".

SECTION 00 7316 - INSURANCE REQUIREMENTS

1.01 PROJECT MANUAL

All requirements of the Project Manual shall apply to this Section.

1.02 MINIMUM INSURANCE COVERAGES

- A. Workmen's Compensation statutory.
 - 1. Employer's Liability \$100,000.
- B. Comprehensive General Liability (including Premises Operations, Independent Contractor's Protective, Products and Completed Operations, Broad Form Property Damage):
 - a. Bodily Injury:

\$1,000,000 - one person aggregate per project endorsement. CG2503 to be included \$2,000,000 - annual aggregate.

b. Property Damage:

\$1,000,000 - each occurrence.

\$2,000,000 - annual aggregate.

- c. Property Damage Liability Insurance shall include coverage for the following hazards: X (Explosion, C (Collapse), U (Underground).
- d. Wavier of subrogation to be included
- e. Additional insured form CG2010 to be included
- C. Contractual Liability (Hold Harmless Coverage).
 - a. Bodily Injury:

\$2,000,000 each occurrence

b. Property Damage:

\$1,000,000 each occurrence

\$2,000,000 aggregate

c. Personal Injury, with employment exclusion deleted:

\$1,000,000.

- D. Comprehensive Automobile Liability (Owned, Non-Owned, Hired):
 - a. Bodily Injury:

\$1,000,000 each person.

\$1,000,000 each accident

b. Property Damage:

\$500,000 each occurrence.

c. Owner to be named as additional insured and provided a Waiver of Subrogation.

- E. Catastrophic Umbrella Coverage, including products complete operations: \$2,000,000
- F. Prime Contractors and all subcontractor's insurance shall be primary and non-contributory on all insurance.

SECTION 01 1100 - SUMMARY OF WORK - SINGLE CONTRACT

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDED

A. Section Includes:

- 1. Work covered by the Contract Documents.
- 2. Contractor's use of premises.
- 3. Coordination of work and trades.
- 4. Owner occupancy during construction.
- 5. Partial occupancy of completed work.
- 6. Temporary exiting.
- 7. Construction scheduling and phasing.
- B. Project is being bid with construction work under one General Contract for all trades.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

- A. Provide and pay for all materials, labor, services, equipment, licenses, permits, fees, taxes, and other items necessary for the execution, installation and completion of Work indicated in Contract Documents.
- B. The Work includes coordination with Architect, Owner's Representative, Owner's separate contractors, material suppliers and vendors.

1.3 CONTRACTOR'S USE OF PREMISES

- A. Contractor shall limit his use of premises for work and storage to the designated Phase area, to allow for Owner's occupancy of areas not included in the current Phase as identified in this Section.
- B. Assume full responsibility for protection and safekeeping of products stored on premises.
 - 1. Move any stored products that interfere with operations of Owner or other Contractor.
 - 2. Obtain and pay for use of additional storage or work areas needed for operations.
 - 3. Available space for construction field offices and storage sheds is limited to the project site. Contractor must arrange for off site storage as required.
- C. Contractor shall allow for any other work outside of this contract, whether by Owner's personnel or Contractors under Owner's separate contracts, to proceed without delay or impediment.

1.4 COORDINATION

A. Schedule, manage and expedite all work under his Contract, coordinating his work with his sub-contractors, material suppliers, vendors, and trades so that no conflicts of timing or location occur.

SUMMARY OF WORK – SINGLE CONTRACT 01 1100 - 2 04/24/2025

- 1. Work shall progress according to approved progress schedule. Schedule dates for incorporation of work, and identify all critical path events and dates.
- 2. Coordinate and provide all floor, ceiling, roof, and wall sleeves.
- 3. Provide all cutting, fitting or patching required.
- B. Keep Architect informed on the progress of the work.
 - 1. Close or cover no work until duly inspected and approved.
 - 2. Uncover un-inspected work and after approval, repair and/or replace all work at no cost to Owner.
 - 3. Notify Architect at least 7 days in advance of utility connections, utility shut-offs, mechanical equipment and oil line cutovers, street or alley closings to allow ample time to receive Owner's written approval of procedure to be followed.
 - 4. Coordinate all operations with the Architect and Owner. Complete in the minimum amount of time.

C. Protection:

- 1. Do not close or obstruct streets, entrance drives, sidewalks or other facilities without permission of the Owner and local authorities.
- 2. Conduct operations with minimum interference.
- 3. Furnish, erect and maintain barricades, warning lights, signs and guards as may be required.

1.5 OWNER OCCUPANCY

- A. Owner will occupy premises during entire period of construction for the conduct of their daily activities and operations.
- B. Owner intends to vacate portions of the existing building in Phases as indicated on the Drawings. Areas of work will be vacated prior to Notice-to-Proceed, until Substantial Completion for each respective Phase. Owner will move all loose furniture and fixtures to temporary locations. Fixed furniture, shelving, equipment, and fixtures will remain in the existing building.
- C. Cooperate with Owner or his representative in all construction operations to minimize conflict and to facilitate Owner's usage of building.
- D. Conduct construction operations to assure least inconvenience to Owner and public.
- E. Provide temporary heating and ventilation, temporary dust partitions, plastic sheeting, plywood sheeting, and any other means required to protect all elements of existing building from damage or deterioration during construction.

1.6 PARTIAL OCCUPANCY

- A. Prior to occupancy, execute Certificate of Substantial Completion for designated area.
- B. Contractor provide: Access for Owner's personnel.
- C. Owner provides, upon occupancy:

- Maintenance
- 2. Operation of HVAC, electrical systems.
- 3. Security.

1.7 TEMPORARY EXITING

- A. The Contractor is responsible for maintaining existing exits and/or designating alternative exits throughout construction in accordance with the construction documents and the Fire Marshall at no increase in Contract Sum. Contractor shall participate in the Owner's fire drills and shall cease all construction activities and operations during such drills and during any fire alarm conditions that may occur.
- **B.** Coordination is required between the Contractor and the Owner to maintain temporary exiting throughout construction. All costs to accomplish these requirements shall be included in the Contractor's bid price and in no way shall any additional monies be borne by the Owner for any work associated with these efforts and requirements.

1.8 CONSTRUCTION SCHEDULING AND PHASING

- A. Owner intends to award the Contract and issue a Notice to Proceed within 30 days after bid opening.
- B. Contractor shall mobilize on site and begin work immediately thereafter.
- C. The following Phasing Outline contains a general scope of work to be completed in each phase. The scoping plan on Drawing A100 indicates proposed areas of work for each Phase. Modifications can be proposed by the Contractor to address specific concerns directly related to construction sequencing.
- D. These descriptions are not intended to be a comprehensive work list, but is shared to communicate intent. Advance notice and close coordination will be required with the Owner to ensure that areas are vacated in a timely manner to facilitate the work.

1. Phase 1:

- Owner will vacate areas indicated on the Phasing Plan for renovation. Areas include, but are not limited to a portion of the Warehouse/Vehicle Garage where work is occurring and Lineman's areas.
- Complete site demolition, re-grading, and utility work to prepare for Multi-Purpose Room addition and Building 2.
- Construct Multi-Purpose Room addition. Intent is for the Multi-Purpose Room to be available to temporarily house displaced staff during subsequent phases. However it is not intended for all work within the addition to be complete at the end of this phase.
- Begin construction of Building 2 (if Alternate 2A is accepted). Construction will continue through subsequent Phase(s).
- Owner will occupy newly renovated areas upon Substantial Completion.

SUMMARY OF WORK – SINGLE CONTRACT 01 1100 - 4 04/24/2025

2. **Phase 2**:

- Owner will relocate staff to the Multi-Purpose room addition to vacate areas indicated on the Phasing Plan for renovation. Areas include Offices, Conference Rooms, and Member Services, as well as, the Employee Lounge and adjacent restrooms.
- Continue construction of Building 2 (if Alternate 2A is accepted).
- Owner will occupy newly renovated areas upon Substantial Completion which will end Phase 2.

3. **Phase 3:**

- Owner will relocate staff to the Multi-Purpose room addition to vacate areas indicated on the Phasing Plan for renovation. Areas include Administrative Offices, Engineering, and Dispatch.
- Complete construction of Building 2 (if Alternate 2A is accepted).
- Complete Multi-Purpose Room construction.
- Owner will occupy newly renovated areas upon Substantial Completion.
- E. Contractor must achieve Substantial Completion for each Phase by the date provided on Proposal Form.
- F. Contractor must achieve Final Completion within (30) thirty days following Substantial Completion of Phase 3.

SECTION 01 1400 - GENERAL CONSTRUCTION REQUIREMENTS

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDED

A. Section Includes:

- 1. Special Provisions.
- 2. Commencement Activity.
- 3. Quality Control.
- 4. Pre-final and Final/Occupancy Inspections
- 5. Project Closeout.

1.2 SPECIAL PROVISIONS

A. Project:

1. The Project is the total construction for which the Contractor is responsible, including all labor, materials and equipment used or incorporated in such construction.

B. Work:

- 1. The Work comprises the completed construction designed under the Project and includes labor necessary to produce such construction, and materials and equipment to be incorporated in such construction.
- C. Contract Documents includes the following (See General Conditions 1.1.1 for definition):
 - 1. Project Manual. (See General Conditions 1.1.7 for definition) The Project Manual is composed of the following:
 - a. The Bidding Requirements.
 - b. The Contract Forms.
 - c. The Conditions of the Contract.
 - d. The Specifications. (See General Conditions 1.1.6 for definition)
 - 2. Drawings (See General Conditions 1.1.5 for definition)
 - 3. Addenda (See Instructions to Bidders 1.3 for definition)
 - 4. Other Documents as identified in the Contract for Construction, the General Conditions of the Contract for Construction, and Supplementary General Conditions

D. Demolition:

 All existing Improvements on the site indicated on the Drawings to be demolished, shall be removed by Contractor. Use such methods as required to complete the work in compliance with all governing authorities and utility company requirements. All existing utility connections shall be disconnected, properly capped and removed by the Contractor. Complete removal of existing foundation walls or

GENERAL CONSTRUCTION REQUIREMENTS 01 1400 - 2 04/24/2025

footings is required under new construction or other new foundations. Remove all below-grade wood and metal. Any existing basements, cisterns and/or other below grade voids shall be filled with compatible fill material suitable for proposed constructions and compacted per specific requirements. Completely remove cisterns located under new construction. All debris, rubbish, salvage and other materials shall be removed from the site. Protect all adjacent properties and structures, and existing buildings from damage.

E. Utilities:

- 1. It is the Contractor's responsibility to coordinate with the appropriate utility companies actual location of mains serving the site and route the building utility lines in the most direct route.
- 2. The location of utilities existing in the building as indicated on the Drawings may be modified by the Contractor to accommodate a more direct route to the utility connection location with written approval from Architect.

F. Permits and Fees:

- The Contractor is responsible for verifying any and all fees required from all utilities, agencies and authorities having jurisdiction. The Contractor shall obtain and pay for the Building Permit and all other permits and governmental fees, licenses and inspections required, whether specifically referenced or not.
- 2. The Contractor is to include in the bid the cost of all charges payable to State, local or special community development agencies and any additional fees as required for the completion of the project, including, but not limited to:
 - a. Water company connection fees and charges
 - Electrical company charges.
 - c. Telephone company charges.
 - d. Sanitary sewer connection fees and charges.
 - e. Gas Company charges.
 - f. Fire sprinkler connection fees and charges.
- G. Historical and Archeological Finds: All items having any apparent historical or archeological interest discovered in the course of construction must be carefully preserved. The Contractor must leave the archeological find undisturbed and immediately report it to the Architect. Work on the project may be stopped until such find is analyzed, inspected and removed by the Governing Authority.

1.3 COMMENCEMENT ACTIVITY

A. Evidence that the Contractor has started procurement of materials, preparation and submission of shop drawings, preparation of subcontracts and other preparatory work must satisfy the requirement that work began upon receipt of Notice to Proceed.

1.4 QUALITY CONTROL

A. Testing:

1. Employ the services of an independent testing laboratory to take samples, perform tests and make inspections. The costs for such laboratory and tests shall be borne by the Contractor.

- 2. Submit testing reports as per Architect.
- 3. Refer to Section 01 4500-Quality Control for additional requirements.

1.5 PRE-FINAL AND FINAL/OCCUPANCY INSPECTIONS

- A. The Contractor is to notify in writing, the Architect, that the work is complete for a Pre-Final Inspection (also referred to as "Final Punchlist Inspection". The Contractor must provide the Architect at least 10 calendar days advance notice.
- B. The Contractor is to diligently complete all punchlist items before a Final/Occupancy Inspection is scheduled.

1.6 PROJECT CLOSEOUT

A. Cleaning during construction:

- 1. The premises and the job site shall be maintained in a reasonable neat and orderly condition and kept free from accumulations of waste materials and rubbish during the entire construction period. Remove crates, cartons, and other flammable waste materials or trash from the work areas at the end of each working day. Do not allow debris to blow onto adjoining properties. Respond immediately to request from adjoining property owners to remove any debris that does manage to show up on adjoining properties.
- 2. Maintain the project in clean condition until the Owner accepts the building.
- 3. Refer to Section 01 7423 Cleaning for additional requirements.

B. Closeout Procedures:

1. Refer to Section 01 7700 - Closeout Procedures for additional requirements.

C. Closeout Submittals:

- Before the project can be closed out, the Contractor shall have provided all submittals required by the Contract Documents. All submittals required by the Contract Drawings or Specifications shall be sent to the Architect for review and coordination, in accordance with the requirements of the respective Drawing or Specification section. Any items that the Architect determines are incomplete or incorrect shall be corrected and resubmitted.
- 2. Refer to Section 01 7800 Closeout Submittals for additional requirements.
- 3. Refer to Section 01 7846 Closeout Maintenance Materials for additional requirements.

D. Retainage:

1. The Architect will assign a monetary value to all punchlist items not completed, and to all required submittals not received, as of the date of "Final Acceptance" and an amount equal to 200 percent of the total value of those items shall be retained and/or deducted from the Contractor's final payment until the Contractor demonstrates to the Architect's satisfaction that such items have been completed or corrected. Refer to the General Conditions and Supplementary General Conditions for additional information regarding retainage.

PROJECT NO. 24-179.000 Harrison REMC - Addition and Renovation Harrison REMC GENERAL CONSTRUCTION REQUIREMENTS 01 1400 - 4 04/24/2025

SECTION 01 2116 - CONTINGENCY ALLOWANCE

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDED

- A. Section Includes:
 - 1. Contingency Allowance in Contract Sum.

1.2 CONTINGENCY ALLOWANCE

- A. Allow a lump sum fee of \$ **200,000.00**.
- B. To be included in the Base Bid of Contract.
- C. Itemize Contingency Allowance on Application and Certificate for Payment and Schedule of Values.
- D. Contingency Allowance to be used for unforeseen conditions encountered during the work.
- E. Do not include any contractor's additional costs in bid.
- F. Adjustments to contingency allowance will include labor, material, transportation, overhead and profit. All costs for these items to be included in all proposals to Architect for adjustments to contract.
- G. Use Funds in Contingency Allowance only on written agreement between Owner, Architect and Contractor.
- H. All Proposals shall be authorized by the Architect prior to execution and recorded in Contractor's as-builts and Architect's project Record Documents.
- I. Adjustment to Allowances will be made by Change Order. Any unused amounts to be credited back to the Owner.

SECTION 01 2300 - ALTERNATES

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDED

- A. Section Includes:
 - 1. Procedures for exercising alternates.
 - 2. Identification and description of alternates.
- B. All items, either indicated on the Drawings or specified in the Project Manual, not specifically indicated to be included in a specific alternate is to be included within the base bid scope of work.

1.2 RELATED REQUIREMENTS SPECIFIED ELSEWHERE

- A. Bidding Requirements: Quotation of cost for each alternate as listed on Proposal Form.
- B. Owner-Contractor Agreement: Alternates accepted by Owner for incorporation into the work.
- C. Sections of Specifications identified by work of each alternate.

1.3 PROCEDURES

- A. Alternates will be exercised at the option of Owner.
- B. Coordinate related work and modify surrounding work as required to complete the Work, including changes under each Alternate, when acceptance as designated in Owner-Contractor Agreement.
- C. All Alternates shall be bid. Base Bid to be all work as shown on the Drawings and Specifications, except Alternates.
- D. Owner reserves the right to accept or reject any and all Alternates as determined solely at the discretion of the Owner. Alternates may be accepted or rejected independently from one another, and in any order of priority or hierarchy as determined by the Owner.

1.4 SCHEDULE OF ALTERNATES

A. ALTERNATE NO. 1: FIRE PUMP

- 1. Give the amount to be **ADDED** to the Base Bid for the following:
 - a. Provide and install the fire pump and all associated piping and electrical work for a fully functional pump for the fire suppression system.
 - b. Construct one-hour rated enclosure for fire pump room as indicated on the Contract Documents. This includes, but is not limited to: sawcut new opening in existing exterior wall

with new door and frame, new metal stud and gypsum board walls and ceiling, concrete stair inside room to transition to exterior grade.

2. Base Bid to include:

- a. A Complete fire suppression system for the building as indicated on the Contract Documents without a fire pump.
- b. The waterline extension along Old Forest Road with a new fire hydrant.
- c. Conduct a flow test at new hydrant to confirm the fire pump is required for this building.

B. ALTERNATE NO. 2A: BUILDING 2

- 1. Give the amount to be ADDED to the Base Bid for the following:
 - a. Construct pre-engineered metal building in its entirety, as indicated on the Contract Documents. This includes, but is not limited to: the pre-engineered metal building package, concrete foundations & slab, electrical, and plumbing work located in the building.
- 2. Base Bid to include:
 - a. Rough grading for building pad.
 - b. Underground piping for sanitary and domestic water stubbed up to building.
 - c. Underground conduit for power and low voltage systems stubbed up to building.

C. ALTERNATE NO. 2B: BUILDING 2 LINER PANEL

- 1. Give the amount to be ADDED to the Base Bid for the following:
 - Install 26 gauge metal liner panels to interior face of metal building wall girts at all exterior walls from top of CMU to bottom of roof purlins.
- Base Bid to include:
 - a. No metal liner panels in Building 2.

D. ALTERNATE NO. 3A: FRONT LANDSCAPING

- 1. Give the amount to be ADDED to the Base Bid for the following:
 - a. Provide and install all new landscaping at northwest (front) area of the building as indicated on Drawing L100.
- 2. Base Bid to include:
 - a. No new landscaping.
 - b. Contractor to remove existing landscaping as indicated on Civil Drawings to coordinate with new scope of work.
 - c. All seed and sod throughout the project.

E. ALTERNATE NO. 3B: REAR LANDSCAPING

- 1. Give the amount to be ADDED to the Base Bid for the following:
 - a. Provide and install all new landscaping at southeast (rear) area of the building as indicated on Drawing L100.
- 2. Base Bid to include:

PROJECT NO. 24-179.000 Harrison REMC - Addition and Renovation Harrison REMC

ALTERNATES 01 2300 - 3 04/24/2025

- a. No new landscaping.
- b. Contractor to remove existing landscaping as indicated on Civil Drawings to coordinate with new scope of work.
- c. All seed and sod throughout the project.

SECTION 01 2973 - SCHEDULE OF VALUES

1.1 REQUIREMENTS INCLUDES

- A. Section Includes:
 - 1. General Requirements.
 - 2. Format and Content.

1.2 GENERAL REQUIREMENTS

- A. Submit to the Architect/Engineer a Schedule of Values allocated to the various portions of the Work.
- B. Upon request of the Architect/Engineer, support the values with data which will substantiate their correctness.
- C. The Schedule of Values, unless objected to by the Architect/Engineer, shall be used as the basis for the Contractor's Application and Certificate for Payment.

1.3 FORMAT AND CONTENT

- A. Type schedule on AIA Document G703, Continuation Sheet for Application and Certificate for Payment. Identify schedule with:
 - 1. Title of Project as listed on cover of Project Manual
 - 2. Architect project number.
 - 3. Name and Address of Contractor.
 - Contract Designation.
 - 5. Date of submission.
- B. Schedule shall list the installed value of the component parts of the Work in sufficient detail, as determined by the Architect, to serve as a basis for computing values for progress payments during construction.
 - 1. Follow the table of contents of this Project manual as the format for listing component items.
 - 2. Identify each line item with the number and title of the respective major section of the specifications.
 - 3. Identify separate line items for all items for materials and labor.
 - 4. Identify further breakdown for any and all items as determined by the Architect.
- C. For Mechanical and Electrical Scope of Work, major products or operations are to be listed.
- D. For the various portions of the work:
 - 1. Each item shall include a directly proportional amount of the contractor overhead and profit.
 - 2. For items on which progress payments will be requested for stored materials, break down the value into:
 - a. The cost of the materials, delivered and unloaded, with taxes paid.
 - b. The total installed value.

PROJECT NO. 24-179.000 Harrison REMC - Addition and Renovation Harrison REMC SCHEDULE OF VALUES 01 2973 - 2 04/24/2025

E. The sum of all values listed in the schedule shall equal the total Contract Sum.

SECTION 01 3100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDED

A. Section Includes:

- 1. Administrative and supervisory personnel.
- Submittals.
- 3. Contractor quality control.
- 4. Coordination Drawings.
- 5. Project coordination.
- B. Procedures for preparation, updating and submittal of Construction Progress Documentation.

1.2 ADMINISTRATIVE AND SUPERVISORY PERSONNEL

A. Project Coordination Administrator: Contractor Representative experienced in administration, supervision, and quality control of building expansion and alteration construction, similar to Work of this Project, including mechanical and electrical work.

B. Project Field Superintendent:

- 1. Contractor Representative experienced in general field supervision of building construction, similar to Work of this Project, including mechanical and electrical work, to supervise, direct, inspect and coordinate Work of Contractor, subcontractors, suppliers and installers, and expedite Work to assure compliance with Construction Schedules.
- 2. Superintendent must read, write, and speak English fluently.
- 3. Superintendent must be present at the Project site whenever work is being performed. Superintendent must remain on the Project from Notice to Proceed to Substantial Completion. Do not change personnel without written permission from the Owner.

1.3 SUBMITTALS

- A. Submit list of Contractor's principal staff assignments, including Project Coordination Administrator, Project Field Superintendent, Quality Control Representative, and other personnel in attendance at site; identify their duties and responsibilities.
- B. Submit all items for execution of Contract as listed in Section 00 4393 Contractor's Bid Submittal checklist.
- C. Submit shop drawings, product data, and other required submittals, in accordance with Section 01 3300 Submittal Procedures, for review and compliance with Contract Documents, for field dimensions and clearances, for relation to available space, and for relation to Work by Owner or separate Contracts.

PROJECT MANAGEMENT AND COORDINATION 01 3100 - 2 04/24/2025

D. Submit Requests for Information and interpretation of Contract Documents in a timely manner and obtain replies from Architect in accordance with the Contract.

1.4 CONTRACTOR QUALITY CONTROL

- A. Perform project quality control in accordance with requirements in the Contract.
- B. Coordinate scheduling of inspection and testing required by individual specification Sections and in accordance with Section 01 4500 Quality Control.

1.5 COORDINATION DRAWINGS

A. Prepare and distribute coordination drawings where close coordination is required for installation of Products and materials fabricated off-site by separate entities, and where limited space availability requires maximum utilization of space for efficient installation of different components. Show interrelationship of components shown on separate shop drawings. Indicate required installation sequences.

1.6 PROJECT COORDINATION

- A. Coordinate construction activities and work of all trades under various Sections of these Specifications and Work of Contract to facilitate orderly installation of each part of Work. Coordinate construction operations included under different Sections of Specifications and Contract that are dependent upon each other for proper installation, connection, and operation.
- B. Where installation of one part of Work is dependent on installation of other components, either before or after that part of Work, schedule construction activities in sequence required to obtain uninterrupted installation.
- C. Obtain drawings, manufacturer's product data, instructions, and other data to provide a complete and proper installation.
 - 1. Check field dimensions prior to installing products. Verify necessary clearances and means of access from equipment storage to final position.
 - 2. Make data and information available to trades involved.
- D. Ensure that utility requirements of operating equipment are compatible with building utilities. Coordinate Work of various specification Sections for installation and final connection of equipment.
 - 1. Assure that mechanical, plumbing, and electrical rough-ins have been properly located.
- E. Coordinate space requirements and installation of mechanical, plumbing, and electrical Work which are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, conduits, and wiring, as closely as possible; make runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- F. Where availability of space is limited, coordinate installation of different components to ensure maximum accessibility for required maintenance, service, and repair.

- G. Provide for installation of items scheduled for future installation.
- H. Where necessary, prepare memoranda for distribution to each party involved outlining special procedures required for coordination. Prepare memoranda for Architect and separate contractors where coordination of their work is required.
- I. In finished areas, conceal pipes, ducts, conduits, and wiring in the construction. Coordinate locations of fixtures and outlets with finish elements.
- J. Coordinate completion and clean up of Work of separate Sections in preparation for completion of work per the Contract.
- K. After Owner occupancy of Project, coordinate access to site for correction of defective Work and Work not in accordance with Contract Documents, to minimize to Owner.

SECTION 01 31 19 - PROJECT MEETINGS

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDED

A. Section Includes:

- 1. Contractor participation in pre-bid conference, pre-construction conferences, progress meetings, and pre-installation meetings.
- 2. Architect shall schedule and chair Project Meetings and prepare summary minutes for distribution by Contractor to all in attendance.

1.2 PRE-BID CONFERENCE

- A. Architect will administer pre-bid conference to provide further understanding of Scope of Work.
- B. Attendance:
 - 1. Architect.
 - 2. All prospective bidding Contractors, Subcontractors, Suppliers and Vendors.
 - 3. Attendance is mandatory for all General Contractors providing a proposal.

C. Agenda:

- Review Notice-to-Bidders.
- 2. Review Bid Requirements and Contractor's Bid Submittal Checklist.
- 3. Review Summary of Work.
- 4. Review Construction Document set.
- 5. Review Project Site (if necessary).
- 6. Questions and Answers.
- D. Notice To Bidders contains time and place of Pre-Bid Conference.

1.3 PRE-CONSTRUCTION CONFERENCES

- A. Architect will administer pre-construction conference.
- B. Attendance:
 - Architect.
 - 2. Owner's Representative.
 - 3. Contractor's Project Manager.
 - 4. Contractor's Job Superintendent.

C. Agenda:

- 1. Execution of Owner-Contractor Agreement.
- 2. Exchange of preliminary submittals.
- 3. Submission of executed bonds and insurance certificates.
- 4. Submission of Schedule of Values. (If not required before hand).
- 5. Designation of personnel representing the parties in Contract.
- 6. Procedures and processing of Requests for Information, field decisions, submittals, substitutions, Applications for Payment, proposal requests. Change Orders, and contract closeout procedures.
- 7. Scheduling.
- 8. Construction facilities and temporary controls.
- 9. Notice to Proceed.
- D. Architect will record minutes and distribute copies to Contractor and Owner and those affected by decisions made. Contractor is responsible for distribution of copies to Subcontractors, Suppliers and Vendors.
- E. Architect will administer mobilization conference at Project site for clarification of Contractor responsibilities in use of site and for review of administrative procedures.

1.4 PROGRESS MEETINGS

A. Architect shall schedule and administer Project Meetings throughout progress of the Work not less frequently than every month. Additional Project Meetings shall be scheduled as appropriate to construction activity.

B. Attendance:

- Architect.
- 2. Owner's Representative.
- 3. Contractor's Project Manager.
- 4. Contractor's Job Superintendent.
- 5. Major Subcontractors and Suppliers.
- 6. Contractor's Quality Control Representative.
- 7. Others as appropriate to agenda topics.

C. Agenda:

- 1. Review of and corrections to minutes of previous meetings.
- 2. Review of Work progress and/or payment progress.
- 3. Field observations, problems, and decisions.
- 4. Identification of problems which impede planned progress.
- 5. Review of submittals schedule and status of submittals.
- 6. Review of off-site fabrication and delivery schedules.
- 7. Maintenance of progress schedule.
- 8. Corrective measures to regain projected schedules.
- 9. Planned progress during succeeding work period.
- 10. Coordination of projected progress.
- 11. Maintenance of quality and work standards.
- 12. Effect of proposed changes on progress schedule and coordination.

- 13. Status of pending changes and substitutions.
- 14. Other business relating to Work.
- 15. Review of Construction Progress Documentation.
- D. Architect will record minutes and distribute copies to Owner and Contractor. Contractor shall distribute copies to all others.
- E. Contractor shall hold separate meetings with workers, sub-contractors and suppliers to coordinate means and methods of construction, and jobsite safety. Do not use Owner/Architect Progress Meetings for such purpose.

1.5 PRE-INSTALLATION MEETINGS

- A. When required in individual specification sections or as determined necessary by Architect, convene a pre-installation meeting at work site prior to commencing work of the section.
- B. Require attendance of parties directly affecting, or affected by, work of the specific section.
- C. Notify Architect seven days in advance of meeting date.
- D. Prepare agenda and preside at meeting:
 - 1. Review conditions of installation, preparation and installation procedures.
 - 2. Review coordination with related work.
 - 3. Agenda items listed in individual specification Sections.
 - 4. Installation schedule.
- E. Architect will record minutes and distribute copies to participants, and those affected by decisions made.

SECTION 01 3200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDED

A. Section Includes:

- 1. Construction Progress Schedule.
- 2. Contractor as-built drawings.
- 3. Provisions for format, content, revisions, submittals and distribution.

1.2 CONSTRUCTION PROGRESS SCHEDULE

A. Format:

- 1. Prepare Schedules as horizontal bar chart with separate bar for each major portion of Work or operation, identifying first work day of each week.
- 2. Sequence of Listings: The Table of Contents of this Project Manual.
- 3. Form: Contractor's option.

B. Content:

- 1. Show complete sequence of construction by activity, with dates for beginning and completion of each element of construction.
- 2. Identify each item by major Specification section number.
- 3. Provide sub-schedules to define critical portions of entire Schedule.
- Show accumulated percentage of completion of each item, and total percentage of Work completed, to correspond with Application for Payment. Percentage of completion shall not include stored materials.
- 5. Provide separate schedule of submittal dates for shop drawings, product data, and samples and dates reviewed submittals will be required from Architect. Show dates for selection of finishes.
- 6. Show delivery dates for Owner furnished items, if any.
- 7. Coordinate content with Section 01 2973 Schedule of Values.

C. Revisions:

- 1. Indicate progress of each activity to date of submittal, and projected completion date of each activity.
- 2. Identify activities modified since previous submittal, major changes in scope and other identifiable changes.
- 3. Provide narrative report to define problem areas, anticipated delays and impact on Schedule. Report corrective action taken or proposed and its effect.

D. Submittals:

1. Submit initial Schedules immediately following Award of Contract. After review, revise data and immediately submit for re-review.

CONSTRUCTION PROGRESS DOCUMENTATION 01 3200 - 2 04/24/2025

- 2. Submit up-dated Progress Schedules with each Application and Certificate for Payment.
- 3. An updated Progress Schedule is required for review/consideration for Application and Certificate for Payment.
- 4. Submit under transmittal letter.

E. Distribution:

- 1. Distribute copies of reviewed schedules to Architect job site file, subcontractors, suppliers and other concerned entities including separate contractors.
- 2. Instruct recipients to promptly report, in writing, problems anticipated by projections shown in Schedules.

1.3 CONTRACTOR AS-BUILT DRAWINGS

A. Format:

- 1. Contractor's job superintendent to record as-built conditions onto a single set of project drawings for all trades included in scope of work.
- 2. As-built set to be kept on site at all times.
- 3. Documentation may be hand written in ink or pasted directly onto drawings. All information must be considered to be permanently affixed.

B. Content:

- 1. Include work of all trades included in scope of work.
- 2. Include all changes, errors, deviations, omissions, additions, clarifications and corrections.
- 3. Include any item installed in a location other than that shown on contract drawings.
- 4. Correct any inaccurate or altered dimension.

C. Revisions:

- 1. As-built drawings shall be updated daily with all work completed.
- 2. Contractor job superintendent to be responsible for subcontractor information on as-built drawings.

D. Submittals:

 As-built drawings may be reviewed at progress meetings or periodically as requested by Architect to review entries to date.

E. Distribution:

- 1. As built drawings shall be given to Architect prior to release of final payment.
- 2. Refer to Section 01 7800 Closeout Submittals.

SECTION 01 3300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDED

A. Section Includes:

- 1. Submittal Schedule.
- 2. Submittal Requirements.
- 3. Shop Drawings.
- 4. Electronic files provided by the Architect.
- 5. Product Data.
- 6. Samples.
- 7. Manufacturer's Information.
- 8. Review by Contractor and Architect.
- 9. Re-submittals.
- 10. Distribution.

1.2 SUBMITTAL SCHEDULE

- A. Submit to the Architect a schedule listing all submittals required for review as required in the individual specifications sections.
- B. List submittals by specification section as listed in the index.

1.3 SUBMITTAL REQUIREMENTS

A. Formats:

- 1. Submit all drawings and technical data electronically in PDF format.
 - a. Furnish all submittals specified in all sections of the specifications.
 - b. Submit each section under a separate transmittal for clarity and ease of review.
 - c. Make a complete submittal for each section; do not issue multiple submittals per section.
 - d. Compile all sheets, drawings, and product data into a single electronic file for review. Do not submit multiple PDF files per sheet or item.
 - e. Identify manufacturer and subcontractor/supplier.
 - f. Submit Material and Safety Data Sheets for all products and materials.
 - g. Name each PDF file to match specifications title and number, matching that as listed in the project manual.
- 2. Submit to Architect via Architect's project management website specific to this project.
- 3. Submit actual samples for finishes, colors, and textures for approval via mail or hand delivery.
- B. Transmit submittals in accordance with approved Progress Schedule and in such sequence to avoid delay in the Work or work of other contracts.

- C. Apply Contractor's stamp, signed or initialed, certifying to review, verification of products, field dimensions and field construction criteria and coordination of information with requirements of Work and Contract Documents.
- D. Coordinate submittals into logical groupings to facilitate interrelation of the several items:
 - 1. Finishes which involve Architect selections of colors, textures, or patterns.
 - 2. Associated items which require correlation for efficient function or for installation.

1.4 SHOP DRAWINGS

- A. Present in a clear thorough manner, drawn by professional draftsman.
- B. Identify project with title as shown on cover of Project Manual; identify each element of drawings by reference to sheet number and detail, schedule, or room number on Contract Documents.
- C. Identify field dimensions; show relation to adjacent or critical features of Work or products.
- D. Sheet Size:

Minimum: 8-1/2 x 11 inches.
 Maximum: 30 x 42 inches.

1.5 ELECTRONIC FILES PROVIDED BY THE ARCHITECT

- A. Architect may make available, at no cost, base xref drawings in AutoCAD format for contractor's use in preparing shop drawings.
- B. AutoCAD version of electronic files will be the latest version being utilized in the Architect's office. The Architect has no obligation to provide electronic files in a format that may be an old, outdated, reduced or simplified version of that being utilized in the Architect's office.
- C. Electronic files are an instrument of the Architect's service, and are the property of the Architect.
- D. The use of the information contained in the electronic files is at the sole risk of the user.
- E. The use of the electronic files does not relinquish the contractor from responsibilities for site and field verification of spaces, construction, conditions, requirements, dimensions, etc.

1.6 PRODUCT DATA

A. Submit only pages which are pertinent; mark each copy of standard printed data to identify pertinent products, referenced to Specification Section and Article number. Show reference standards, performance characteristics, and capacities; wiring and piping diagrams and controls; component parts; finishes; dimensions; and required clearances.

- B. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the Work. Delete information not applicable.
- C. Provide manufacturer's published catalog pages and industry cutsheets, with all items and options marked as appropriate to the project.

1.7 SAMPLES

- A. When finishes are specified on the Drawings, submit samples of the specified finish for approval.
- B. When finishes are not specified on the Drawings, submit full range of manufacturer's standard finishes, except when more restrictive requirements or price groups are specified, indicating colors, textures, and patterns, for Architect's selection.
- C. Submit physical samples to illustrate functional characteristics of products, including parts and attachments.
- D. Label each sample with identification required for transmittal letter.
- E. Submit number of samples specified in individual specifications sections but not less than three (3).
- F. Special circumstances may require additional samples for determination of acceptance, such as textures, patterns, colorways, etc. Provide sample in the quantity and/or size as required for this determination. Requirements to be determined solely by the Architect. All such samples will be returned to the Contractor, less those retained for Owner and Architect files.
- G. Samples for selection of finishes need to be submitted as actual samples of the actual colors, materials and textures for proper selection and review of available choices. Samples for finishes already selected as indicated in the Drawings may be color charts in lieu of actual samples, if acceptable to the Architect.
- H. All samples may be retained for Owner and Architect files.
- I. See individual Specification sections for additional information and requirements.

1.8 MANUFACTURER'S INFORMATION

- A. Manufacturer's instructions for storage, protection, preparation, assembly, installation, adjusting, balancing and finishing.
- B. Installation details, anchoring requirements or other information specifically required by manufacturer.
- C. Specific information or details required by Manufacturer to uphold warranty of product specified.

1.9 CONTRACTOR'S REVIEW

A. Review submittals prior to transmittal; verify subcontractor's field measurements, field construction criteria, manufacturer's catalog numbers, and conformance of submittal with requirements of Contract Documents.

PROJECT NO. 24-179.000 Harrison REMC - Addition and Renovation Harrison REMC

C.

SUBMITTAL PROCEDURES 01 3300 - 4 04/24/2025

B. Coordinate submittals with requirements of Work and of Contract Documents.

Affix a stamp and sign each drawing, manufacturer's data, sample, etc. as follows:	
	This submittal has been reviewed by (Name of
	Contractor) and approved with respect to the means, methods, techniques, sequences, and
	procedures of construction, and safety precautions and programs incidental thereto. (<i>Name of</i>
	Contractor) also warrants that this submittal
	complies with contract documents and comprises no variations or increase in contract price thereto.
	Bv:-

D.	Notify Architect in writing at time of submittal, of any deviations from requirements of Contract Documents
	Architect will neither accept incomplete submittals, nor those which in the Architect's opinion, have not beer
	properly reviewed by the Contractor.

Date:

- E. Do not fabricate products or begin work which requires submittals until return of submittal with Architect acceptance.
- F. Submittals which have not been thoroughly reviewed by Contractor prior to being forwarded to Architect will be rejected and returned for review.

1.10 ARCHITECT'S REVIEW

- A. Architect will review shop drawings, product data, and samples and return submittals within a reasonable time frame for complete review and approval.
- B. Architect's review is for conformance with information given and design concept expressed in the Contract Documents. The review shall not constitute approval of safety precautions, or of any construction means, methods, techniques, sequences or procedures. The Architect's approval of a specific item shall not indicate approval of an assembly of which the item is a component.
- C. Review of shop drawings does not authorize changes to the contract sum unless stated in a separate letter or change order.

1.11 RE-SUBMITTALS

A. Make re-submittals under procedures specified for initial submittals; identify changes made since previous submittals.

PROJECT NO. 24-179.000 Harrison REMC - Addition and Renovation Harrison REMC SUBMITTAL PROCEDURES 01 3300 - 5 04/24/2025

1.12 DISTRIBUTION

A. Duplicate and distribute reproductions of shop drawings, copies of product data, and samples, which bear Architect's stamp of approval, to job site file, Contractor's Record Documents file, sub-contractors, suppliers and other entities requiring information.

SECTION 01 4120- STRUCTURAL INSPECTION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Structural Inspections are additional to testing and inspection requirements which may be shown elsewhere in the specifications and on the drawings.
- B. The Inspection Agency shall conduct inspections under the supervision of a qualified professional engineer licensed in the State of Indiana (Inspector).
- C. The Inspection Agency shall be subject to approval by the Structural Engineer of Record.
- D. The Inspection Agency shall be retained by the General Contractor. Costs for reinspection and retesting, should discrepancies be found, shall be provided at no extra cost to Owner.

1.3 QUALITY ASSURANCE

- A. Certification Authorities: Certification Authorities providing certification which may be applicable to Project include:
 - 1. American Concrete Institute (ACI).
 - 2. American Welding Society (AWS).
 - 3. National Institute of Certified Engineering Technology (NICET).
- B. Inspection Agency Qualifications: To qualify for acceptance, an independent testing agency must demonstrate to Structural Engineer of Record's satisfaction, based on evaluation of agency-submitted criteria conforming to ASTM E 699, that it has the experience and capability to satisfactorily conduct the testing indicated without delaying the Work.
 - 1. Each inspector performing work on the Project shall be qualified to perform inspections for the particular type of construction or operation requiring inspection. Certification Authorities providing certification applicable to Project include, but are not limited to, the following:
 - a. Steel Construction
 - Material verifications, bolted connections, visual observation of welds AWS Level 1 / AWS Certified Weld Inspector (CWI).
 - 2) Ultrasonic, Radiographic, and Liquid Penetrant and Magnetic Particle weld inspection AWS Ultrasonic Testing Level 1.

b. Concrete Construction

- 1) Use of design mix ACI Level 2, NICET Level 1, or ICC Reinforced Concrete Special Inspector (RCSI).
- 2) Material verifications, sampling of fresh concrete ACI Level 2, NICET Level 1 (concrete), or ICC Reinforced Concrete Special Inspector (RCSI).

- 3) Reinforcing inspection NICET Level 2 (concrete) or ICC Reinforced Concrete Special Inspector (RCSI).
- c. Soils Bearing Materials
 - 1) NICET Level 2 (soils).
- 2. Available Inspection Agency: Subject to compliance with requirements, Inspection Agencies that may perform Inspection Work include, but are not limited to, the following:
 - a. CSI of Kentucky, 858 Contract Street, Lexington, KY 40505 (859) 309-6021
- 3. For Inspection Agencies not listed herein, submit qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified. Engineer reserves the right to accept or reject Inspection Agency candidates based on the past experience, knowledge, and capacity of the proposed candidate. Inspection Agency shall be approved by Engineer prior to hiring by General Contractor.
- C. Inspector Qualifications: A professional engineer who is legally authorized to practice in the State of Indiana and who is experienced in providing testing and inspection services of structure system types similar to this Project in material, design, and extent.

PART 2 - EXECUTION

2.1 INSPECTION OF STEEL CONSTRUCTION

- A. Verify that certification numbers on bolt, nut, and washer containers correspond to the identification numbers on mill test reports and that manufacturer's symbol and grade markings appear on all bolts and nuts. Also verify that bolts, nuts, and washers are being properly cared for at the site.
- B. Verify that identification markings on weld filler materials conform to ASTM standards specified on the approved construction documents. Also verify that weld filler material is being properly cared for.
- C. Test and inspect high-strength bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A325 or A490 Bolts."
 - 1. Verify that direct-tension indicator gaps comply with ASTM F 959, Table 2.
 - 2. Verify that twist-off-type tension-control assemblies have been properly tightened.
- D. Inspect and test welds during fabrication (where applicable) and erection of structural steel as follows:
 - 1. Certify welders and conduct inspections and tests as required. Record types and locations of defects found in work. Record work required and performed to correct deficiencies.
 - 2. Use non-destructive testing according to AWS D1.1-2000, Section 6.11, on all welds that appear to have excessive inclusions, porosites, cracks, and incomplete penetrations as described by AWS D1.1-2000, or have the questionable weld removed and rewelded.
 - 3. Perform non-destructive testing according to AWS D1.1-2000, Section 6.11, on 25 percent of field welded complete penetration and/or partial penetration groove welds and on all splices of main members where those splices are required. When rejection rate exceeds 5 percent, increase frequency of testing from 25 percent to 100 percent until rejection rate is 5 percent or less for a minimum of 20 welds.

- 4. Perform periodic inspection according to AWS D1.1-2000, Section 6.9 (visual inspection) on all field welds and on all floor, form, and roof deck welds.
- E. Inspect all mechanical fastening of floor, form, and roof deck. Verify fastener type and perimeter and intermediate fastener spacing.
- F. In addition to visual inspection, inspect and test field welded shear connectors according to requirements of AWS D1.1-2000, Section 7.8, and as follows:
 - 1. Verify number, location, and application of all weld shear connectors.
 - 2. Perform bend tests on a minimum of 10 percent of all shear connectors and when visual inspections reveal either less than a continuous 360-degree flash or welding repairs to any shear connector.
 - 3. Conduct tests on additional shear connectors when weld fracture occurs on shear connectors already tested, according to requirements of AWS D1.1-2000.

2.2 INSPECTION OF COLD-FORMED STEEL CONSTRUCTION

- A. Verify use of proper metal gauge and yield strength of cold-formed metal products. Verify proper screw size and penetration.
- B. Perform inspection of light-gauge, cold-formed metal construction to verify installation of blocking, fasteners, and fastening with the contract document provisions.
- C. Perform inspection of shear wall, sheet diaphragms, and strap bracing.
 - 1. Verify grade and thickness of shear panels.
 - 2. Verify the size and quantity of framing members at panel edges.
 - 3. Verify screw diameter, length, and spacing.
 - 4. Verify installation of shear wall hold-down anchors.
- D. Verify the installation of all permanent bracing of light-gauge, cold-formed metal truss assemblies in accordance with the approved truss shop drawings and structural drawings.
 - 1. Verify placement of all compression web member bracing, laps, fastening, and intermittent cross bracing.
 - 2. Verify placement of all chord bracing, laps, fastening, and intermittent cross bracing.
 - 3. Verify placement of all chord bracing, laps, fastening, and intermittent cross bracing.
 - 4. Verify placement of all chord bracing, laps, fastening, and intermittent cross bracing.

2.3 INSPECTION OF CONCRETE CONSTRUCTION

- A. Periodically verify the use of the proper design mix.
- B. Verify use of proper grade and ASTM designation of reinforcing steel, including prestressing tendons.
- C. Perform periodic inspection on placement, spacing, clear cover, number, and splice lap lengths of reinforcing steel, including prestressing tendons.
- D. Monitor concrete quality by means of site and laboratory tests. The Inspection Agency is authorized to reject plastic concrete not conforming to specifications. Immediately inform the Contractor, the Architect and the Structural Engineer of inadequacies in concrete quality. Sampling and testing for quality control during concrete placement shall include the following:

- 1. Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
 - a. 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.
 - b. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 - c. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture..
 - d. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each set of composite sample.
 - e. Compression Test Specimen: ASTM C 31; one set of four standard 6" diameter by 12" or five standard 4" diameter by 8"cylinders for each compressive-strength test, unless otherwise directed. Mold and store cylinders for laboratory-cured test specimens except when field-cured test specimens are required.
 - f. Compressive-Strength Tests: ASTM C 39; test one specimen at 7 days, two 6"x12" or three 4"x8" specimens tested at 28 days, and one specimen retained in reserve for later testing if required. Additional cylinder tests (such as at 14 days) for contractor convenience and scheduling shall be paid for by the Contractor. A compressive-strength test shall be the average compressive strength from a set of specified number specimens obtained from same composite sample and tested at age indicated.
 - g. When frequency of testing will provide fewer than five strength tests for a given class of concrete, conduct testing from at least five randomly selected batches or from each batch if fewer than five are used.
 - h. 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 the in-place concrete.
 - i. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
- 2. Test results shall be reported in writing to Architect, Structural Engineer, ready-mix producer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain the Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted but shall not be used as the sole basis for acceptance or rejection.
- F. Additional Tests: The testing agency will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by Architect. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed.

2.4 INSPECTION OF MASONRY CONSTRUCTION

A. At onset of masonry construction and periodically thereafter, verify proportions of site-prepared mortar, construction of mortar joints, and location of reinforcement and connectors.

- B. Perform periodic inspection to verify size, grade, and type of reinforcement.
- C. Perform periodic inspection to verify cleanliness of grout space, placement of all reinforcement and connectors, including lap splice lengths, and proportions of site-prepared grout.
- D. Perform periodic inspection of grout placement to verify compliance with contract document provisions.
- E. Sample and test grout compressive strength according to ASTM C 1019 and the following:
 - 1. Compression Test Sample: one set of three standard cube specimens for each compressivestrength test, unless otherwise directed. Mold and store cubes for laboratory-cured test specimens except when field-cured test specimens are required.
 - 2. Compressive-Strength Tests: one sample for each day's grouting; one specimen tested at 7 days, one specimen tested at 28 days, and one specimen retained in reserve for later testing if required.

2.5 INSPECTION OF SOILS

- A. Inspect the existing site soil conditions, fill placement, and load-bearing requirements for compliance with the recommendations of the approved geotechnical investigation report.
- B. During placement and compaction of the engineered fill material, verify that the material being used, maximum lift thickness, and in-place dry density comply with the recommendations of the approved geotechnical report.
 - 1. Testing agency to inspect and test subgrades and each fill or backfill layer.
- C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.
- D. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 6938, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:
 - 1. Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least 1 test for every 2000 sq. ft. or less of building slab, but in no case fewer than 3 tests.
 - 2. Foundation Wall Backfill: At each compacted backfill layer, at least 1 test for each 100 feetor less of wall length, but no fewer than 2 tests.

2.6 REPORT REQUIREMENTS

- A. Inspector shall keep records of all inspections.
- B. The Inspector shall furnish inspection reports to the Architect, Structural Engineer, and General Contractor weekly as construction progresses.
- C. Inform General Contractor and / or Fabricator of all discrepancies immediately for correction.
 - 1. Document in writing correction of discrepancies.
 - 2. If discrepancies are not corrected, the discrepancies shall be brought to the attention of the Code Official and the Structural Engineer prior to the completion of that phase of the work.

PROJECT NO. 24-179.000 Harrison REMC - Addition and Renovation Harrison REMC

STRUCTURAL INSPECTION 01 4120 - 6 04/24/2025

D. Submit a final report of inspections documenting completion of all required Structural Inspections and correction of any discrepancies noted in inspections to the Structural Engineer. Final report shall be prepared by, sealed, and signed by the Inspector and shall include a complete list of materials and work inspected during the course of the project.

SECTION 01 4200 - REFERENCES

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDED

A. Section Includes:

- 1. Specification format and content.
- 2. Quality assurance.
- Reference standards.
- Abbreviations.

1.2 SPECIFICATION FORMAT AND CONTENT

- A. Specification Format: Specifications are organized into Divisions and Sections based on Construction Specifications Institute (CSI) Division format and Master Format numbering system.
- B. Specification Content: This Specification uses certain conventions in use of language and intended meaning of certain terms, words, and phrases when used in particular situations or circumstances. These conventions are explained as follows:
 - Abbreviated Language: Language used in Specifications and other Contract Documents is abbreviated type. Words and meanings shall be interpreted as appropriate. Words that are implied, but not stated shall be interpolated as the sense required. Singular words will be interpreted as plural and plural words interpreted as singular where applicable and context of Contract Documents so indicates.
 - Imperative and streamlined language is used generally in Specifications. Requirements expressed
 in imperative mood are to be performed by Contractor. At certain locations in text, for clarity,
 subjective language is used to describe responsibilities that must be fulfilled indirectly by Contractor,
 or by others when so noted.
 - 3. The words "shall be" shall be included by inference wherever a colon (:) is used within a sentence or phrase.

1.3 QUALITY ASSURANCE

- A. For Products or workmanship specified by association, trade, or other consensus standards, comply with requirements of standard, except when more rigid requirements are specified or are required by applicable codes. Such standards are made a part of Contract Documents by reference.
- B. Conform to reference standard by date of issue current on original date of issue indicated on Contract Documents.
- C. Obtain copies of standards when required by Contract Documents.

- D. Maintain copy at Project Site during submittals, planning, and progress of specific Work, until Substantial Completion.
- E. Should specified reference standards conflict with Contract Documents, request clarification from the Architect before proceeding.
- F. The contractual relationship, duties, and responsibilities of the parties in Contract nor those of Architect shall not be altered from Contract Documents by mention or inference otherwise in any reference document.

1.4 REFERENCE STANDARDS

- A. Conflicting Requirements: Where compliance with two or more standards is specified, and the standards may establish different or conflicting requirements for minimum quantities or quality levels. Refer requirements that are different, but apparently equal, and uncertainties to Architect for decision before proceeding.
 - Minimum Quantity or Quality Levels: Quantity or quality level shown or specified shall be the
 minimum provided or performed. Actual installation may comply exactly with minimum quantity or
 quality specified, or it may exceed minimum within reasonable limits. In complying with these
 requirements, indicated numeric values are minimum or maximum, as appropriate for context of
 requirements. Refer uncertainties to Architect for decision before proceeding.
- B. Copies of Standards: Each entity engaged in construction on Project is required to be familiar with industry standards applicable to that entity's construction activity. Copies of applicable standards are not bound with Contract Documents.
 - 1. Where copies of standards are needed for performance of a required construction activity, Contractor shall obtain copies directly from publication source.

1.5 ABBREVIATIONS

A. Abbreviations and Names: Trade association names and titles of general standards are frequently abbreviated. Where such acronyms or abbreviations are used in Specifications or other Contract Documents, they mean the recognized name of trade association, standards generating organization, authority having jurisdiction, or other entity applicable to context of text provision. Refer to "Encyclopedia of Associations," published by Gale Research Company, available in most libraries.

SECTION 01 4500 - QUALITY CONTROL

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDED

A. Section Includes:

- 1. General Requirements.
- 2. Qualifications.
- 3. Laboratory Requirements.
- 4. Building Survey.
- 5. Quality Control Procedures.
- 6. Testing and Inspection Laboratory Services.
- 7. Contractor Field Inspection and Testing.
- 8. Contractor's Daily Report.
- 9. Contractor's Test and Inspection Reports.
- 10. Non-Compliance Check-Off List.
- 11. Completion and Inspection of Work.

1.2 GENERAL REQUIREMENTS

A. Survey:

- 1. Engage licensed surveyor, without extra cost to the Owner.
- 2. Assure correct position of building on site, establish correct levels, lines and grades, verify column centers, walls, trenches, establish grades and bench marks at all grading and drainage improvements, and otherwise fully and completely layout work required by this Contract.
- B. Inspection, Sampling, and Testing is required for:
 - 1. Soils Compaction Control
 - 2. Cast-In-Place Concrete
 - 3. Mortar, Grout and CMU Units
 - 4. Anchor Bolt Torque
 - 5. Structural Steel Connections
 - 6. Metal Roof Deck Fastening
 - Mechanical testing
 - 8. Electrical testing
- C. Employment of Testing Laboratory or Inspector shall in no way relieve Contractor of his obligation to perform Work in accordance with Contract and Contract Documents.

1.3 QUALIFICATIONS

A. Testing laboratory's qualifications:

- 1. Testing laboratory should be pre-qualified prior to bidding.
- 2. Testing laboratory must have a registered professional engineer as full time staff.
- 3. Testing laboratories wishing to be included on the pre-qualified list herein shall submit qualifications in writing to the Architect no later than ten (10) days prior to the bid.

B. Pre-qualified testing laboratories:

- ECS Southeast, LLP
 1762 Watterson Trail; Louisville, KY 40299
 502-493-7100; 502-493-8190 fax
- Hagerty Engineering, Inc.
 335 Spring Street B; Jeffersonville, IN 47130
 502-553-3211
- Asher Engineering, Inc.
 1021 South Floyd Street; Louisville, KY 40203
 502-589-0073; 502-589-0076 fax
- ATC Group Services / Cardno ATC
 11001 Bluegrass Parkway, Suite 250; Louisville, KY 40299
 502-710-0264; 502-267-4072 fax

1.4 LABORATORY REQUIREMENTS

- A. Meet basic requirements of ASTM E 329 for inspection and testing agencies for concrete and steel as used in construction.
- B. Perform specified inspections, sampling and testing of materials and methods of construction:
 - 1. Comply with specified standards; ASTM, other recognized authorities, and as specified.
 - 2. Ascertain compliance with requirements of Contract Documents.
- C. Promptly notify Architect/Engineer and Contractor of irregularities or deficiencies of Work which are observed during performance of services.
- D. Promptly submit two (2) copies of all reports, inspections and tests to Architect, to include the following:
 - 1. Date, project title and number.
 - 2. Testing Laboratory name and address.
 - 3. Name and signature of inspector.
 - 4. Dates of inspection, sampling, and test.
 - 5. Record of temperature and weather.
 - 6. Identification of product and specification section.
 - 7. Location in project.
 - 8. Type of inspection or test.
 - 9. Observations regarding compliance with Contract Documents.

1.5 BUILDING SURVEY

A. Horizontal Control Survey:

- 1. After earthwork is completed and before any foundation excavation commences, Contractor shall run and maintain a closed, offset traverse outside the building perimeter a suitable distance with 2" x 2" hub stakes driven flush and bearing a Surveyor's tack at all intervening building grids.
 - Each hub shall be flagged, protected, and identified by a clearly visible guard stake.
 - b. Appropriate temperature, and sag corrections must be applied if traverse is measured by Surveyor's chain.
- 2. If transit visibility between opposing hubs straddling the building is impossible, additional lines of hubs tacked, flagged, protected, and identified as above) shall be installed along lines through the building and tied into the perimeter traverse.
- 3. The completed traverse (if not run by) shall be checked, drawn up and certified by a Licensed Surveyor employed by the Contractor and approved by the Architect.
 - An experience record and professional references shall be submitted along with a request for the approval of any Surveyor.
 - b. One copy of the certified drawing shall be posted in the Contractor's field office for reference.
 - c. Additional copies of the drawing shall be posted in the Contractor's field office for reference.
 - d. Until such time as all foundation; reinforced concrete piers and columns; and steel column anchor bolts are in place, all stakes will be maintained.
 - e. The services of the approved Surveyor shall be secured by the Contractor to re-establish all hubs damaged or lost for any reason.
- 4. All foundations; concrete column dowels and forms; and steel column anchor bolts shall be located by transits set up only over traverse hub stakes.
 - a. Anchor bolts shall be secured in final position by fixing into wood templates, or other approved methods before any concrete is cast.
 - b. The Architect reserves the right to reject the equipment or the personnel.

B. Vertical Control:

- 1. After earthwork is completed, the Contractor shall establish building bench marks of 2" Ø i.d. Galvanized Pipe driven a minimum of 4'-0" into ground and having tops level with finished ground floor.
 - a. Sufficient bench marks shall be installed for each ground floor level so that no level shot will exceed 200 feet.
 - b. Level circuits will begin at and close to bench marks referenced on the site plans.
- 2. The approved Licensed Surveyor shall include in his certification that he has checked (or set) all herein required bench marks.

1.6 QUALITY CONTROL PROCEDURES

- A. Monitor quality control over Contractor staff, subcontractors, suppliers, manufacturer's, products, services, site conditions, and workmanship.
- B. Comply fully with manufacturer's published instructions, including each step in sequence of installation.

- C. Should manufacturer's published instructions conflict with Contract Documents, request clarification from Architect before proceeding.
- D. Comply with specified standards as a minimum quality for Work, except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Perform Work by persons who are thoroughly qualified and trained in their respective trade, to produce workmanship of specified quality.
- F. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.
- G. Perform tests required by governing authorities having jurisdiction and utilities having jurisdiction.

1.7 TESTING AND INSPECTION LABORATORY SERVICES

A. Selection and Payment:

- 1. Employment and payment for services of an Independent Testing and Inspection Laboratory to perform specified testing and inspection, by Contractor.
- 2. Employment of Independent Testing and Inspection Laboratory in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents

B. Quality Assurance:

- 1. Comply with requirements of ASTM C 802, ASTM C 1077, ASTM C 1093, ASTM D 290, ASTM D 3740, ASTM D 4561, ASTM E 329, ASTM E 543, ASTM E 548, and ASTM E 699.
- 2. Laboratory: Authorized to operate in State in which Project is located.
- 3. Laboratory Staff: Maintain a full time registered engineer on staff to review services.
- 4. Testing Equipment: Calibrated at reasonable intervals with devices of and accuracy traceable to either National Bureau of Standards or accepted values of natural physical constraints.

C. Laboratory Responsibilities:

- 1. Contractor should ensure the Laboratory has the following responsibilities and limits on authority (See D).
- 2. Test samples of mixes submitted by Contractor.
- Provide qualified personnel at Project site. Cooperate with Architect and Contractor in performance of services.
- 4. Perform specified sampling, testing, and inspection of Products in accordance with specified standards.
- 5. Determine compliance of materials and mixes with requirements of Contract Documents.
- 6. Promptly notify Contractor Quality Control Representative and Architect of observed irregularities or non-conformance of Work or Products.
- 7. Perform additional tests as required by Architect.
- D. Attend appropriate preconstruction meetings and progress meetings.

- E. Limits on Authority:
 - 1. Laboratory may not release, revoke, alter, or expand on requirements of Contract Documents.
 - 2. Laboratory may not approve or accept any portion of Work.
 - 3. Laboratory may not assume any duties of Contractors.
 - 4. Laboratory has no authority to stop Work.

1.8 CONTRACTOR FIELD INSPECTION AND TESTING

- A. Contractor: Test and Inspect Work provided under this Contract to ensure Work is in compliance with Contract requirements. Required tests and inspections are indicated in each individual Specification Section.
- B. Preparatory Inspection: Performed prior to beginning Work and prior to beginning each segment of Work and includes:
 - 1. Review of Contract requirements.
 - 2. Review of shop drawings and other submittal data after return and approval.
 - 3. Examination to assure materials and equipment conform to Contract requirements.
 - 4. Examination to assure required preliminary or preparatory Work is complete.
- C. Initial Inspection: Performed when representative portion of each segment of Work is completed and includes:
 - 1. Performance of required tests.
 - 2. Quality of workmanship.
 - 3. Review for omissions or dimensional errors.
 - 4. Examination of products used, connections and supports.
 - 5. Approval or rejection of inspected segment of Work.
- D. Follow-Up Inspections: Performed daily, and more frequently as necessary, to assure non-complying Work has been corrected.
- E. Testing and Inspection: Perform testing and inspection in accordance with requirements in individual Sections.

1.9 CONTRACTOR'S DAILY REPORT

- A. Submit daily report to Architect, for days that work was performed. Include the following information:
 - 1. Contractor name and address.
 - 2. Job reference and information.
 - 3. Date, weather, minimum and maximum temperatures, rainfall, and other pertinent weather occurrences
 - 4. Daily workforce of Contractor and subcontractors, by trades.
 - 5. Description of work started, ongoing work, and work completed by each subcontractor.
 - 6. Coordination implemented between various trades.
 - 7. Approval of substrates received from various trades.

- 8. Nonconforming and unsatisfactory items to be corrected.
- Remarks.
- 10. Reports may be faxes to Architect no more than one week's worth of reports at one time. Submit daily if requested by Architect.

1.10 CONTRACTOR'S TEST AND INSPECTION REPORTS

- A. Prepare and submit, to Architect, a written report of each test or inspection signed by Contractor Quality Control Representative performing inspection within two (2) days following day inspection was made.
- B. Include the following on written reports of inspection:
 - Cover sheet prominently identifying that inspection "CONFORMS" or "DOES NOT CONFORM" to Contract Documents.
 - 2. Date of inspection and date of report.
 - 3. Project name, location, solicitation number, and Contractor.
 - 4. Names and titles of individuals making inspection, if not Contractor's Project Field Superintendent.
 - 5. Description of Contract requirements for inspection by referencing Specification Section.
 - 6. Description of inspection made, interpretation of inspection results, and notification of significant conditions at time of inspection.
 - 7. Requirements for follow-up inspections.

1.11 NON-COMPLIANCE CHECK-OFF LIST

A. Maintain check-off list of Work that does not comply with Contract Documents, stating specifically what non-complying, date faulty Work was originally discovered, and date Work was corrected. No requirement to report deficiencies corrected same day it was discovered. Submit copy of Non-Compliance Check-Off List of non-complying work items to Architect on a weekly basis.

1.12 COMPLETION AND INSPECTION OF WORK

A. Prior to final acceptance by Architect, submit a certification signed by Contractor to Architect stating that all Work has been inspected and all Work, except as specifically noted, is complete and in compliance with Contract Documents.

B. Record Documents:

- By Contractor Quality Control Representative. Ensure that "As-Builts" required are marked to show
 any deviations which have been made during the course of construction and are kept current on a
 daily basis. Upon completion of the Work, certify the accuracy of the "As-Builts" and submit to
 Architect.
- 2. Refer to Section 01 3200 Construction Progress Documentation.
- Refer to Section 01 7800 Closeout Submittals.

SECTION 01 5100 - TEMPORARY UTILITIES

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDED

A. Section Includes:

- 1. Responsibility of Owner and Contractor.
- 2. Provisions for temporary electrical power.
- 3. Provisions for temporary lighting.
- 4. Provisions for temporary heating and ventilation
- 5. Provisions for temporary water.
- 6. Provisions for temporary telephone and internet.
- 7. Regulatory Agency Requirements.

1.2 RESPONSIBILITY

A. Responsibility of Owner:

- 1. Owner is not responsible for the establishment or payment of any temporary utilities.
- 2. Pay all utility bills from the utility companies for Owner's existing established utility services within existing buildings and construction limits for the duration of construction.
- Owner is not responsible for any costs directly to the contractor for non-established utility items including such items as fuels, tanks, generators, extensions, hookups, feeds, cords, hoses, wiring, etc. as may be required by the contractor for their ability to provide needed temporary utilities specified herein.
- 4. Owner is not responsible for any Contractor job overhead costs such as cell phones, internet, water hauling, etc. that may be required as part of the construction activities.

B. Responsibility of Contractor:

- 1. Pay all utility bills for all new or temporary utility services within construction limits for duration of construction.
- 2. Coordinate establishment, timing and all requirements of all temporary utilities with all utility companies and authorities having jurisdiction.
- 3. Coordinate establishment, timing and all requirements of all permanent utilities, including new services and/or reworking of existing services, with all utility companies and authorities having jurisdiction.
- 4. Provide, install, re-install, remove, coordinate, etc, any and all temporary utilities to all areas of the site and project resulting from any and all phasing of the work.
- 5. Provide temporary electrical power, as required.
- 6. Provide temporary lighting, as required.
- 7. Provide temporary heating and ventilation, as required.
- 8. Provide temporary water, as required.
- 9. Provide temporary telephone, fax and internet, as required.
- 10. Coordinate shut-offs of any and all utilities with Owner at least 24 hours in advance.

11. Each individual Contractor to provide temporary utilities for all contractors, crews and trades under their control or within the scope of work for their contract.

1.3 DESCRIPTION

A. Temporary Electrical Power:

- 1. Contractor may need to provide portable electric generators until utility service is available.
- 2. Provide adequate electrical power centers, wiring and services for all tools, equipment and miscellaneous items.
- 3. Locate so that power is available at any point with no more than 100 foot extension.
- 4. If required, provide minimum 200 ampere volt service entrance for voltage required.
- 5. Provide weather-proof distribution boxes at power centers, minimum four 20-amp 120 volt grounded outlets, with ground fault circuit breaker protection. Additional circuits as required.
- 6. Provide equipment grounding continuity for entire system.
- 7. Individual contractors and users provide grounded UL approved extension cords from power center.
- 8. Contractor to provide power for any and all temporary field offices, architect's field office, storage and construction buildings.
- 9. Contractor to provide power for temporary lighting, heating, ventilation and air conditioning.
- 10. Contractor to provide power for pumping, welding and other special equipment or procedures.
- 11. Provide temporary covers or plates for any and all openings, electrical boxes, receptacles, etc. that may be open during construction or awaiting installation of final covers or plates.

B. Temporary Lighting:

- 1. Provide work lighting, safety lighting and security lighting.
- 2. Provide lighting for construction and storage areas.
- 3. Provide lighting for Owner's tours or access to site areas for review.
- 4. Lightings Levels:
 - a. General work lighting and safety lighting 5 foot candles.
 - b. Finishing and detail work 20 foot candles.
- 5. Periods of Service:
 - a. Work and safety lighting continuous during working hours.
 - b. Security lighting at all hours of darkness.
- 6. Replace lamps throughout, as required.
- 7. Provide temporary exit signs as required for phasing of work or relocation of exits and egress paths.

C. Temporary Heating and Ventilation:

- 1. Provide as required to protect work and products against dampness and cold.
- 2. Provide suitable ambient temperatures for installation and curing of materials.
- 3. Provide adequate ventilation for safe working environment in accord with health regulations.
- 4. Heat and ventilate temporary field offices and other storage and construction buildings.
- 5. Temperatures Required:
 - a. Minimum 40°F, 24 hours a day.
 - b. During working hours and 24 hours a day during concrete and masonry work: 50°F.

- c. During interior finish work, 24 hours a day, 7 days prior to placing finishes until substantial completion: 70°F.
- 6. Ventilation required to prevent hazardous accumulation and harmful exposure of dusts, fumes, mists, vapors or gases.
- 7. Ventilation required for curing installed materials, humidity dispersal and sanitary facilities.
- 8. Gas for temporary heating shall be from portable tanks only, not the use of natural gas system.
- 9. Building system may be used for temporary heat <u>only</u> with approval of Architect. Areas must be sufficiently cleaned so as not to cause damage to system from construction dust and dirt.
- 10. New filters are to be installed prior to operation of system.
- 11. Contractor to replace all filters with new in all temporary and permanently installed units during construction every two (2) weeks minimum, and more frequently during times and in areas of heavy demolition work. Maintain and install additional cloth filters over all return air outlets at all times.
- 12. New filters must be replaced just prior to owner occupancy.

D. Temporary Water:

- 1. Provide service standpipe, centrally located, with minimum of two (2) 3/4" hose bibbs.
- 2. Discharge pressure: Minimum 20 psi.
- 3. Individual contractors and users provide hoses from hose bibbs.
- 4. Maintain adequate water volume for all purposes.
- 5. Provide water for temporary sanitary facilities, field offices, storage buildings, and cleaning and construction operations.
- 6. Obtain required certification from authorities.
- 7. If offsite water is required, Contractor shall pay all costs of water and hauling.
- 8. Provide temporary caps, valves, shut-offs, and spigots as required.
- 9. Contractor is to coordinate supply of water to areas of building which are to remain in service.
- 10. Running of hoses through portions of an existing building is not allowed without approval of Owner.

E. Temporary Telephone and Internet:

- 1. Provide, maintain and pay for telephone service to Contractor's field offices throughout construction.
- 2. Contractor's job site superintendent is required to have a cellular/mobile phone at all times during normal working hours.
- 3. Use of cellular/mobile phones are allowed for temporary phone service, except at field offices.
- 4. Use of Owner's lines is prohibited; phone or internet.
- 5. If contractor desires internet or e-mail service for their use at the jobsite, the contractor shall be responsible to provide it, and shall bear all costs for its installation and use. Use of any Owner's wireless internet service is prohibited, without express permission.

1.4 REGULATORY AGENCY REQUIREMENTS

- A. Obtain and pay for permits as required by authorities.
- B. Obtain and pay for temporary easements as required across property other than Owners.
- C. Comply with applicable Federal, State, and Local Codes:
 - 1. Occupational Safety and Health Act of 1970, as amended.

- 2. National Electric Code.
- 3. National Electric Safety Code.
- D. Comply with Utility Regulations.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Materials may be new or used, adequate in capacity for the purpose intended, without creating unsafe conditions or violating codes.
- B. Comply with Electrical Basic Materials and Methods, Division 26:
 - 1. Temporary wiring shall include green equipment grounding conductor and all outlets shall be grounding type.
 - 2. Provide required facilities, including transformers, conductors, poles, conduits, raceways, breakers, fuses and switches.
 - 3. Provide vapor proof and explosion proof fixtures in applicable areas.
- C. Comply with Basic Mechanical Requirements, Division 23:
 - 1. Provide required facilities, including piping, valves, pumps, pressure regulators and tanks.
 - 2. Portable Heaters: Oil or gas fired with electric blower, not requiring vent from heated space.
 - 3. Salamanders shall not be used.

PART 3 - EXECUTION

3.1 GENERAL

- A. Comply with applicable sections of Division 23, Mechanical and Division 26, Electrical.
- B. Install work in neat and orderly manner, structurally sound.
- C. Locate services to avoid interference with traffic, work and storage areas, material handling equipment and cranes.
- D. Modify service as work progress requires.

3.2 INSTALLATION

A. Electrical:

- 1. Service and distribution may be overhead or underground.
- 2. Locate lighting to provide full illumination of required areas.

- 3. Locate controls at entrance to each area.
- 4. Install security lighting throughout all areas.
- 5. Wire temporary heating equipment.
- 6. Do not run branch circuits on floor.
- B. Heating and Ventilation:
 - 1. Locate to provide equitable distribution as required.
- C. Water:
 - 1. Do not run piping on floor or ground.
 - 2. Locate water outlets to provide service convenient to work.
 - 3. Provide drip pan under hose bibbs within the building, connect to drain.
 - 4. Provide insulation to prevent pipes from freezing.
 - 5. Provide temporary pumps, tanks and compressors as necessary to maintain pressure.

3.3 REMOVAL

- A. Remove completely all temporary materials and equipment upon completion of construction or when no longer required.
- B. Clean and repair damage caused by temporary installation and restore to satisfactory condition per Owner and Architect.
- C. Immediately prior to completion of project, remove temporary lamps and install new lamps throughout.

SECTION 01 5300 - TEMPORARY CONSTRUCTION

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDED

A. Section Includes:

- 1. Temporary Structures:
 - a. Contractor's Field Offices.
 - b. Storage Trailers.
 - c. Enclosures.
 - d. Toilets.
 - e. Stairs, Ladders, Ramps, etc.
 - f. Temporary Fence.
 - g. Project Signage.
 - h. Construction Road, Parking Facilities.
- 2. Access Roads and Parking Areas.
- Installation.
- 4. Removal and Cleanup.
- 5. Protection.

PART 2 - PRODUCTS

2.1 TEMPORARY STRUCTURES

A. A. Contractor's Field Offices:

- 1. Provided by General Contractor.
- 2. Provided by each individual General or Prime Contractor if multiple contracts are applicable.
- 3. The Contractor's offices required for general use and project meetings.
- 4. Type Option: Portable typical trailer units.
- 5. Windows, operable, screened; provide view of construction.
- 6. Automatic heating to maintain min 70°F.
- 7. Furnish emergency first-aid equipment, ABC fire extinguisher, extra hard hats.
- 8. Telephones with loud outside gong on Contractor's line.
- 9. Fax line and fax machine.
- 10. Furnishings: Provide desk, chairs, adequate drawings reference board, drawing racks, and filing cabinets as needed.
- 11. Security: Provide window and door locks so that each office can be made independently secure.
- B. Thermometer: Install a <u>new</u> bulb type weather thermometer on outside of office, adjacent to window for inside reading. Do not install in direct sunlight.

C. Storage Trailers:

- 1. Provided by each General or Prime Contractor or subcontractor as required.
- 2. Coordinate location with Architect.
- 3. Remove at project completion and clean up area.

D. Enclosures:

- 1. Provided by each individual General or Prime Contractor.
- 2. Provide temporary weather-tight enclosures for all exterior openings.
- 3. Equip exterior doors with locks and closures.

E. Toilets:

- 1. Provided by each individual General or Prime Contractor.
- 2. Provide temporary sanitary facilities during construction period.
- 3. Enclose toilet facilities for construction personnel.
- 4. Portable units acceptable. No chemical toilets permitted.
- 5. Do not use toilets in existing or new building.

F. Stairs, Ladders, Ramps, etc.:

- 1. Provided by each individual General or Prime Contractor.
- 2. Provide temporary stairs, ladders, ramps runways, scaffolds, derricks, chutes and similar items required for proper execution of work by the trades.

G. Temporary Fence:

- 1. Provided by each individual General or Prime Contractor.
- 2. Chain link fence, 6'-0" high, minimum.
- 3. Provide fencing located as necessary to enclose the entire project construction limits, prior to work beginning. Provide with gates of sufficient size and quantity. Coordinate all locations and requirements with Architect and Owner's Representative.
- 4. Routing of fencing shall include all areas the Owner deems necessary to ensure the safety of the inhabitants of the site and the general public, as determined by construction operations on site.
- 5. Provide separate entrance gates for union and non-union personnel. Gates shall be clearly identified. Locate gates at opposite ends of the project site.

H. Project Signage:

- 1. Provided by each individual General or Prime Contractor.
- 2. Provide project identification sign of wood frame and exterior grade medium density overlay plywood construction, painted with lettering by professional sign painter, per Architect's design and colors. List title of project, Owner, Architect and Contractor. See drawings for detail, if applicable.
- 3. Signage of individual contractors or sub-contractors will be allowed only for identification of temporary offices and off site storage areas.
- 4. No other signage or advertisement will be allowed on the project site.

I. Construction Road, Parking Facilities:

- 1. Provided by each individual General or Prime Contractor.
- 2. Crushed Stone, #53 size.

2.2 ACCESS ROADS AND PARKING AREAS

- A. Construct and maintain temporary roads accessing public thoroughfares to serve construction area.
- B. Extend and relocate as Work progress requires. Provide detours necessary for unimpeded traffic flow.
- C. Provide and maintain access to fire hydrants, free of obstructions.
- D. Provide means of removing mud from vehicle wheels before entering streets.
- E. Parking: Provide temporary gravel surface parking areas to accommodate construction personnel.
 - 1. When site space is not adequate, provide additional off-site parking.
 - 2. Do not allow vehicle parking on existing pavement.
 - 3. Designate two parking spaces near Architect's field office.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Temporary Structures:

- 1. Locate as directed to avoid interference with work.
- 2. Relocate as required and as directed by Architect.
- 3. Construct with code-approved service connections.
- 4. Mount fire extinguishers in prominent accessible location.
- 5. Maintain offices during construction period.
- 6. Provide wooden steps and landing with handrail.
- 7. Provide crushed stone walkway.
- 8. Provide temporary concrete walks and pathways as indicated on temporary exiting plans. Locate, relocate, and coordinate as required to accommodate phasing of work, progress of work, code and fire officials, and concerns of Owner and Architect.

B. Temporary Enclosures:

- 1. Erect temporary doors as soon as enclosing walls are up.
- 2. Cover window or wall openings in advance of finishing operations when temporary heat is required.
- 3. Replace with permanent closures as soon as possible.
- 4. Install temporary partitions as required to control dust and moisture penetration into existing and completed spaces.
- 5. Provide temporary protection for installed products.
- 6. Provide temporary enclosures and fencing protection as indicated on temporary exiting plans. Locate, relocate, and coordinate as required to accommodate phasing of work, progress of work, code and fire officials, and concerns of Owner and Architect.

C. Temporary Toilets:

- 1. Locate as directed in convenient location to avoid interference with project.
- 2. Anchor portable units to prevent dislocation.
- 3. Service daily.
- 4. Relocate as work progresses.

D. Temporary Road Construction:

- 1. Locate construction road and parking areas at permanent locations.
- 2. Incorporate temporary stone roads into final paved areas as base course.
- 3. Maintain roads during construction period.
- 4. Inspect and correct base course to specified thickness and level before paving is installed.

E. Temporary Construction Apparatus:

- 1. Erect Scaffolding, securely in conformance with labor laws and safety codes.
- 2. Construct stairs, ladders, ramps, runways and derricks security to sustain 100 psf minimum live load or as required for their use.

3.2 REMOVAL AND CLEAN UP

- A. Remove all temporary structures and materials completely upon completion of construction.
- B. Remove debris and clean area.
- C. Repair all damage and restore to finish condition.

3.3 PROTECTION

A. Safety:

1. Maintain lights and barricades on all obstruction and hazards during contract period in conformance to federal and local laws and codes.

B. Fire Protection:

- 1. Provide multi-purpose dry chemical extinguishers.
- 2. Locate one extinguisher adjacent to each stairway.
- 3. Wherever and whenever any burning, welding, cutting or soldering operations are in progress, or equipment is in use, or any work involving a fire hazard is performed, the Contractor or Subcontractor responsible for such operation shall have at all times acceptable fire extinguishers or protection within ten feet of the operation.

C. Piping:

- 1. Keep materials out of piping by capping or other protection.
- 2. Trades responsible for stoppage shall bear expense of cleaning.

D. Equipment:

1. Each contractor and subcontractor shall take necessary precautions to protect and secure own equipment, tools and material.

E. Surface Water Control:

- 1. Grade site to drain properly at all times, without accumulation of water.
- 2. Maintain excavations free of water. Pump excavation as required.
- 3. Protect site from erosion. Do not allow erosion to leave site.

SECTION 01 6200 - PRODUCT OPTIONS AND SUBSTITUTIONS

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDED

- A. Section Includes:
 - 1. Contractor's options.
 - 2. Requests for substitutions.

1.2 CONTRACTOR'S OPTIONS

- A. For products specified only by referenced standards, select product meeting standards and submit for approval in accordance with this section.
- B. For products listing several manufacturers or model numbers, the following criteria apply:
 - 1. For specification sections naming a list of acceptable manufacturers and only one manufacturer's specific model name or number, alternate products from the list of acceptable manufacturers are acceptable only if they are equivalent to the named, specific, model name or number in all respects. If the alternate manufacturer's product is not equivalent to the named, specific, model name or number in all respects, then that manufacturer's product is not an acceptable substitution, even though they are named as an acceptable manufacturer in the specification section. Proposed products from listed alternate manufacturers with no model name or model number listed must be submitted in accordance with this section.
 - 2. For specification sections naming a list of acceptable manufacturers, and no specific model number from any of the listed manufacturers is named in the specification, alternate products from named manufacturers are acceptable provided that they are equivalent to the listed performance criteria and referenced standards in all respects. If the alternate manufacturer's product is not equivalent to the listed performance criteria and referenced standards in all respects, then that manufacturer's product is not an acceptable substitution, even though they are named as an acceptable manufacturer in the specification section.
 - 3. For specification sections naming a list of acceptable manufacturers and a number of manufacturer's specific model numbers, any of the named, specific, referenced products as listed are acceptable. Alternate products from the listed acceptable manufacturers are acceptable only if they are equivalent to at least one of the named, specific, model names or numbers in all respects. If the alternate manufacturer's product is not equivalent to at least one of the named, specific, model names or numbers in all respects, then that manufacturer's product is not an acceptable substitution, even though they are named as an acceptable manufacturer in the specification section. Proposed products from listed alternate manufacturers without a listed model name or number must be submitted in accordance with this section.

PRODUCT OPTIONS AND SUBSTITUTIONS 01 6200 - 2 04/24/2025

C. For products specified by naming only one product and manufacturer, there is no option, and no substitution will be allowed. This item may have been specified in this manner to standardize the Owner's maintenance procedures or stock inventory, comply with the Owner's warranty requirements, or to maintain compatibility with existing construction. In some instances, this item may have been specified to determine a level of quality or performance desired and requests for substitutions may be accepted for consideration as determined by the Architect.

1.3 REQUESTS FOR SUBSTITUTIONS

- A. During period of bid preparation, Architect will consider written requests for substitutions, received at least ten (10) calendar days prior to bid date; requests received after that time will not be considered.
- B. Products proposed for installation by the Contractor and approved by the Architect shall not be changed except with written consent of the Architect.
- C. Submit all information to the Architect electronically via e-mail or CD, unless otherwise permitted. If hard copies are permitted, submit two (2) copies of all information.
- D. Include the following information in request. Submittals or product catalogs without the following specific information listed will not be considered.
 - 1. Complete data substantiating compliance of proposed substitution with Contract Documents.
 - 2. Product Data:
 - a. Product identification, including manufacturer's name and address.
 - b. Manufacturer's literature;
 - 1) Product description.
 - 2) Performance and test data.
 - 3) Reference standards.
 - 4) Material safety and data sheets.
 - c. Samples.
 - d. Name and address of similar projects which may be visited in vicinity of project on which product was used and date of installation.
 - 3. Construction Method: detailed description and drawings of proposed method.
 - 4. Itemized comparison of proposed substitution with product or method specified.
 - 5. Data relating to changes in construction schedule.
 - 6. Relation to separate contracts.
 - 7. Accurate cost data on proposed substitution in comparison with product or method specified.
 - 8. Literature of item proposing to replace, proving equality and comparison.
- E. In making the request for substitution, Bidder/Contractor represents:
 - 1. They have investigated proposed product or method and determined that it is equal or superior in all respects to that specified.
 - 2. They will provide the same warranty requirements for substitution item as for product or method specified.
 - 3. They will coordinate and accommodate installation of accepted substitution into the work, making such changes as may be required for work to be complete in all respects and trades.

PRODUCT OPTIONS AND SUBSTITUTIONS 01 6200 - 3 04/24/2025

- 4. The Bidder/Contractor waives all claims for any and all additional costs or time related to this substitution which consequently become apparent, by contractor, subcontractors, vendors, and suppliers. Bidder/Contractor shall be responsible for any and all costs, direct or indirect, resulting from this Request.
- 5. Cost data is complete and includes all related costs under his Contract, but excludes:
 - a. Costs under separate contracts.
 - b. Architect's redesign costs, if any.
- F. Substitutions will not be considered if (in the opinion of the Architect):
 - 1. Request is not received within the proper timeframe for consideration prior to the bid date.
 - 2. Request does not contain the proper information for determination of substitution.
 - 3. Item has been specified with no substitutions permitted.
 - 4. Item is not considered to be equal to that specified.
 - 5. Item would require substantial revision to the Contract Documents or design intent.
 - 6. Item would have an adverse effect on the project or construction schedule.
 - 7. Item would have an adverse effect on other trades or scope of work.
 - 8. Item is deemed unacceptable by the Owner for any reason.
 - 9. Item is deemed not equal to the desired aesthetic or have an adverse aesthetic effect; including colors, textures, patterns or appearance specified or intended.
 - 10. They are indicated or implied on shop drawings or project data submittal without formal request submitted in accordance with this Section.
 - 11. They have not been included in an addendum during bidding.
 - 12. They are made after award of Contract.
- G. It is the responsibility of the bidder to make a complete and proper submission for their request for substitution, to the correct party as indicated in the specifications and within the required timeframe. The Architect is not responsible for any errors in the bidders submission, including such items as sending information to the incorrect contact person, or sending the request to the incorrect mailing address, fax number or e-mail address.
- H. The decision of the Architect is FINAL.

SECTION 01 6500 - PRODUCT DELIVERY AND HANDLING

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDED

A. Section Includes:

- 1. Material shipments and project delivery to job site.
- 2. Handling of materials and products included in project.
- 3. Phasing of the work.

1.2 DELIVERY

- A. Delivery materials, supplies or equipment to Project site during working hours.
- B. Deliveries made during other than normal working hours must be received by an authorized agent of the Contractor.
- C. No employee of the Owner is authorized to receive any shipment designated for this project.
- D. The Owner assumes no responsibility for receiving any shipments designated for this project.
- E. Under no circumstances may shipments be directed to, or in care of, the Owner.

1.3 HANDLING

A. All materials furnished under this Contract shall be identified, shipped, addressed, consigned, etc., to the Contractor who may be charged therewith by giving the name of the Contractor, the name of the project, the street and the city.

1.4 PHASING OF THE WORK

- A. Work will be phased, limiting installation of materials to separate areas of site or times of construction.
- B. Any and all coordination of materials on site related to phasing of the work shall be accomplished by the Contractor at no additional costs to the Owner.
- C. All materials, equipment, and associated items and components for the scope of work are to be delivered to the site only as and when needed for installation. Time allowed on site prior to installation shall be a reasonable timeframe as deemed acceptable by the Architect.
- D. All items on site shall be stored off the ground and protected by watertight encapsulating cover in preparation for immediate installation.

PROJECT NO. 24-179.000 Harrison REMC - Addition and Renovation Harrison REMC PRODUCT DELIVERY AND HANDLING 01 6500 - 2 04/24/2025

E. Any and all items on site in a timeframe deemed unacceptable by the Architect for any reason, or deemed to be damaged by improper handling or storage, are to be removed from the site and returned to the manufacturer, without cost to the Owner. Products shall be replaced entirely with new materials at the time needed and deemed acceptable for installation.

SECTION 01 7329 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDED

A. Section Includes:

- 1. Make several parts fit properly.
- 2. Uncover work to provide for installation of ill-timed work.
- 3. Remove and replace defective work.
- 4. Remove and replace work not conforming with requirements of Contract Documents.
- 5. Remove samples of installed work as specified for testing.
- 6. Remove existing construction necessary to install new materials, equipment, mechanical or electrical items.

PART 2 - PRODUCTS

2.1 MATERIALS

A. For replacement of work removed: Comply with Specifications.

PART 3 - EXECUTION

3.1 PREPARATION

A. General:

- 1. Do not endanger any other work by cutting or altering work or any part of it.
- 2. Do not cut or alter work of another contractor without the written consent of Architect.
- 3. Patching and refinishing shall be executed by the trade experienced in such finishing work.

B. Prior to cutting:

- 1. Provide shoring, bracing and support as required to maintain structural integrity of project.
- 2. Provide protection for other portions of project.
- 3. Provide protection from elements.
- 4. Advise Architect designating time work will be uncovered to provide for observation.

3.2 PERFORMANCE

A. Execute cutting and demolition by methods which will prevent damage to other work and will provide proper surfaces to receive installation of repairs and new work.

- B. Execute excavating and backfilling by methods which will prevent damage to other work and will prevent settlement.
- C. Execute fitting and adjustment of products to provide a finished installation to comply with specified tolerances, finishes.
- D. Cut existing concrete openings for piping, floor drains, etc., by core drilling.
- E. Cut existing walls, floors, ceilings, roofs, etc. necessary for the proper installation of new materials, equipment, mechanical or electrical items. Provide all necessary framing, lintels, hangers, etc. to maintain the structural integrity of the building system after cutting.
- F. Employ original installer to perform cutting and patching for exposed finished surfaces.
- G. Restore work which has been cut or removed; install new products to provide completed work in accord with requirements of Contract Documents.
- H. Contractor is responsible for cost to restore or patch adjacent surfaces to original condition.
- I. Fit work airtight to pipes, sleeves, ducts, conduits and other penetrations.
- J. Refinish entire surface as necessary to provide an even finish.
 - 1. Continuous surfaces: To nearest intersections.
 - 2. Assembly: Entire refinishing.

SECTION 01 7423 - CLEANING

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDED

A. Section Includes:

- 1. Description of general cleaning requirements.
- 2. Regulatory agency requirements.
- 3. Cleaning during construction.
- 4. Final Cleaning.

1.2 DESCRIPTION

- A. The General Contractor is responsible for all cleaning unless specifically noted otherwise.
- B. Maintain premises and public properties free from accumulations of waste, debris, and rubbish, caused by operations.
- C. Remove temporary piping and wiring: by respective contractors.
- D. At completion of work, remove waste materials, rubbish, tools, equipment, machinery and surplus materials, and clean all sight-exposed surface; leave project clean and ready for occupancy.

1.3 REGULATORY AGENCY REQUIREMENTS

- A. Maintain project in accord with Occupational Safety & Health Act of 1970 as amended, in terms of clean up.
- B. Conduct cleaning and disposal operations to comply with local ordinances and anti-pollution laws.
 - 1. Do not burn or bury rubbish and waste materials on project site.
 - 2. Do not dispose of volatile wastes such as mineral spirits, oil or paint thinner in storm or sanitary drains, or bury below ground.

PART 2 - PRODUCTS

2.1 MATERIAL

- A. Use only cleaning materials recommended by manufacturer of surface to be cleaned.
- B. Use cleaning materials only on surfaces recommended by cleaning material manufacturer.

PART 3 - EXECUTION

3.1 CLEANING DURING CONSTRUCTION

- A. Execute cleaning to ensure that building, grounds and public properties are maintained free from accumulations of waste material and rubbish on a daily basis by all trades.
- B. Wet down dry materials and rubbish to lay dust and prevent blowing dust.
- C. At reasonable intervals during progress of Work, clean site and public properties, and dispose of waste materials, debris and rubbish.
- D. Provide on-site containers for collection of waste materials, debris and rubbish.
- E. Remove waste materials, debris and rubbish from site and legally dispose of at public or private dumping areas off Owner's property.
- F. Handle materials in a controlled manner with as few handlings as possible; do not drop or throw materials from heights.
- G. Schedule cleaning operations so that dust and other contaminants resulting from cleaning process will not fall on wet, newly painted surfaces.
- H. Ensure that no construction materials or items are accessible to public on site or grounds.

3.2 FINAL CLEANING

- A. Employ experienced workman or professional cleaners for final cleaning.
- B. In preparation for substantial completion or occupancy, conduct final inspection of sight-exposed interior and exterior surfaces, and of concealed spaces.
- C. Remove grease, dust, dirt, stains, labels, fingerprints and other foreign materials from sight-exposed interior and exterior finished surfaces; polish surfaces so designated to shine finish.
- D. Wash and clean all glass, removing labels.
- E. Clean and polish fixtures, equipment and materials.
- F. Repair, patch and touch-up marred surfaces to specified finish, to match adjacent surfaces.
- G. Vacuum all carpeted areas; wax and polish all tile and resilient flooring areas.
- H. Remove all foreign materials from roof and site area.
- I. Broom clean paved surfaces; rake clean other surfaces of grounds.

- J. Each Prime Contractor shall be responsible for cleaning all equipment installed by the respective contractors.
- K. Mechanical and Electrical Work:
 - 1. Respective contractors shall perform cleaning of their equipment.
 - 2. Mechanical contractor shall clean all strainers in his respective piping work.
 - 3. Replace throw-away type air conditioning filters or media if units were operated during construction, or clean ducts, blowers and coils if air conditioning units were operated without filters.
 - 4. This does not include replacing filters used for performance testing and balancing.
 - 5. Replace burned out or inoperative pilot and lighting lamps; by contractor furnishing respective equipment or fixture.
 - 6. Replace all bulbs in fixtures used for temporary lighting during construction.
- L. Conduct final cleaning and preparation of surfaces and materials as per manufacturer's recommendation and in strict accordance with manufacturer's guidelines.
- M. All materials and finishes shall be stripped, waxed, polished, buffed, etc., upon Substantial Completion for their use by Owner.
- N. Owner will assume responsibility for cleaning as time designated on Certificate of Substantial Completion, Conditional Acceptance or partial occupancy, whichever is first, for Owner's acceptance of Project or portion thereof.

SECTION 01 7700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDED

A. Section Includes:

- 1. Administrative procedures in closing out the work.
- 2. Procedures for Substantial Completion.
- 3. Procedures for Final Inspection.
- 4. Required contractor guarantees.
- 5. Evidence of payments and release of liens.
- 6. Final adjustment of accounts.
- 7. Final Application and Certificate for Payment.
- 8. Post construction inspection.
- 9. Closeout submittals required are specified in Section 01 7800.
- 10. Closeout maintenance materials required are specified in Section 01 7846.

1.2 SUBSTANTIAL COMPLETION

- A. Submit written certification to Architect that project or designated portion of project is substantially complete and ready for use by Owner.
- B. Architect will make an inspection within a reasonable time after receipt of such notice. The Contractor is responsible for the final punchlist inspection in accordance with the General Conditions. No inspection by the Architect will be made until the Contractor submits written certification that the punchlist has been issued and complete. The Architect's Substantial Completion inspection is not for the purpose of preparing a "todo" list for the Contractor to use in finishing the work. If it becomes apparent at the time of the Substantial Completion inspection that items affecting life safety, accessibility, security, or full intended use of space are not complete, the inspection will be terminated and the Contractor will be liable for the costs of reinspection.
- C. Should Architect consider that work is not substantially complete:
 - 1. Architect shall immediately notify Contractor, in writing, stating reasons.
 - 2. Contractor to remedy deficiencies and send second written notice of substantial completion to Architect.
 - 3. Architect will re-inspect Work.
 - 4. Contractor to pay costs of Architect's re-inspection.
- D. When Architect/Engineer considers that work is substantially complete; Architect will prepare and issue a Certificate of Substantial Completion, AIA Document G704, complete with signatures of Owner and Contractor, accompanied by Contractor's list of items to be completed or corrected ("Punchlist") as verified and amended by the Architect. Retainage amounts will be adjusted per General Conditions and Supplementary General Conditions.

1.3 FINAL INSPECTION

- A. Contractor shall submit written certification that:
 - 1. Contract Documents have been reviewed.
 - 2. Work has been completed and inspected in accordance with Contract Documents.
 - 3. Equipment and systems have been tested in presence of Owner's representative and are operational.
 - 4. Work is completed, and ready for final inspection.
 - 5. If any items from the Certificate of Substantial Completion Inspection are not completed, the final inspection will be terminated and the Contractor will be liable for the costs of re-inspection.
- B. Architect will make final inspection after receipt of certification.
- C. Should Architect consider that work is incomplete or defective:
 - 1. He shall promptly notify Contractor, in writing, stating reasons.
 - 2. Contractor shall take immediate steps to remedy the stated deficiencies, and send second written notice to Architect/Engineer certifying that Work is complete.
 - 3. Architect will re-inspect Work.
 - 4. Contractor to pay costs of Architect's re-inspection.
 - 5. Final payment will not be released.
- D. When Architect finds that work is acceptable in accordance with Contract Documents, he shall request contractor to prepare Project Closeout Submittals in accordance with Section 01 7800.

1.4 GUARANTEES

- A. Contractor agrees to make good all damage to the construction of building or site or equipment which in the opinion of the Architect is a result of or incidental to the use of materials, equipment or workmanship which are inferior, defective or not in accordance with the specifications.
- B. In case repairs become necessary, the Owner will give written notice to the Contractor to make same and in case of failure of the Contractor to commence such repairs within 30 days after such notice, the Owner may make the repairs either by its own employees or by independent contract and may thereupon recover from the Contractor and his Sureties the cost of the repairs so made together with the cost of supervision and inspection thereof. The Owner will have sixty (60) days after the expiration of said guarantee period in which to notify the Contractor of any such repairs necessary on the date of such expiration. The determination of the necessity for repairs shall rest entirely with the Architect whose decision upon the matter shall be final and obligatory upon the Contractor.
- C. The Guarantees herein stipulated shall extend to the whole body of the improvement and all its appurtenances.

1.5 EVIDENCE OF PAYMENTS AND RELEASE OF LIENS

- A. Contractor to execute and submit:
 - 1. Contractor's Affidavit of Payment of Debts and Claims (AIA Document G706).
 - 2. Contractor's Affidavit of Release of Liens (AIA Document G706A)
 - 3. Consent of Surety to Final Payment (AIA Document G707).
- B. All submittals shall be duly executed before delivery to Architect.

1.6 FINAL ADJUSTMENT OF ACCOUNTS

- A. Submit final statement of account to Architect.
- B. Statement shall reflect all adjustments:
 - 1. Original Contract Sum.
 - 2. Additions and deductions resulting from:
 - a. Change Orders.
 - b. Cash Allowances
 - c. Contingency Allowance.
 - d. Unit Prices
 - e. Deductions for uncorrected work.
 - f. Penalties and Bonuses.
 - 3. Total Contract Sum, as adjusted.
 - 4. Previous payments.
 - 5. Sum remaining due.
- C. Architect will prepare final Change Order reflecting approved adjustments to Contract Sum not previously made by Change Orders or Allowance Adjustments.

1.7 FINAL APPLICATION AND CERTIFICATE FOR PAYMENT:

- A. Contractor shall submit final application in accordance with procedures and requirements of General and Supplementary Conditions prior to submission of Final Application and Certificate for Payment.
- B. Architect will review Final Application and issue Final Certificate in accordance with provisions of General Conditions.
- C. Should final completion be materially delayed through no fault of Contractor, Architect may issue a Semi-Final Certificate for Payment in accordance with provisions of General Conditions.

PROJECT NO. 24-179.000 Harrison REMC - Addition and Renovation Harrison REMC CLOSEOUT PROCEDURES 01 7700 - 4 04/24/2025

1.8 POST CONSTRUCTION INSPECTION

- A. Prior to expiration of one year from date of Substantial Completion, Architect may make visual inspection of Project in company with Owner and Contractor to determine whether correction of Work is required in accordance with provisions of General Conditions.
- B. For Guarantee beyond one year Architect may make inspections at request of Owner after notification to Contractor.
- C. Architect will promptly notify Contractor, in writing, of any observed deficiencies.
- D. Any/all corrections to work at that time to be at Contractor's expense.

SECTION 01 7800 - CLOSEOUT SUBMITTALS

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDED

A. Section Includes:

- 1. Operation and Maintenance Manuals.
- 2. Product Warranties.
- 3. Project Record Documents (As-Built Drawings).
- 4. Spare-Parts.
- 5. Certificates of Inspection.
- 6. Keys and Keying Schedule.
- 7. Instruction of Owner's Personnel.
- 8. Certificate of Occupancy.
- 9. Certification of Asbestos and Lead-Based Paint.
- 10. Closeout maintenance materials required.
- B. Unless specifically permitted by the Architect, the Contractor is to provide all items listed herein to the Owner via the Architect prior to the date of Substantial Completion.

1.2 OPERATION AND MAINTENANCE MANUALS

A. Submission Requirements:

- 1. Furnish Owner with all manual information electronically on thumb drive in PDF format.
- 2. Furnish Owner with one (1) set of bound hard copy manuals.
- 3. Submit to Architect for review of information and forwarding to Owner for Owner's records.

B. Preparation:

- 1. Prepare data by personnel experienced in maintenance and operation of described products.
- 2. Obtain information directly from manufacturer of equipment or product.

C. Format:

- 1. Prepare organization of data in the format of an instructional manual.
- 2. Cover:
 - a. Identify manual with title OPERATION AND MAINTENANCE MANUAL.
 - b. Identify title of Project.
 - c. Identify subject matter of contents.

3. Organization:

- a. Divide sections for each separate product and system, with description of product and major component parts of equipment.
- b. For any hard copies required, provide tabbed dividers between each section.

4. Text:

- a. Include all manufacturer's published data and product cutsheets.
- b. For any hard copies required, provide on 20 pound paper.

5. Drawings:

- a. Provide applicable drawing files from manufacturer or Architect's drawing files as required. Contact Architect to obtain PDF drawing files as needed.
- b. For any hard copies required, provide with reinforced punched binder tab. Bind in with text. Fold larger drawings to size of text pages.

6. Binders (for any hard copies required):

- a. Commercial quality, 8-1/2 x 11 inch three D side ring binders with durable plastic covers; 2 inch maximum ring size.
- b. When multiple binders are used, correlate data into related consistent groupings.

D. Contents:

- 1. Table of Contents: Provide title of Project; names, addresses, and telephone numbers of Architect/Engineer, Subconsultants, and Contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume.
- 2. For Each Product or System: List names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
- 3. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
- 4. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.
- 5. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.
- 6. Warranties: Include a copy of each.
- 7. Reports: Include a copy of all test reports, certificates, testing and balance data, etc.

E. Manual for Materials and Finishes:

- 1. Building Products, Applied Materials, and Finishes: Include product data, with catalog number, size, composition, and color and texture designations. Provide information for re-ordering custom manufactured Products.
- 2. Instructions for Care and Maintenance: Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- 3. Moisture Protection and Weather Exposed Products: Include product data listing applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.
- 4. Additional Requirements: As specified in individual Product specification Sections.
- 5. Provide a list of all materials and finishes with scanned photo files or actual samples of all products.

F. Manual for Equipment and Systems:

1. Each Item of Equipment and Each System: Include description of unit or system, and component parts. Identify function, normal operating characteristics, and limiting conditions. Include performance

- curves, with engineering data and tests, and complete nomenclature and model number of replaceable parts.
- 2. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.
- 3. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- 4. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- 5. Include color coded wiring diagrams as installed.
- 6. Provide servicing and lubrication schedule, and list of lubricants required.
- 7. Include manufacturer's published operation and maintenance instructions.
- 8. Include sequence of operation by controls manufacturer.
- 9. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- 10. Provide control diagrams by controls manufacturer as installed.
- 11. Provide Contractor's coordination drawings, with color coded piping diagrams as installed.
- 12. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- 13. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- 14. Include test and balancing reports as specified in Section 23 0593 Testing, Adjusting and Balancing.
- 15. Additional Requirements as specified in individual Product specification Sections.
- 16. Provide a list of design data, settings, setpoints, etc., as applicable for equipment.

1.3 PRODUCT WARRANTIES

A. Submission Requirements:

- 1. Furnish Owner with all warranty information electronically on thumb drive in PDF format.
- 2. Furnish Owner with one (1) set of bound hard copy warranties.
- 3. Submit to Architect for review of information and forwarding to Owner for Owner's records.

B. Preparation:

- 1. Gather Warranties required for specific Products or Work as specified in each individual Section.
- 2. Obtain information directly from responsible Subcontractor, supplier, and manufacturer of equipment or product within 10 days after completion of applicable item of Work.
- 3. Except for items put into use with Architect approval, leave date of beginning of time of warranty until the Date of Final Acceptance is determined.
- 4. Verify that documents are in proper form, are complete, contain full information, are notarized, and are fully executed and valid.
- 5. Co-execute submittals when required.
- 6. Retain warranties until time specified for submittal.

C. Format:

1. Prepare organization of data in the format of an instructional manual.

Cover:

- a. Identify manual with title WARANTIES.
- b. Identify title of Project.
- c. Identify subject matter of contents.

3. Organization:

- Separate each warranty keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary.
- b. List Subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
- c. For any hard copies required, provide tabbed dividers between each warranty.
- 4. Binders (for any hard copies required):
 - a. Commercial quality, 8-1/2 x 11 inch three D side ring binders with durable plastic covers; 2 inch maximum ring size.
 - b. When multiple binders are used, correlate data into related consistent groupings.

D. Contents, Each Volume:

1. Table of Contents: Neatly typed, in sequence of Table of Contents of Project Manual, with each item identified with number and title of specification Section in which specified, and name of Product or Work item.

E. Time of Submittals:

- 1. For equipment or component parts of equipment put into service during construction with Architects approval, submit documents within 10 days after acceptance.
- 2. Make other submittals within 10 days after Date of Final Completion, prior to final Application for Payment.
- 3. For items of Work for which acceptance is delayed beyond Date of Final Completion, submit within 10 days after acceptance.

1.4 PROJECT RECORD DRAWINGS ("AS-BUILTS")

A. Submission Requirements:

- 1. Furnish Owner with original record document prints.
- 2. Furnish Owner with one (1) additional hard copy set of record document prints.
- 3. Furnish Owner with all as-built information electronically on thumb drive in PDF format.
- 4. Submit to Architect for review of information and forwarding to Owner for Owner's records.

B. Project Record Documents required:

- 1. Marked-up copies of Contract Drawings.
- 2. Marked-up copies of Shop Drawings.
- 3. Marked-up copies of Specifications, addenda and Contract Modifications.
- 4. Marked-up Product Data submittals.
- 5. Field records for variable and concealed conditions.
- 6. Record information on Work that is recorded only schematically.

C. Maintenance of Documents:

Store record documents in field office apart from Contract Documents used for construction. Do
not permit Project Record Documents to be used for construction purposes. Maintain and protect
record documents from damage in a clean, dry, legible condition. Make documents available at all
times for inspection by Architect.

D. Record Drawings:

- 1. During construction, maintain a set of black-line white-prints of Contract Drawings and Shop Drawings for Project Record Document purposes.
 - Mark these Drawings to indicate actual installation where installation varies from installation shown originally. Give particular attention to information on concealed elements which would be difficult to identify or measure and record later. Items required to be marked include but are not limited to:
 - 1) Dimensional changes to Drawings.
 - 2) Revisions to details shown on Drawings.
 - 3) Depths of foundations below first floor.
 - 4) Locations and depths of underground utilities.
 - 5) Revisions to routing of piping and conduits.
 - 6) Revisions to electrical circuitry.
 - 7) Actual equipment locations.
 - 8) Duct size and routing.
 - 9) Locations of concealed internal utilities.
 - 10) Changes made by Contract Modification.
 - 11) Details not on original Contract Drawings.
 - b. Responsibility for Markup and Supervision: Contractor Quality Control Representative; as specified in Section 01 4500 Quality Control. Where feasible, individual or entity who obtained record data, whether individual or entity is installer, subcontractor, or similar entity, is required to prepare mark-up on Record Drawings.
 - 1) Accurately record information in an understandable Drawing technique.
 - 2) Record data as soon as possible after it has been obtained. In case of concealed installations, record and check mark-up prior to concealment.
 - Contractor Quality Control Representative: Affix signature and certify accuracy of Record Drawings.
 - c. Mark completely and accurately record prints of Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions. Where Shop Drawings are marked, show cross-reference on Contract Drawings location.
 - d. Mark record sets with red erasable colored pencil; use other colors to distinguish between changes for different categories of Work at same location.
 - e. Mark important additional information which was either shown schematically or omitted from original Drawings.
 - f. Note construction change directive numbers, alternate numbers, Contract Modification numbers and similar identification.
 - g. At time of Final Acceptance, submit record Drawings to Architect for Owner records. Organize into sets, bind and label sets for Owner's continued use.
- 2. Copies and Distribution: After completing Record Drawings, print one (1) black-line print of each Drawing, whether or not changes and additional information were recorded. Organize copies into a

sets Bind each set with durable paper cover sheets, with appropriate identification, including titles, dates and other information on cover sheets.

a. Organize and bind original marked-up set of prints that were maintained during construction in same manner.

E. Additional Record Submittals:

- Refer to other specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Immediately prior to Final Acceptance, complete additional records and place in order, properly identified and bound or filed, ready for use and reference. Submit to Architect.
 - a. Categories of requirements resulting in miscellaneous records include, but are not limited to the following:
 - 1) Field records on excavations and foundations.
 - 2) Field records on underground construction and similar Work.
 - 3) Survey showing locations and elevations of underground lines.
 - 4) Inverted elevations of drainage piping.
 - 5) Survey establishing building lines and levels.
 - 6) Authorized measurements utilizing unit prices or allowances.
 - 7) Records of plant treatment.
 - 8) Ambient and substrate condition tests.
 - 9) Certifications received in lieu of labels on bulk products.
 - 10) Batch mixing and bulk delivery records.
 - 11) Testing and qualification of tradesmen.
 - 12) Documented qualification of installation firms.
 - 13) Load and performance testing.
 - 14) Inspections and certifications by governing authorities.
 - 15) Leakage and water-penetration tests.
 - 16) Fire resistance and flame spread test results.
 - 17) Final inspection and correction procedures.

1.5 SPARE-PARTS

- A. Provide Products, replacement stock, spare parts, maintenance, and extra materials in quantities specified in individual specification Sections.
- B. Deliver to Project Site and place in location as directed by Architect; obtain receipt prior to Final Payment.

1.6 CERTIFICATES OF INSPECTION

- A. General.
- B. Plumbing.
- C. HVAC.
- D. Electrical.

- E. Fire Sprinkler.
- F. Fire Alarm.

1.7 KEYS

A. Submit keys and keying schedule to Owner.

1.8 INSTRUCTION OF OWNER'S PERSONNEL

- A. Prior to final inspection or acceptance, fully instruct Owner's designated operating and maintenance personnel in the operation, adjustment, and maintenance of all products, equipment and systems.
- B. Such instructions shall occur at a time designated by the Architect/Engineer at the completion of the job at a meeting set up by the contractor and attended by the representatives of the Owner and manufacturer.
- C. Services of factory instructor or representative to teach Owner's representative on operation of equipment will be arranged by the contractor, shall begin after equipment has been placed in satisfactory operating condition and shall continue for a period of time as deemed necessary by the Architect.
- D. Contractor shall verify in writing that such periods of instruction have been held with the Owner's representative.
- E. Minimum length of training session to be two (2) hours.
- F. Session will need to be video recorded by Contractor for use by Owner.
- G. Notify Architect to attend all training sessions.

1.9 CERTIFICATE OF OCCUPANCY

- A. Where the Local Authority of Location of project requires either temporary or permanent Certificate of Occupancy, obtain and pay for Certificates and furnish a copy to the Architect for forwarding to the Owner.
- B. Contractor to verify requirements with Local Building Officials.

1.10 CERTIFICATION OF ASBESTOS MATERIAL AND LEAD-BASED PAINT

- A. The use of asbestos containing materials, in excess of 1 percent as defined by applicable US Environmental Protection Agency regulations, is prohibited in the project.
- B. The use of lead-based paint is prohibited in the project.
- C. Prepare and submit to Architect the "Certification of Asbestos and Lead-Based Paint (New Work)" for new material furnished or installed as part of the Work (attached).

PROJECT NO. 24-179.000 Harrison REMC - Addition and Renovation Harrison REMC CLOSEOUT SUBMITTALS 01 7800 - 8 04/24/2025

END OF SECTION 01 7800

PROJECT NO. 24-179.000 Harrison REMC - Addition and Renovation Harrison REMC

CLOSEOUT SUBMITTALS 01 7800 - 9 04/24/2025

Certificate of Asbestos and Lead-Based Paint

(New Work)

To:	TowerPinkster
Subject:	Certification for new construction
Facility name:	
Facility address:	
Certification for n	ew construction:
This Contractor he	reby certifies that no asbestos-containing material in excess of 1 percent as defined by
applicable US Envi	ironmental Protection Agency regulations, and lead-based paint has been furnished or installed
at the referenced p	roject.
Contractor name:	
Signature:	
Address:	
Telephone:	
Date executed:	The namely for making a false statement is present by 40 UCC 4004
	The penalty for making a false statement is prescribed by 18 USC 1001.

CLOSEOUT MAINTENANCE MATERIALS 01 7846 - 1 04/24/2025

SECTION 01 7846 - CLOSEOUT MAINTENANCE MATERIALS

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDED

A. Section Includes:

- 1. Maintenance Materials.
- Owner Verification.

1.2 MAINTENANCE MATERIALS

A. General Requirements:

- 1. No maintenance stock to be used by the Contractor for any reason.
- 2. Provide maintenance stock for each and every style, type or color specified for each product.
- 3. Provide maintenance stock at end of the project and directly to the Owner.
- 4. Wrap and protect all materials for storage by the Owner.
- 5. Packages and containers to be manufacturer's unopened and unsealed packaging. If quantities listed exceed a manufacturer's single container, additional unopened and unsealed containers shall be supplied until minimum quantity is met.
- 6. Packages and containers shall include manufacturer's label and product information.
- 7. Paint products shall include manufacturer's color and mix formulas.

B. Floor and Wall Tile::

- 1. Provide to Owner maintenance stock of at least (12) floor tiles.
- 2. Provide to Owner maintenance stock of at least (12) wall tiles.

C. Acoustical Ceiling Tile:

1. Provide to Owner maintenance stock of at least (30) tiles.

D. Luxury Vinyl Tile Flooring:

1. Provide to Owner maintenance stock of at least (20) tiles.

E. Rubber Base:

1. Provide to Owner maintenance stock of at least (40) linear feet.

F. Modular Carpet Tiles:

1. Provide to Owner maintenance stock of at least (24) tiles.

PROJECT NO. 24-179.000 Harrison REMC - Addition and Renovation Harrison REMC

CLOSEOUT MAINTENANCE MATERIALS 01 7846 - 2 04/24/2025

- G. Paint:
 - 1. Provide to Owner maintenance stock of at least (2) unopened gallon containers.

1.3 OWNER VERIFICATION

- A. Owner to sign-off receipt of each item.
- B. Provide to Architect, copy of this Specification Section with Owner's signature next to each item listed, verifying that they have been received by the Owner's representative and entered into their stock.

END OF SECTION 01 7846

SECTION 02 3000 - SUBSURFACE EXPLORATION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Sub-Surface Exploration Report:
 - 1. Prepared by: PAUL PRIMAVERA & ASSOCIATES 301 E. CHESTNUT ST. CORYDON, IN 47112

502-693-9412

- 2. Report is intended for informational purposes of interpolating and understanding subsurface conditions of the project site, and becomes a part of the Contract Documents.
- B. Boring Logs:
 - 1. Included for Contractor's information, but not a warranty of subsurface conditions.
- C. Representations or Warranties:
 - 1. None are made by the inclusion of this report.
 - 2. Neither the Owner nor the Architect//Engineer will be responsible for interpretations or conclusions drawn from this report by the Contractor.
 - 3. Data is made available solely for the convenience of the Contractor.
- D. Additional Investigation:
 - 1. Contractor should visit the site to acquaint himself with site conditions.

END OF SECTION 02 3000

GEOTECHNICAL SITE FEASIBILITY EXPLORATION

HARRISON REMC CAMPUS ADDITIONS AND IMPROVEMENTS AND NEW POLE YARD 1165 OLD FOREST ROAD CORYDON, INDIANA



PPA PROJECT NO. 24-24928

July 25, 2024

PREPARED FOR:

Mr. Kyle Wilson Tower Pinkster 630 Walnut St. Jeffersonville, IN 47130





July 25, 2024

Mr. Kyle Wilson Tower Pinkster 630 Walnut St. Jeffersonville, IN 47130 Kyle.wilson@towerpinkster.com

Re: Report of Geotechnical Subsurface Exploration

> Harrison REMC Campus Additions and Improvements and New Pole Yard 1165 Old Forest Road, Corydon, IN PPA Project No. 17-13685

Dear Mr. Wilson:

Submitted herewith is the report of the geotechnical subsurface exploration performed by Paul Primavera & Associates (PPA) for the referenced project. This report contains the results of our field exploration and observation program, an engineering interpretation of the associated data with respect to the available project characteristics, and recommendations to aid project development planning, design, and construction of earth-supported structures.

We appreciate the opportunity to be of service to you on this project. If we can be of any further assistance, or if you have any questions regarding this report, please do not hesitate to contact either of the undersigned.

Sincerely.

Paul Primavera & Associates

Travis Andres, P.E.

STATE OF ADIANA ANDIANA SONAL ENGINEERING Principal Geotechnical Engineer

Licensed Indiana 11300496

Table of Contents

1	PURPOSE AND SCOPE				
2	PROJECT INFORMATION				
3	GENERAL SUBSURFACE CONDITIONS			1	
	3.1	Subsurface Soil/Bedrock Conditions			
	3.2	Ground	d Water	3	
4	DESI	GN REC	OMMENDATIONS	3	
	4.1	Genera	al Construction Considerations	3	
	4.2	Spread	d Footings	4	
	4.3	Floor Slabs5			
	4.4	Pavement			
		4.4.1	Asphalt Pavement	6	
		4.4.2	Concrete Pavement		
	4.5	Site Gr	rading and Drainage	7	
5	GEN	ERAL CO	INSTRUCTION PROCEDURES AND RECOMMENDATION	S7	
	5.1	Site Pr	eparation	7	
	5.2				
	5.3	5.3 Foundation Excavation Observations		8	
	5.4 Construction Dewatering				
	5.5 Karst Sinkhole Remediation		9		
6	LIMITATIONS OF STUDY10				

Appendix

Important Information about Geotechnical Report Site Location Plan Boring Location Plan Boring Logs and Legend

1 PURPOSE AND SCOPE

The purpose of this study was to determine the general subsurface conditions at the project site and to evaluate this data with respect to site development and foundation and pavement concept consideration for the planned development. Twenty-five (25) soil test borings and soundings were extended to select depths judged acceptable for the proposed development and specific planned structure locations by the geotechnical engineer. Location plans and logs of the encountered conditions are included in the Appendix.

Also, included is an evaluation of the site with respect to potential construction problems and recommendations dealing with earthwork and quality control during construction. The purpose of the exploration was to evaluate geotechnical feasibility for the owner and designers to evaluate the site.

2 PROJECT INFORMATION

Project information was provided through email and phone correspondence with Kyle Wilson of Tower Pinkster and Ryan Strohbeck of Harrison REMC. PPA has prior geotechnical consulting experience on the site. Most recently, PPA assisted Harrison REMC on the northern portion of this project site, the proposed new pole yard area, by providing geotechnical consulting related to existing karst conditions prior to their purchase of the property in January 2024.

The project site consists of two properties across Old Forest Road. The north site is currently vacant and undeveloped. A proposed pole laydown yard with gated entrance and perimeter fence area are planned for the north site. The south site is currently the existing Harrison REMC headquarters campus, with office, lounge, garage, and indoor and outdoor storage areas. Various interior renovations, facility additions, and storage structures and parking areas are planned for the existing campus site. The building types are unknown at this time; however, for purposes of this proposal and initial planning purposes, all facility additions and new structures are expected to be single-story, shallow foundation supported, slab on grade structures. A combination of light and heavy-duty asphalt and aggregate pavements are expected for the campus site and heavy-duty aggregate base is expected for the pole yard site. Site grading on the magnitude of nearly 5 feet of cut/fill is expected to establish design grades based on existing site topography.

3 GENERAL SUBSURFACE CONDITIONS

3.1 Subsurface Soil/Bedrock Conditions

A review of the Geologic Map of Indiana by the Indiana Geological Survey indicates the site is underlain by native soils formed as residual from the underlying limestone of the St. Louis and Ste. Genevieve limestone formations of the Blue River Group. These limestone formations are known to be karstic in nature with sinkhole development known in the project vicinity and on this site. Bedrock surface elevations in this geology can vary drastically over relatively short distances due to the relatively solutioned and pinnacled surface nature. Several apparent sinkholes were identified previously by PPA and also appear on available topographic mapping for the site. Those locations have already been considered in the site development and design drawings by Heritage Engineering.

The general subsurface conditions were investigated by twenty-five (25) soil borings and soundings with depths ranging from 4.5 to 29.5 ft below existing grade (BEG) at the approximate locations shown on the Boring Location Plan (Figure 2 in the Appendix). The subsurface conditions disclosed by the field investigation are summarized in the following paragraphs. Detailed descriptions of the subsurface conditions encountered in each test pit are presented on the Test Pit Logs in the Appendix.

Surface Materials:

In general, the test borings encountered either topsoil, gravel, or asphalt pavement at the existing ground surface. Where encountered, topsoil thicknesses throughout both the campus and yard site ranged 3 to 10 inches; asphalt was measured 4 inches thick in B-1 and was underlain by 6 inches of crushed stone on the campus site; crushed stone base thicknesses ranged 4 to 12 inches in the existing pole yard area of the campus.

Fill Materials:

Fill was encountered in test borings B-4 and B-5 and was observed at the ground surface in the sinkholes located adjacent to sounding locations S-1 and S-3. The fill materials encountered in the borings is described as intermixed lean and fat clay, likely associated with the existing campus site development. The fill appears to be well consolidated and likely placed in a controlled manner as part of the prior site grading of the development. The fill observed in the sinkhole adjacent to sounding S-1 consisted of 2 inch minus crushed limestone and appeared to have been placed to fill the sinkhole surface void. The raveling of that stone down into the sinkhole was apparent. The fill observed in the sinkhole adjacent to sounding S-3 consisted a mixture of clay, gravel, and cored limestone and shale rock fragments that appeared to be waste from utility pole boring/coring installations.

Native Materials:

A combination of Lean Clay (CL) and Fat Clay (CL) was encountered beneath the surface and fill materials at all locations. The lean clay typically overlaid fat clay with an approximately discerned transition depth as indicated on the boring logs. In general, the clay was brown to red-brown and tan in color, firm to very stiff, moist to very moist and extended to boring termination depths or boring refusal on weathered to sound limestone bedrock.

Refusal Materials:

Refusal materials were encountered at depths ranging 4.5 to 29.5 feet in the exploration excavations. Refusal is defined as the depth at which an excavation or drilling method can no longer be readily advanced using the specific exploration equipment. In an area of limestone bedrock overlain by residual soil, refusal can result on weathered bedrock that could include void and filled fractures, joints, or seams, unweathered limestone floaters, pinnacles, crevices or competent continuous bedrock. Refusal may not necessarily coincide with the bedrock surface. Refusal can also occur on obstructions such as debris, old foundations, slabs, utilities, or similar inclusions above the bedrock surface.

Sinkhole Soundings:

Obtaining representative samples of materials within a sinkhole or closed contour depression can be difficult; therefore, soundings to bedrock with no sampling was performed at sounding locations S-1, S-2, and S-3. Refusal depths at these locations ranged 12.8 to 29.5 feet. Interpretation of the drilling operations suggests multiple voids, limestone fragments, boulder, and floaters with were encountered throughout,

which are typical conditions encountered in open sinkhole excavations. Specific recommendations for remediation of the encountered sinkholes on the main campus are provided in Section 5.5. Recommendations for remediation of the encountered sinkholes on the pole yard site were provided in an previously delivered PPA report to HREMC, titled *Karst Reconnaissance Study* and dated January 10, 2024.

3.2 Ground Water

Groundwater was not encountered in any of the exploration excavations. The site is located within a known karstic area with a complex subsurface karst drainage network. Groundwater levels typically coincide with the water levels of nearby creeks and rivers and can potentially vary widely with varying flow levels and following heavy precipitation events. Sinkholes are typically the governing surface drainage features in the vicinity, which lead to this complex underground drainage network. To better define the ground water regime at this site, an extensive ground water monitoring program would be required and is not considered practical or necessary for this project. It is not uncommon to encounter significant amounts of ground water in excavations that extend near or into bedrock or in sinkhole remediation excavations. The ground water flow patterns can also be changed because of construction and changes in site grading. Therefore, varying ground water levels could be encountered in the future, but typically are not encountered within the excavation and construction limits of the proposed development and construction type.

4 DESIGN RECOMMENDATIONS

The following design recommendations have been developed based on the previously described project information and subsurface conditions. If there is any change in the project information or site location, our office should review to determine if alterations to our evaluation and recommendations are warranted.

4.1 General Construction Considerations

Based upon the results of the subsurface investigation performed at this site in conjunction with the assumed finished floor elevations, the most feasible and economical foundation system for support of the proposed structures appears to be conventional shallow spread footings bearing on stiff natural clay soils, sound limestone bedrock, or on well-compacted engineered fill materials that are placed over these natural materials. It is important to note that weathered limestone was encountered at relatively shallow depths in various areas of the site. Depending on the design grades, limestone may be encountered at or even above the design subgrade or foundation bearing elevation. Design recommendations for spread footings are provided in Section 4.2.

Careful evaluation of the footing bearing materials will be required at the time of construction to identify uncontrolled fill materials that must be removed from beneath the foundations and replaced with engineered fill. It is important that the observation and evaluation methods outlined in Section 5.3 be implemented and that any soft natural soils, old fill materials, and remnants from previous construction revealed by such observations and evaluations be removed and replaced.

4.1.1 Construction in Karst

The proposed project site is underlain by a limestone formation that has an irregular surface and is subject to dissolution along joints and bedding planes within the rock mass. It is known that karst features (such as clay-filled zones, solution channels, voids and sinkholes) have developed on site. Some of which may have been previously remediated, but the documentation is unavailable to confirm. Construction within an area of severe karst terrain, such as on this site, is accompanied by a degree of risk due to the potential for future ground subsidence, of which is no different than much of the surrounding area. Several sinkholes and closed contour depressions have been identified in the site vicinity, including this site, and based on local experience, may be encountered with further exploration and during construction (i.e. site cutting, proofrolls, etc.). Careful observation, testing, and inspection during site preparation and earthwork is very helpful to identify potential buried karst features that will require attention and possible remediation.

4.1.2 Fine Grained Clay Soils

Clays encountered in the exploration excavations have the potential to undergo volume changes with fluctuations in moisture content and may destabilize during varying moisture and site activities during construction. This potential for shrinkage or expansion is often the result of a combination of factors including the availability of excess moisture and the removal of overburden soil or addition of fill materials and structural loads. The risk of volume changes in site soils can be managed by ensuring proper drainage of surface water away from the buildings, limiting irrigation watering near the buildings and preventing leaks in the water lines or drains.

4.2 Spread Footings

Our findings show that the proposed structures can be supported on conventional shallow spread footings bearing on stiff natural soils or engineered fill over stiff natural soils provided that any unsuitable materials (such as soft natural soil or unsuitable existing fill) are removed and replaced with engineered fill. It will be necessary to remove any unsuitable materials, including pockets of soft natural soils, all old uncontrolled fill materials judged unsuitable or remnants from previous construction, below the nominal spread footing bearing elevations to re-establish the nominal design bearing level using engineered fill, flowable fill, or lean concrete as described in Section 5.2. Spread footings that bear on stiff natural soils or on engineered fill that is placed over stiff natural soils, can be designed for a **net allowable bearing pressure of 2,500 lbs/sq.ft**. It is important that the soil at the base of each spread footing excavation be carefully observed and evaluated as described in Section 5.3 to determine whether the actual bearing materials are consistent with those upon which the recommendations are based.

Based on geologic mapping, our experience in the project area, and the results of the test pits, it is our opinion that the subsurface conditions at this site meet the **seismic design criteria for Site Class C** based on Section 1613.3.2 of the 2018 International Building Code and the use of shallow spread foundations.

Wall footings should be at least 1.5 ft wide and column footings should be at least 2.5 ft wide for bearing capacity considerations. All exterior footings and footings in unconditioned areas should bear at a depth of at least 2.0 ft below the final exterior grade for frost protection, per the Indiana Building Code requirements for Harrison County.

Provided that the footings are designed as prescribed herein and the footing excavations are observed and evaluated as outlined in Section 5.3, it is estimated that the total and differential foundation settlements should not exceed about 1 and ¾ in., respectively. Careful field control will contribute substantially to minimizing the settlements.

Uplift forces on the spread footings can be resisted by the weight of the footings and the soil material that is placed over the footings. It is recommended that the soil weight considered to resist uplift loads be limited to that immediately above and within the perimeter of the footings (unless a much higher factor of safety is used). A total soil unit weight of 110 lbs/cu.ft can be used for the backfill material placed above the footings, provided it is compacted as recommended in Section 5.2. It is also recommended that a factor of safety of at least 1.3 be used for calculating uplift resistance from the footings using the recommendations of this section.

Lateral forces on a spread footing can be resisted by the passive lateral earth pressure against the side of the footing and by friction between the soil and the base of the footing. A uniform allowable passive pressure of 110 lbs/sq.ft per foot of depth can be used for the portion of the footing that is below a depth of 2 ft below the final exterior grade (no portion of the footing above this depth should use for lateral resistance). An allowable coefficient of friction between the base of the footing and the underlying soil of 0.2 based on a factor of safety of 1.5 can be used in conjunction with the minimum downward load on the base of the footing.

4.3 Floor Slabs

Floor slabs can be supported on stiff, low-plasticity natural soils, existing fill soils judged suitable by the engineer via proofrolling, or on new compacted structural fill. It is recommended that the slab-on-grade floors be supported on a minimum of 4 in. thick layer of granular material such as crushed stone. However, it is strongly suggested that a minimum of 6 in. of crushed stone be provided based on the moisture sensitive nature of site soils. This is to help equalize moisture conditions beneath the floor slab and provide uniform support for the slab. Provided that a minimum of 4 inches of crushed stone is placed beneath the floor slabs, a modulus of subgrade reaction of 100 lbs/cu. in. can be used for design of the floor slabs.

4.4 Pavement

Controlling subsurface water in pavement areas is important to enhancing the long-term performance of the pavements. The pavement subgrade surface should be uniformly sloped to facilitate drainage through the granular base and to avoid ponding water beneath the pavement. The subgrade should also be prepared Section 5 of this report.

The following report sections outline recommendations for asphalt and concrete pavements as well as crushed stone based for automobile parking and drive areas, truck zones, and laydown areas. It is important to note that the recommendations for the automobile parking areas assume that these areas will not be subject to any heavy truck traffic. Therefore, in areas where truck traffic cannot be controlled (i.e., driveways), it is suggested that the thicker pavement section be utilized.

4.4.1 Asphalt Pavement

Based on the estimated traffic loading and the conditions encountered at the site, the following <u>minimum</u> asphalt pavement sections are recommended:

Automobile Parking Areas 3 inches of asphalt

6 inches of granular base (INDOT #53 or #73 stone)

Driveway Areas 5 inches of asphalt

and Truck Zones 6 inches of granular base (INDOT #53 or #73 stone)

A thinner pavement section would be acceptable to satisfy minimum criteria based on light duty traffic only. However, the **minimum** pavement section provided herein is strongly recommended to provide long-term stability, decreased maintenance, and more feasible remediation at the end of the pavement's useful life.

4.4.2 Concrete Pavement

Concrete pavement thicknesses were determined from methods developed by the Portland Cement Association (PCA), the American Association of State Highway and Transportation Officials (AASHTO) and the American Concrete Institute (ACI). These methods assume that the subgrade is firm, well-compacted and non-pumping and that all joints are properly designed, located and sealed to minimize moisture seepage into the subgrade. It is also important to ensure that proper concrete curing practices will be employed and that traffic will not be allowed until the concrete has had sufficient time to cure.

For design calculation purposes, the compressive strength of the concrete was assumed to be 4,000 lbs/sq.in. The modulus of subgrade reaction of the soil (k) was estimated to be 100 lbs/cu.in.

Based on the above information, the following minimum concrete pavement sections are recommended:

Automobile Parking Areas 5 inches of concrete

6 inches of granular base (INDOT #53 or #73 stone)

Driveway Areas and Truck Zones 6 inches of concrete

8 inches of granular base (INDOT #53 or #73 stone)

4.4.3 Crushed Stone Base

It is considered likely that the laydown area entrance drives and storage bays will consist of crushed stone base. Based on the estimated traffic loading and the observed performance of the existing laydown areas and drives, the following minimum crushed stone pavement sections are recommended:

Driveway Areas 12 inches of granular base (INDOT #53 or #73 stone)

and Truck Zones

Equipment Laydown Bays 8 inches of granular base (INDOT #53 or #73 stone)

The above recommended stone base sections are considered adequate for the expected loading; however, the durability and reliability of the stone base, concrete, and asphalt sections can be improved

with incorporation of a woven geotextile placed atop the soil subgrade, beneath the installed stone base section. Incorporation of which will greatly decrease the potential for subgrade degradation, rutting, potholing, and subsequent pavement stresses. If considered, Mirafi HP-Series woven geotextiles intended for stabilization and soil reinforcement applications are recommended.

4.5 Site Grading and Drainage

Proper surface and subgrade drainage should be provided at the site to minimize any increase in moisture content of the foundation soils. Pavement subgrades should be sloped to drain and stone base underlying pavement sections should be daylighted where possible at the edge of pavements. The exterior grade should be sloped away from the structures to prevent ponding of water. Any roof drains or down spouts should be channeled or piped well away from the structure.

5 GENERAL CONSTRUCTION PROCEDURES AND RECOMMENDATIONS

Even under the best of circumstances, the conditions encountered during construction should be expected to vary somewhat from the exploration results and may differ to the extent that modifications to the foundation recommendations become necessary. PPA should be retained as geotechnical consultant throughout the earth-related phases of this project to correlate actual soil and rock conditions with test pit data, identify variations, conduct additional tests that may be needed and recommend solutions to earth-related problems that may develop.

5.1 Site Preparation

After site stripping and prior to placement of fill or installation of building and pavement structures, the exposed subgrade should be carefully observed by the geotechnical engineer by probing and testing as needed. Any organic material still in place, frozen, wet, soft or loose soil, uncontrolled fill, existing demolition debris and pavements, foundation remnants, utilities and other undesirable materials should be removed. The exposed subgrade should furthermore be evaluated by proofrolling with suitable equipment to check for pockets of soft material which may be hidden visually. Any unsuitable materials thus exposed should be removed and replaced with well-compacted, engineered fill as outlined in Section 5.2.

After the site has been cleared and prior to the placement of any fill, the PPA engineer should check the site to identify any sinkholes or other near surface karst features that may be evident. Proofrolling in the building and pavement areas with a loaded dump truck, heavy roller compactor, or scraper/grader is recommended to check for hidden sinkholes or dolines in which soil collapse may be imminent. In general, an identified sinkhole or karst feature should be excavated down to the "throat" of the solution feature, or as close to the throat as reasonable to explore the extents and aid in determination of potential remedial measures. PPA should be retained to examine the excavated areas and to assist in remedial measures for the karst feature throats. Specific recommendations for sinkhole and karst feature stabilization would be made by the geotechnical engineer at the time of construction based upon the specific conditions encountered.

Care should be exercised during the grading operations at the site. It is important that positive surface drainage be established at the beginning of the earthwork operations and be maintained throughout the project. Surface water must not be allowed to pond. Due to the nature of the near surface soils, the traffic of construction equipment may create pumping and general deterioration of the shallower soils, especially if excess surface water is present. The grading, therefore, should be done during a dry season, if possible. Based on our experience on other nearby sites, it is likely that the subgrade soils in some areas will be wet and soft when exposed. The extent to which yielding subgrade may be a problem is difficult to predict beforehand since it is dependent upon several factors.

It may be possible to improve or stabilize the subgrade soils in the areas that are found to be excessively wet, soft or yielding at the time of construction, by discing, aerating and recompacting (moisture conditioning). If moisture conditioning is unsuccessful, time sensitivity is an issue, or site grading operations are planned through the winter months, mechanical or chemical subgrade stabilization, or removal of the unsuitable soils and replacement with crushed limestone or engineered soil fill is expected to be required. The best method for stabilizing the subgrade should be determined in the field at the time of construction based upon the actual field conditions in conjunction with the specific soil type encountered at the locations requiring stabilization, the size of the areas requiring stabilization and the construction schedule.

5.2 Fill Compaction

All engineered fill beneath structures and pavements should be prepared, placed, and compacted in a manner to achieve a dry density of at least 95 percent of the standard Proctor maximum dry density (ASTM D-698). The compaction should be accomplished by placing the fill in about 8 in. (or less) loose lifts and mechanically compacting each lift to at least the specified minimum dry density. Generally, soil fill materials should be compacted using a non-vibratory sheeps-foot roller and sand or aggregate fill materials should be compacted using a vibratory smooth-drum roller or other method judged acceptable by the geotechnical engineer. Field density tests and/or proofrolling should be performed on each lift as necessary to ensure that adequate moisture conditioning and compaction effort with subsequent stability is being achieved. The soils encountered on the site are considered suitable as general fill material provided the recommendations provided in Sections 4 and 5 are considered.

It is recommended that only well-graded granular material, such as pit-run sand and gravel or INDOT #53 or #73 crushed limestone or lean concrete be used to fill undercut excavations beneath footings and other excavations of limited lateral dimensions where proper compaction of cohesive materials is difficult and compaction can only be accomplished with small vibratory equipment.

5.3 Foundation Excavation Observations

The soil at the base of each spread footing or basement excavation should be observed and evaluated by a geotechnical engineer to ensure the footing will bear on satisfactory material. At the time of such inspection, it will be necessary to make hand auger borings or use hand penetration devices in the base of the foundation excavation to determine whether subgrade soils are satisfactory for foundation support.

Where undercutting is required to remove unsuitable materials to reach acceptable bearing materials, the proposed footing bearing elevation may be re-established by backfilling. The fill should be limited

to low plasticity site soils or well-graded crushed stone compacted to the minimum dry density recommended in Section 5.2. Alternatively, lean concrete or cementitious flowable fill may be used.

Soils exposed in the bases of all satisfactory foundation excavations should be protected against any detrimental change in condition such as disturbance, dramatic moisture changes, and freezing. If possible, all footing concrete should be placed the same day the excavation is made. If this is not practical, the footing excavations should be adequately protected or removal of any softened materials from such disturbance, moisture change, or freeze/thaw will be required prior to placement of reinforcement and concrete pouring.

If encountered, the limestone bedrock known to underly this site is expected to be too hard to be removed with conventional soil excavation equipment. If required, hoe-ramming or other pneumatic rock removal equipment will likely be necessary. Mass rock excavation is not expected as part of the development.

5.4 Construction Dewatering

No measurable groundwater was encountered in the test borings and soundings; however, depending on the seasonal conditions, some seepage into excavations may be experienced, particularly in deeper excavations that encroach bedrock, within sinkholes, or near existing underground utility trenches. It is anticipated that such seepage can be handled by conventional dewatering methods such as by pumping from sumps. However, in cases where a saturated layer is encountered in the base or sidewall of the excavation, it will not be possible to pump water directly from the base of the excavation without causing deterioration of the subgrade soil. In this case, it will be necessary to pump from a sump located adjacent to the excavation. The best dewatering system for each case must be determined at the time of construction based upon actual field conditions. Dewatering is not expected to be required.

5.5 Karst Sinkhole Remediation

The existing sinkholes located adjacent to sounding locations S-1, S-2, and Y-7 appear to be located outside of proposed development areas; however, the new developments may encroach on these areas. S-1 and Y-7 may be left as-is but should be monitored during earthwork and following construction for the potential need to remediate. At minimum, it is recommended that the existing drainage characteristics, such as contributing runoff volumes and rates draining to these features be either maintained or decreased. Increasing such rates could lead to increased and uncontrolled growth of the features that could detrimentally encroach any adjacent improvements.

The existing sinkholes located adjacent to S-3 and Y-4 appear to be located within proposed development areas. Pavement and laydown areas are planned for the respective locations, which is considered acceptable.

The sinkhole features at S-2, S-3, and Y-4 should be further explored via open excavation and potentially remediated based on the conditions encountered in those excavations. It is recommended this be performed during the earthwork and grading operations of the project. Although remedial measures will be determined at the time of excavation based on actual conditions encountered, they are expected to consist of excavation to a throat in the bedrock surface, sloping back the surrounding soils, and installation of a geosynthetic filter wrapped stone envelope capped with compacted clay. Depending on the site grading and drainage design these features may be remediated or improved by

considering this potential. Additional planning and discussion with PPA will be required if that is the case.

6 LIMITATIONS OF STUDY

An inherent limitation of any geotechnical engineering study is that conclusions must be drawn based on data collected at a limited number of discrete locations. The recommendations provided in this report were developed from the information obtained from the excavations that depict subsurface conditions only at these specific locations and at the time designated on the logs. Soil and bedrock conditions at other locations may differ from conditions occurring at these pit locations. The nature and extent of variations between the excavations may not become evident until the course of construction. If variations then appear evident, it will be necessary to re-evaluate the recommendations of this report after performing on-site observations during the excavation period and noting the characteristics of any variation.

Our professional services have been performed, our findings obtained, and our recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices. This warranty is in lieu of all other warranties either express or implied. This company is not responsible for the independent conclusions, opinions, or recommendations made by others based on the field exploration and laboratory test data presented in this report.

The scope of our services does not include any environmental assessment or investigation for the presence or absence of hazardous or toxic materials in the soil, ground water or surface water within or beyond the site studied.

PPA assumes no responsibility for any construction procedures, temporary excavations (including utility trenches), temporary dewatering or site safety during or after construction. The contractor will be solely responsible for all construction procedures, construction means and methods, construction sequencing and for safety measures during construction. All applicable federal, state and local laws and regulations regarding construction safety must be followed, including current Occupational Safety and Health Administration (OSHA) Regulations including OSHA 29 CFR Part 1926 "Safety and Health Regulations for Construction", Subpart P "Excavations", and/or successor regulations. The Contractor is solely responsible for designing and constructing stable, temporary excavations and should brace, shore, slope, or bench the sides of the excavations as necessary to maintain stability of the excavation sides and bottom.

Appendix

Important Information About Your Geotechnical Engineering Report

Figure 1: Site Vicinity Plan Figure 2: Test Pit Location Plan

Boring Logs and Legend

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you - assumedly a client representative - interpret and apply this geotechnical-engineering report as effectively as possible. In that way, you can benefit from a lowered exposure to problems associated with subsurface conditions at project sites and development of them that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed herein, contact your GBA-member geotechnical engineer. Active engagement in GBA exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Understand the Geotechnical-Engineering Services Provided for this Report

Geotechnical-engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical-engineering services is typically a geotechnical-engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical-engineering study conducted for a given civil engineer will <u>not</u> likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared solely for the client.

Likewise, geotechnical-engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical-engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will <u>not</u> be adequate to develop geotechnical design recommendations for the project.

Do not rely on this report if your geotechnical engineer prepared it:

- · for a different client;
- · for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it;
 e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. If you are the least bit uncertain about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

Read this Report in Full

Costly problems have occurred because those relying on a geotechnicalengineering report did not read the report in its entirety. Do <u>not</u> rely on an executive summary. Do <u>not</u> read selective elements only. Read and refer to the report in full.

You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:

- · the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- · the composition of the design team; or
- project ownership.

As a general rule, always inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. The geotechnical engineer who prepared this report cannot accept responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface using various sampling and testing procedures. Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing is performed. The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgement to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team through project completion to obtain informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, they are <u>not</u> final, because the geotechnical engineer who developed them relied heavily on judgement and opinion to do so. Your geotechnical engineer can finalize the recommendations only after observing actual subsurface conditions exposed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnicalengineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a continuing member of the design team, to:

- · confer with other design-team members;
- help develop specifications;
- review pertinent elements of other design professionals' plans and specifications; and
- be available whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction-phase observations.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, but be certain to note

conspicuously that you've included the material for information purposes only. To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, only from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and be sure to allow enough time to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. Read these provisions closely. Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. Unanticipated subsurface environmental problems have led to project failures. If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

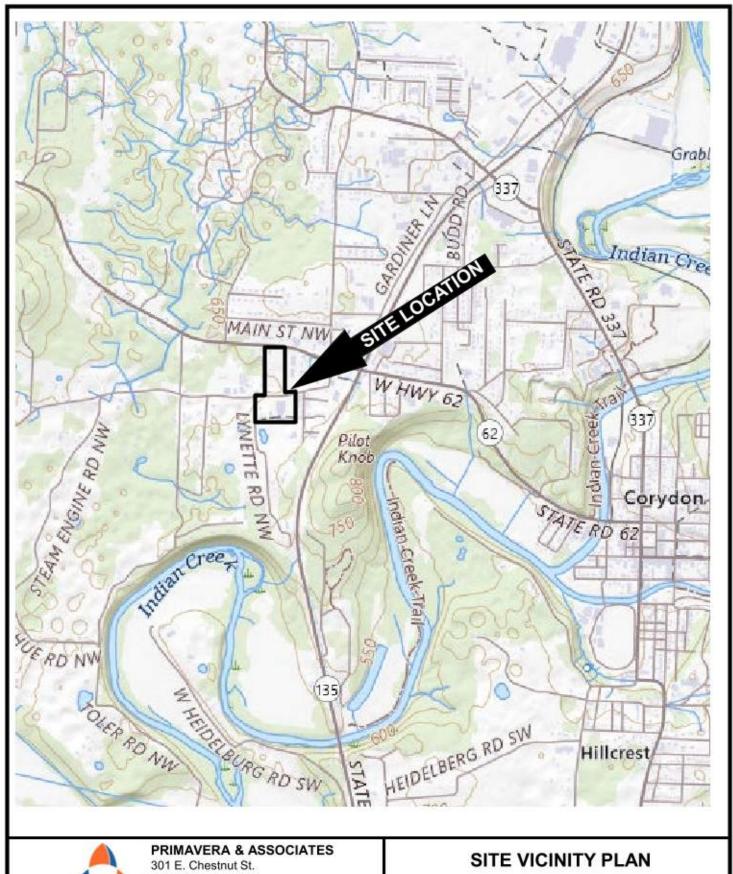
While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer's services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration. Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. Geotechnical engineers are not building-envelope or mold specialists.



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Corydon, IN 47112 812-738-4124

PROJECT NO: 24928

DESIGNED BY: TA REVIEWED BY: JC DRAWN BY: TA DATE: 6/18/24 FIGURE: 1

Harrison REMC Headquarters **Old Forest Road** Corydon, IN





PRIMAVERA & ASSOCIATES

301 E. Chestnut St. Corydon, IN 47112 812-738-4124

PROJECT NO: 24928

DESIGNED BY: TA REVIEWED BY: JC

DRAWN BY: TA DATE: 6/18/24 FIGURE: 2

BORING LOCATION PLAN

Harrison REMC Headquarters Old Forest Road Corydon, IN



Project: Harrison REMC Headquarters, David

C Lett

Address: 1165 Old Forest Road, Corydon, IN

BORING LOG

Boring No. B-1 Page: 1 of 1

Drilling Start Date: 6/10/24 Boring Depth

Drilling End Date: 6/10/24

Drilling Company: GL

Drilling Method: Direct Push
Drilling Equipment: Geoprobe 7700

Driller: MR

Logged By: TA

Boring Depth (ft): 5.8

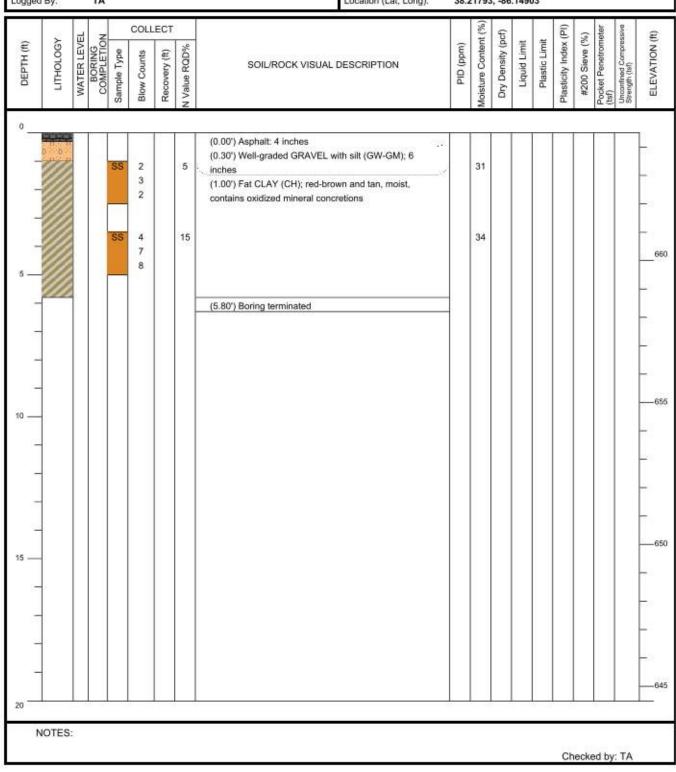
Boring Diameter (in): 3.0

Sampling Method(s): Split Spoon

DTW During Drilling (ft): N/A
DTW After Drilling (ft): N/A

Ground Surface Elev. (ft): 664.5

Location (Lat, Long): 38.21793, -86.14903





Project: Harrison REMC Headquarters, David

Let

Address: 1165 Old Forest Road, Corydon, IN

BORING LOG

1 of 1

Boring No. B-2

Page:

Drilling Start Date: 6/10/24 Boring Depth

Drilling End Date: 6/10/24

Drilling Company: GL

Drilling Method: Direct Push
Drilling Equipment: Geoprobe 7700

Driller: MR

Logged By: TA

Boring Depth (ft): 9.75

Boring Diameter (in): 3.0

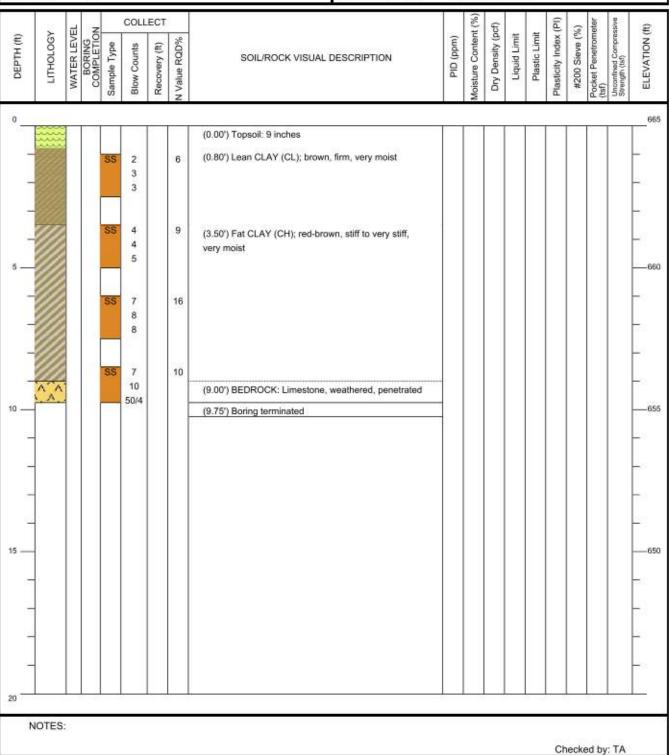
Sampling Method(s): Split Spoon

DTW During Drilling (ft): N/A

DTW After Drilling (ft): N/A

Ground Surface Elev. (ft): 665.0

Location (Lat, Long): 38.21751, -86.14786





Project: Harrison REMC Headquarters, David

Let

Address: 1165 Old Forest Road, Corydon, IN

BORING LOG

Boring No. B-3 Page: 1 of 1

Drilling Start Date: 6/10/24

Drilling End Date: 6/10/24

Drilling Company: GL

Drilling Method: Direct Push
Drilling Equipment: Geoprobe 7700

Driller: MR

Logged By: TA

Boring Depth (ft): 11.2

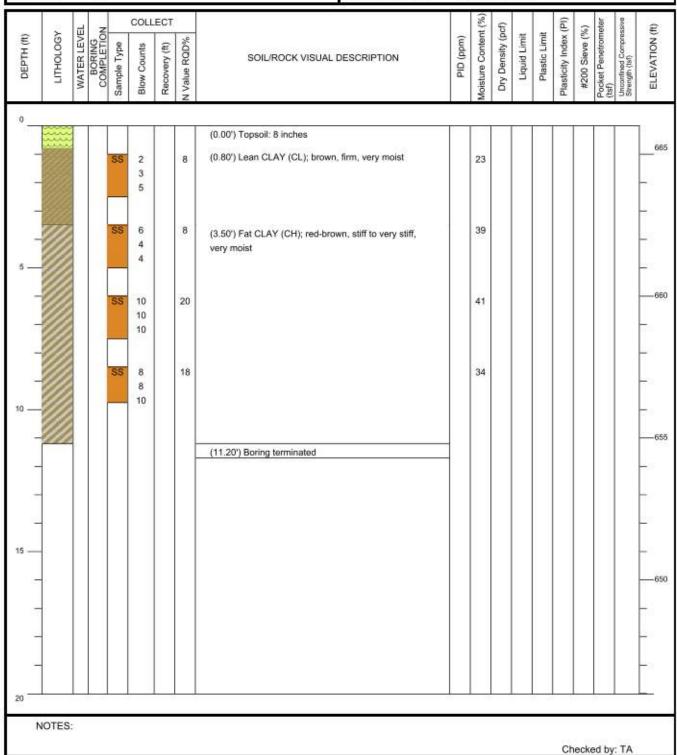
Boring Diameter (in): 3.0

Sampling Method(s): Split Spoon

DTW During Drilling (ft): N/A
DTW After Drilling (ft): N/A

Ground Surface Elev. (ft): 666.0

Location (Lat, Long): 38.21731, -86.14787





Harrison REMC Headquarters, David Project:

Address: 1165 Old Forest Road, Corydon, IN **BORING LOG**

1 of 1

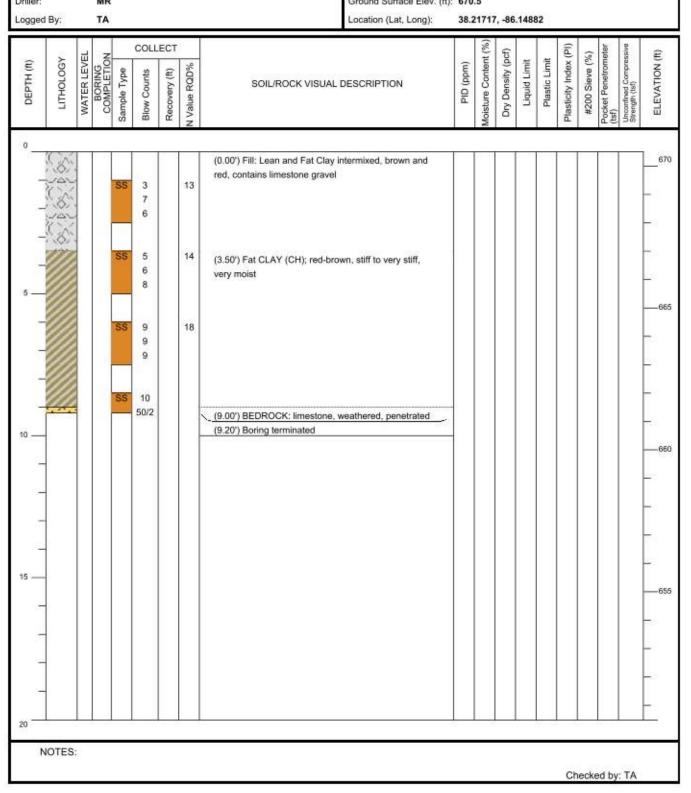
Boring No. B-4

Page:

Drilling Start Date: 6/7/24 Boring Depth (ft):

Drilling End Date: 6/7/24 Boring Diameter (in): 0.0 Drilling Company: GL Sampling Method(s): Split Spoon

Drilling Method: **Direct Push** DTW During Drilling (ft): N/A DTW After Drilling (ft): N/A Drilling Equipment: Geoprobe 7700 MR Ground Surface Elev. (ft): 670.5 Driller:





Harrison REMC Headquarters, David Project:

Address: 1165 Old Forest Road, Corydon, IN **BORING LOG**

1 of 1

Boring No. B-5 Page:

Drilling Start Date: 6/7/24 Boring Depth (ft):

Drilling End Date: 6/7/24

Drilling Company: GL

Drilling Method: **Direct Push** Drilling Equipment: Geoprobe 7700

MR Driller:

TA Logged By:

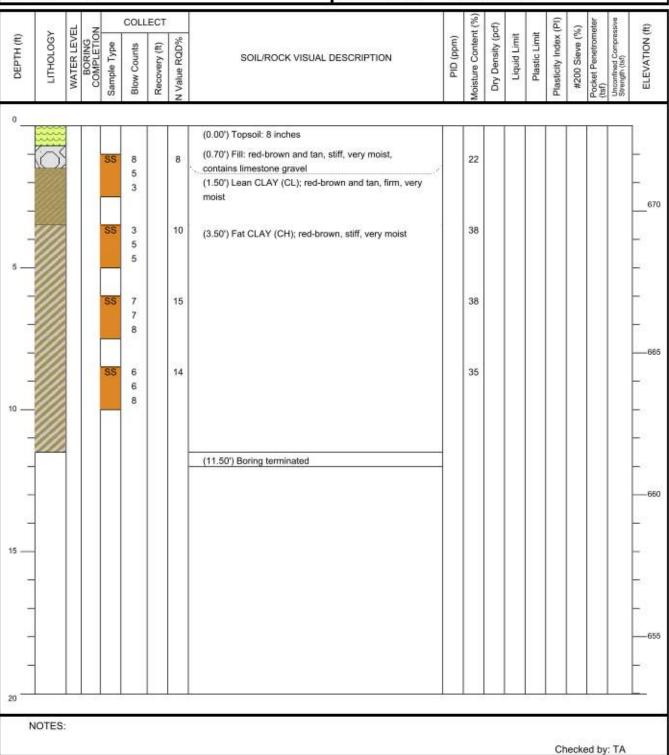
Boring Diameter (in): 3.0

Sampling Method(s): Split Spoon

DTW During Drilling (ft): DTW After Drilling (ft): N/A

Ground Surface Elev. (ft): 673.0

38.21713, -86.14818 Location (Lat, Long):





Project: Harrison REMC Headquarters, David

Lett

Address: 1165 Old Forest Road, Corydon, IN

BORING LOG

Boring No. B-6 Page: 1 of 1

0.0

Drilling Start Date: 6/7/24 Boring Depth (ft): 13.4

Drilling End Date: 6/7/24 Boring Diameter (in):

Drilling Company: GL Sampling Method(s): Split Spoon

Drilling Method; Direct Push

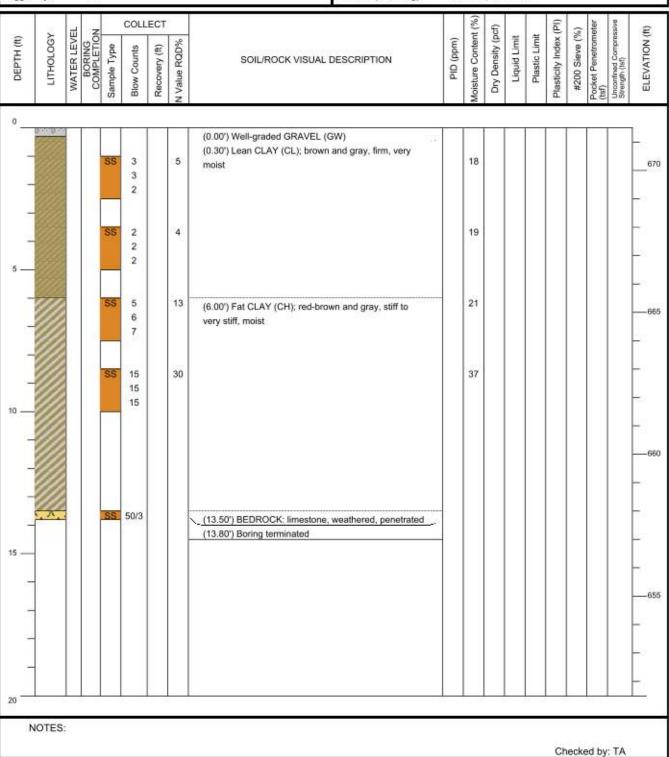
DrW During Drilling (ft): N/A

Drilling Equipment: Geoprobe 7700

DTW After Drilling (ft): N/A

Driller: MR Ground Surface Elev. (ft): 671.5

Logged By: TA Location (Lat, Long): 38.21696, -86.14882





Harrison REMC Headquarters, David Project:

Address: 1165 Old Forest Road, Corydon, IN **BORING LOG**

1 of 1

Boring No. B-7

Page:

Drilling Start Date: 6/7/24 Boring Depth (ft):

Drilling End Date: 6/7/24

Drilling Company: GL

Drilling Method: **Direct Push** Drilling Equipment: Geoprobe 7700

MR Driller:

TA Logged By:

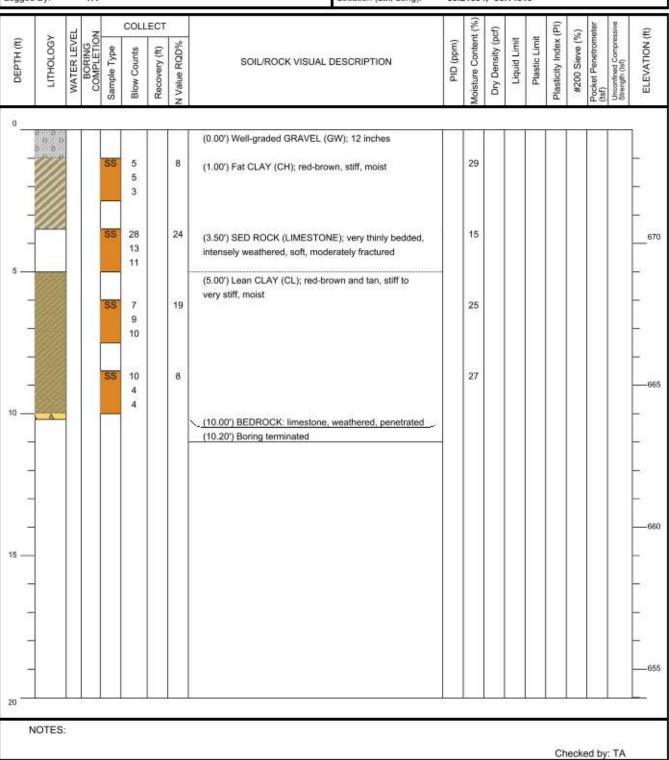
Boring Diameter (in): 3.0

Sampling Method(s): Split Spoon

DTW During Drilling (ft): DTW After Drilling (ft): N/A

Ground Surface Elev. (ft): 674.0

38.21694, -86.14819 Location (Lat, Long):





Project: Harrison REMC Headquarters, David

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Address: 1165 Old Forest Road, Corydon, IN

BORING LOG

Boring No. G-1 Page: 1 of 1

Drilling Start Date: 6/10/24

Drilling End Date: 6/10/24
Drilling Company: GL

Drilling Method: Direct Push
Drilling Equipment: Geoprobe 7700

Driller: MR

Logged By: TA

Boring Depth (ft): 15

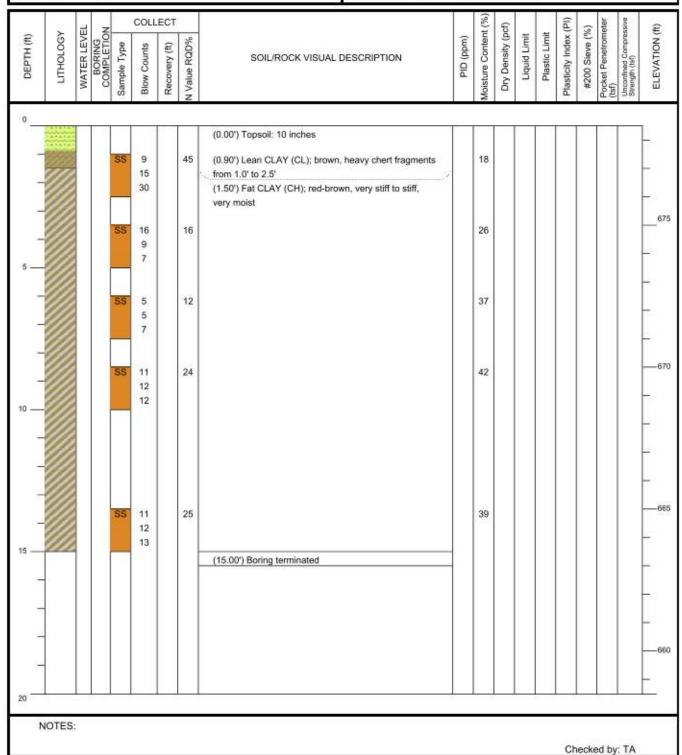
Boring Diameter (in): 3.0

Sampling Method(s): Split Spoon

DTW During Drilling (ft): N/A
DTW After Drilling (ft): N/A

Ground Surface Elev. (ft): 678.5

Location (Lat, Long): 38.21706, -86.14781





Harrison REMC Headquarters, David Project:

Address: 1165 Old Forest Road, Corydon, IN **BORING LOG**

1 of 1

Boring No. P-1

Page:

Drilling Start Date: 6/10/24

Drilling End Date: 6/10/24 Drilling Company: GL

Drilling Method: **Direct Push** Drilling Equipment: Geoprobe 7700

MR Driller:

TA

Boring Depth (ft): 10

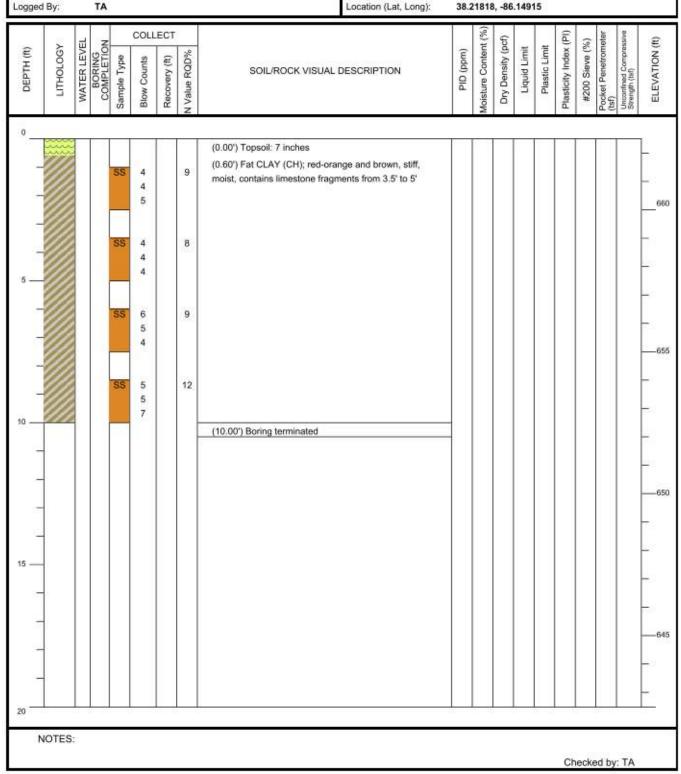
Boring Diameter (in): 3.0

Sampling Method(s): Split Spoon

DTW During Drilling (ft): N/A DTW After Drilling (ft): N/A

Ground Surface Elev. (ft): 662.5

38.21818, -86.14915 Location (Lat, Long):





Harrison REMC Headquarters, David Project:

Address:

BORING LOG

Boring No. P-2

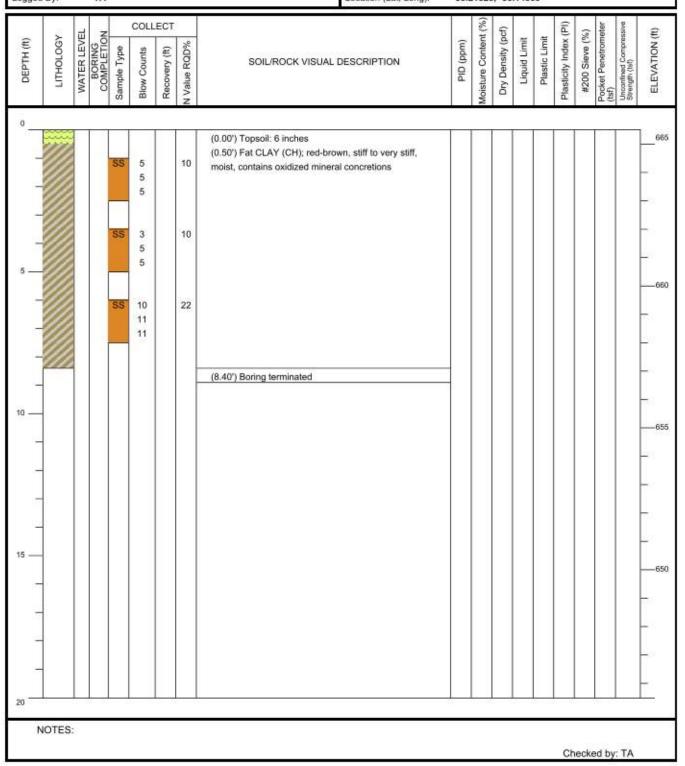
1165 Old Forest Road, Corydon, IN Page: 1 of 1

Drilling Start Date: 6/10/24 Boring Depth (ft): Drilling End Date: 6/10/24 Boring Diameter (in): 3.0

Drilling Company: GL Sampling Method(s): Split Spoon

Drilling Method: **Direct Push** DTW During Drilling (ft): N/A Drilling Equipment: Geoprobe 7700 DTW After Drilling (ft): N/A MR Ground Surface Elev. (ft): 665.5 Driller:

TA 38.21823, -86.14809 Logged By: Location (Lat, Long):





Project: Harrison REMC Headquarters, David

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Address: 1165 Old Forest Road, Corydon, IN

BORING LOG

Boring No. P-3 Page: 1 of 1

Drilling Start Date: 6/7/24

Drilling End Date: 6/7/24

Drilling Company: GL
Drilling Method: Direct Push

Drilling Equipment: Geoprobe 7700

Driller: MR

Logged By: TA

Boring Depth (ft): 10

Boring Diameter (in): 3.0

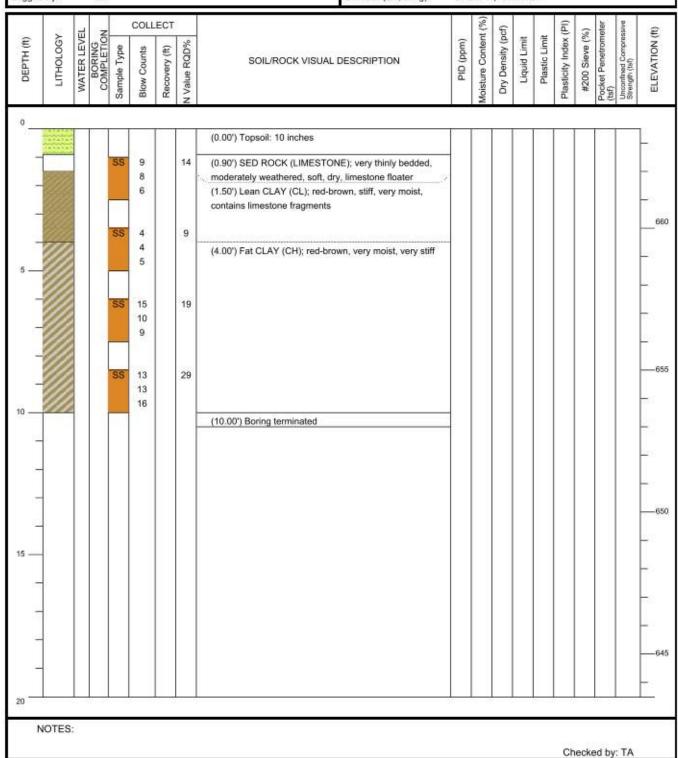
Sampling Method(s): Split Spoon

DTW During Drilling (ft): N/A

DTW After Drilling (ft): N/A

Ground Surface Elev. (ft): 663.5

Location (Lat, Long): 38.21744, -86.15020





Project: Harrison REMC Headquarters, David

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Address: 1165 Old Forest Road, Corydon, IN

BORING LOG

Boring No. P-4 Page: 1 of 1

Drilling Start Date: 6/7/24
Drilling End Date: 6/7/24

Drilling Company: GL

Drilling Method: Direct Push
Drilling Equipment: Geoprobe 7700

Driller: MR

Logged By: TA

Boring Depth (ft): 10

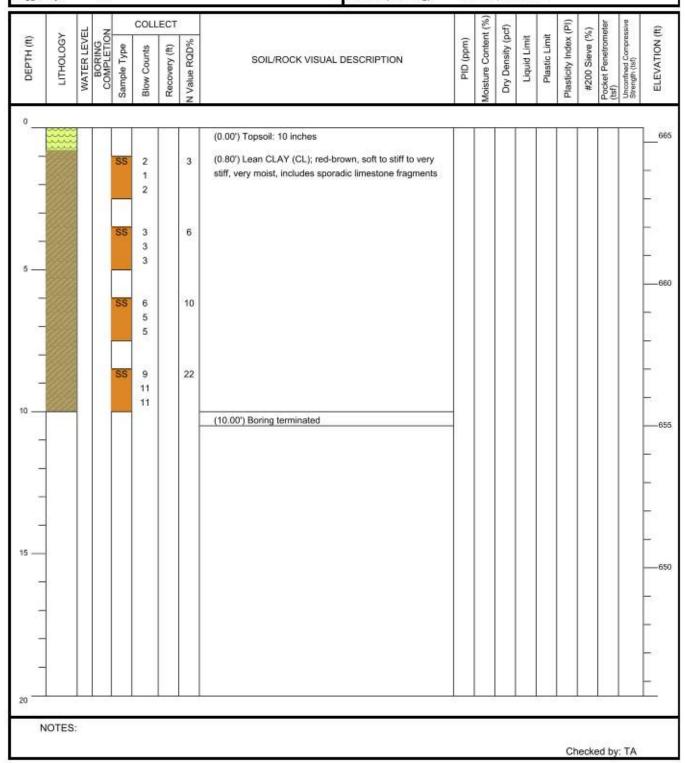
Boring Diameter (in): 3.0

Sampling Method(s): Split Spoon

DTW During Drilling (ft): N/A
DTW After Drilling (ft): N/A

Ground Surface Elev. (ft): 665.5

Location (Lat, Long): 38.21718, -86.14972





Project: Harrison REMC Headquarters, David

Lett

Address: 1165 Old Forest Road, Corydon, IN

BORING LOG

1 of 2

Boring No. S-1

Page:

Drilling Start Date: 6/7/24 Boring Depth (ft): 2

Drilling End Date: 6/7/24
Drilling Company: GL

Drilling Method: Direct Push

Drilling Equipment: Geoprobe 7700

Driller: MR

Logged By: TA

Boring Diameter (in): 3.0

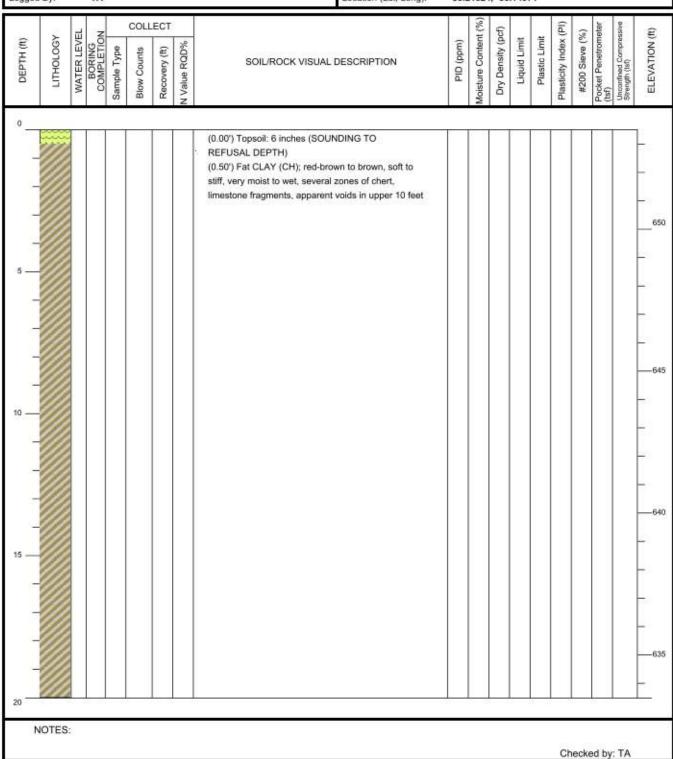
Sampling Method(s): N/A

DTW During Drilling (ft): N/A

DTW After Drilling (ft): N/A

Ground Surface Elev. (ft): 653.5

Location (Lat, Long): 38.21824, -86.14971





Project: Harrison REMC Headquarters, David

Lett

Address: 1165 Old Forest Road, Corydon, IN

BORING LOG

2 of 2

Boring No. S-1

Page:

Drilling Start Date: 6/7/24 Boring Depth (ft): 21.3

Drilling End Date: 6/7/24

Drilling Company: GL

Drilling Method: Direct Push
Drilling Equipment: Geoprobe 7700

Driller: MR

Logged By: TA

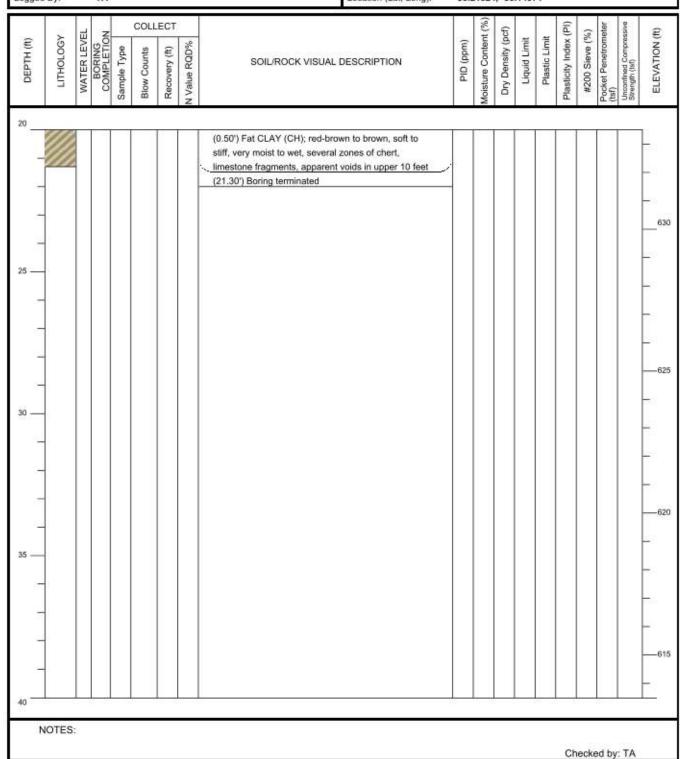
Boring Diameter (in): 3.0

Sampling Method(s): N/A

DTW During Drilling (ft): N/A
DTW After Drilling (ft): N/A

Ground Surface Elev. (ft): 653.5

Location (Lat, Long): 38.21824, -86.14971





Harrison REMC Headquarters, David Project:

Address: 1165 Old Forest Road, Corydon, IN **BORING LOG**

1 of 2

Boring No. S-2

Page:

Drilling Start Date: 6/10/24 Boring Depth (ft):

Drilling End Date: 6/10/24 Drilling Company: GL

Drilling Method: **Direct Push** Drilling Equipment: Geoprobe 7700

Driller: MR

Logged By: TA

Boring Diameter (in): 3.0

Sampling Method(s): N/A

DTW During Drilling (ft): N/A DTW After Drilling (ft): N/A

Ground Surface Elev. (ft): 656.0

Location (Lat, Long): 38.21732, -86.14990

_ >	교 공		COLL				0000	#	ğ			÷	9	161	N N
LITHOLOGY	WATER LEVEL BORING COMPLETION	Sample Type	Blow Counts	Recovery (ft)	N Value RQD%	SOIL/ROCK VISUAL DESCRIPTION	PID (ppm)	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plastic Limit	Plasticity Index (PI)	#200 Sieve (%)	Pocket Penetrometer (tsf)	Unconfined Compressive Strength (181)
						(0.00') Topsoil: 6 inches (SOUNDING TO REFUSAL) (0.50') Fat CLAY (CH); red-brown to brown, soft to stiff, very moist to wet, several zones of chert, limestone fragments, apparent voids in upper 10 feet									



Harrison REMC Headquarters, David Project:

Address: 1165 Old Forest Road, Corydon, IN **BORING LOG**

Boring No. S-2 Page: 2 of 2

Drilling Start Date: 6/10/24 Boring Depth (ft):

Drilling End Date: 6/10/24 Drilling Company: GL

Drilling Method: **Direct Push** Drilling Equipment: Geoprobe 7700

MR Driller:

TA Logged By:

Boring Diameter (in): 3.0

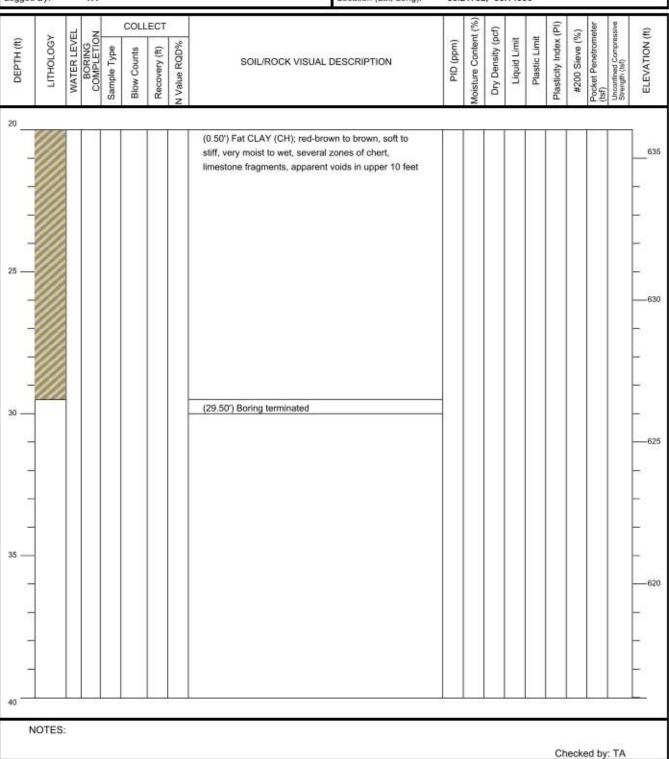
Sampling Method(s): N/A

DTW During Drilling (ft): N/A

DTW After Drilling (ft): N/A

Ground Surface Elev. (ft): 656.0

38.21732, -86.14990 Location (Lat, Long):





Harrison REMC Headquarters, David Project:

Address: 1165 Old Forest Road, Corydon, IN **BORING LOG**

Boring No. S-3

Page: 1 of 1

Drilling Start Date: 6/7/24 Drilling End Date: 6/7/24

Drilling Company: GL

Drilling Method: **Direct Push** Drilling Equipment: Geoprobe 7700

MR Driller:

TA Logged By:

Boring Depth (ft):

Boring Diameter (in): 3.0

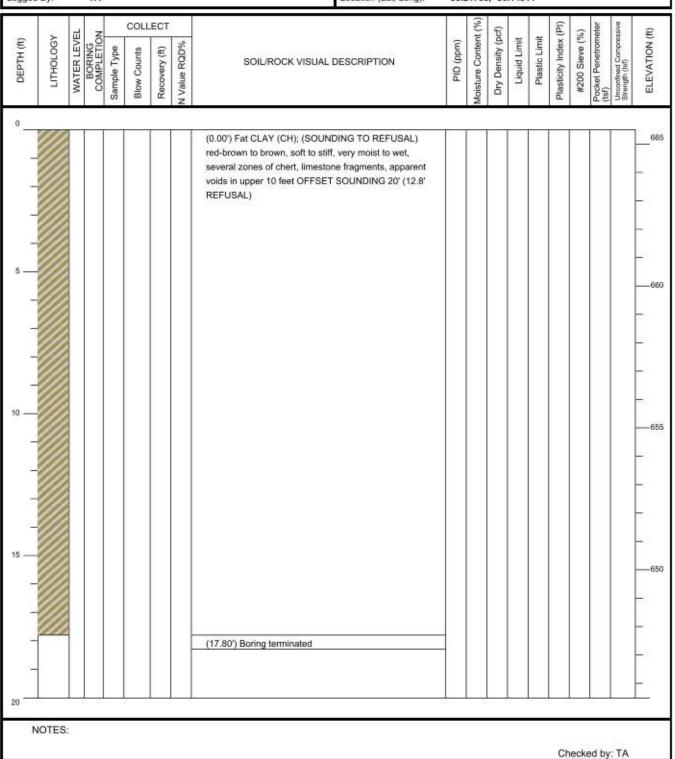
Sampling Method(s): N/A

DTW During Drilling (ft): N/A DTW After Drilling (ft): N/A

Ground Surface Elev. (ft): 665.5

38.21708, -86.14911 Location (Lat, Long):

17.8





Project: Harrison REMC Headquarters, David

' Lett

Address: 1165 Old Forest Road, Corydon, IN

BORING LOG

Boring No. Y-1 Page: 1 of 1

Drilling Start Date: 6/10/24

Drilling End Date: 6/10/24

Drilling Company: GL

Drilling Method: Direct Push
Drilling Equipment: Geoprobe 7700

Driller: MR

Logged By: TA

Boring Depth (ft): 6.75

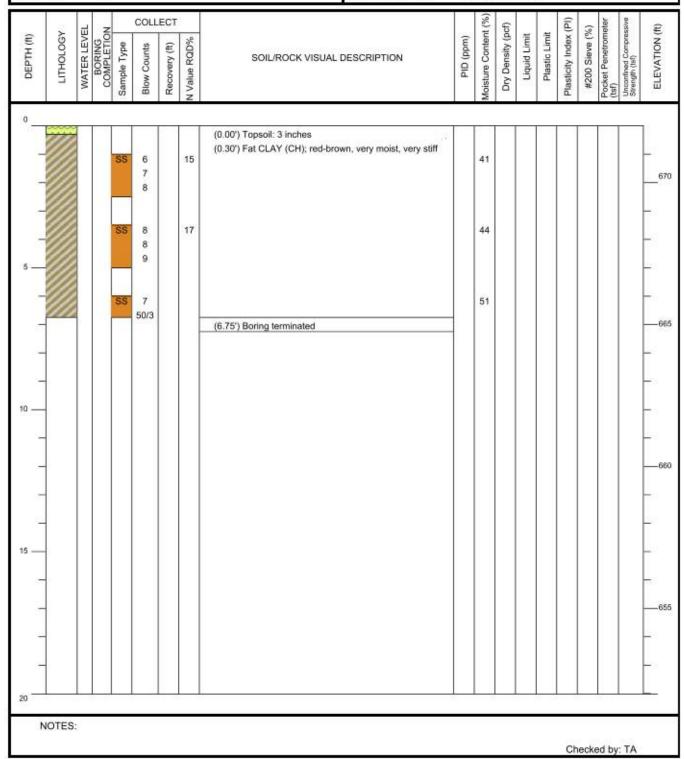
Boring Diameter (in): 3.0

Sampling Method(s): Split Spoon

DTW During Drilling (ft): N/A
DTW After Drilling (ft): N/A

Ground Surface Elev. (ft): 672.0

Location (Lat, Long): 38.22064, -86.14908





Harrison REMC Headquarters, David Project:

Address: 1165 Old Forest Road, Corydon, IN **BORING LOG**

Boring No. Y-2 Page: 1 of 1

Drilling Start Date: 6/10/24 Boring Depth (ft): Drilling End Date: 6/10/24

Drilling Company: GL

Drilling Method: **Direct Push** Drilling Equipment: Geoprobe 7700

MR Driller:

TA Logged By:

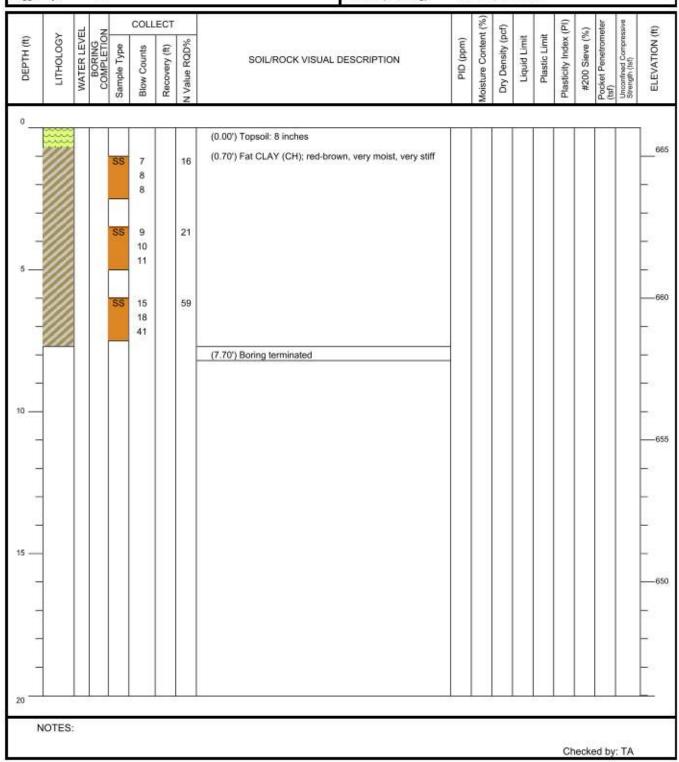
Boring Diameter (in): 3.0

Sampling Method(s): Split Spoon

DTW During Drilling (ft): N/A DTW After Drilling (ft): N/A

Ground Surface Elev. (ft): 666.0

38.21993, -86.14908 Location (Lat, Long):





Harrison REMC Headquarters, David Project:

Address: 1165 Old Forest Road, Corydon, IN **BORING LOG**

Boring No. Y-3 Page: 1 of 1

Drilling Start Date: 6/10/24 Boring Depth (ft): Drilling End Date: 6/10/24

Drilling Company: GL

Drilling Method: **Direct Push**

Drilling Equipment: Geoprobe 7700

MR

TA Logged By:

Driller:

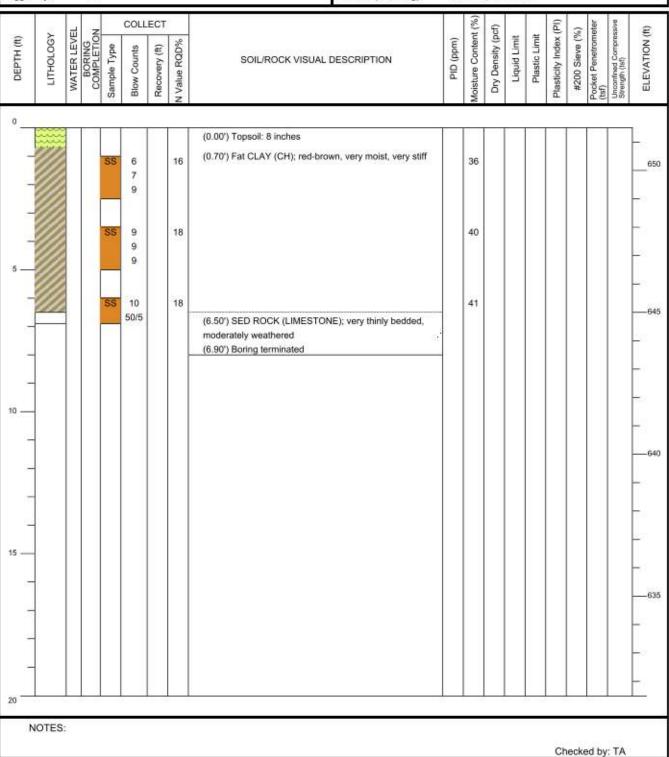
Boring Diameter (in): 3.0

Sampling Method(s): Split Spoon

DTW During Drilling (ft): N/A DTW After Drilling (ft): N/A

Ground Surface Elev. (ft): 651.5

38.21935, -86.14908 Location (Lat, Long):





Project: Harrison REMC Headquarters, David

Lett

Address: 1165 Old Forest Road, Corydon, IN

BORING LOG

Boring No. Y-4 Page: 1 of 1

Drilling Start Date: 6/10/24

Drilling End Date:

Drilling Company: GL

Drilling Method: Direct Push
Drilling Equipment: Geoprobe 7700

Driller: MR

Logged By: TA

Boring Depth (ft):

Boring Diameter (in): 3.0

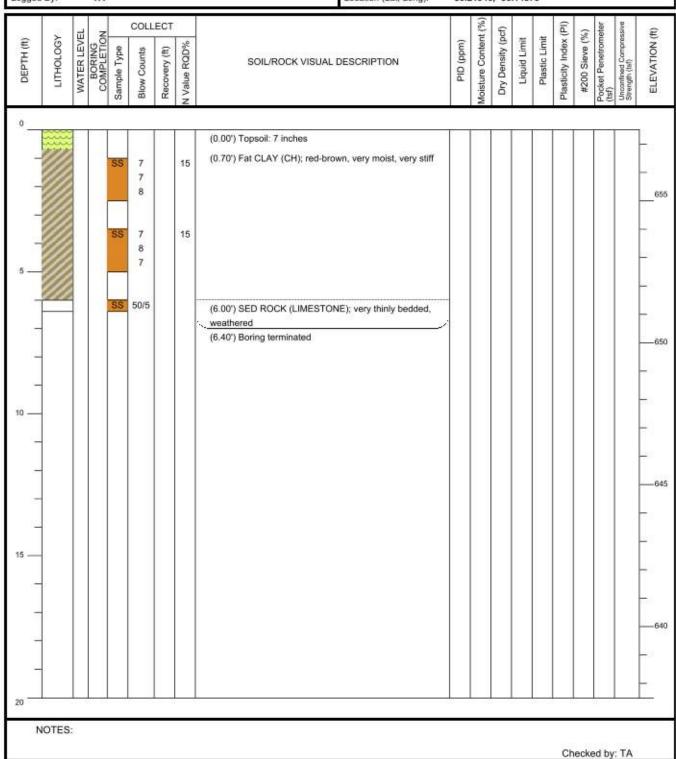
Sampling Method(s): Split Spoon

DTW During Drilling (ft): N/A

DTW After Drilling (ft): N/A

Ground Surface Elev. (ft): 657.5

Location (Lat, Long): 38.21946, -86.14878





Harrison REMC Headquarters, David Project:

Address: 1165 Old Forest Road, Corydon, IN **BORING LOG**

1 of 1

Boring No. Y-5

Page:

Drilling Start Date: 6/10/24 Boring Depth (ft): Drilling End Date: 6/10/24

Drilling Company: GL

Drilling Method: **Direct Push** Drilling Equipment: Geoprobe 7700

MR Driller:

TA Logged By:

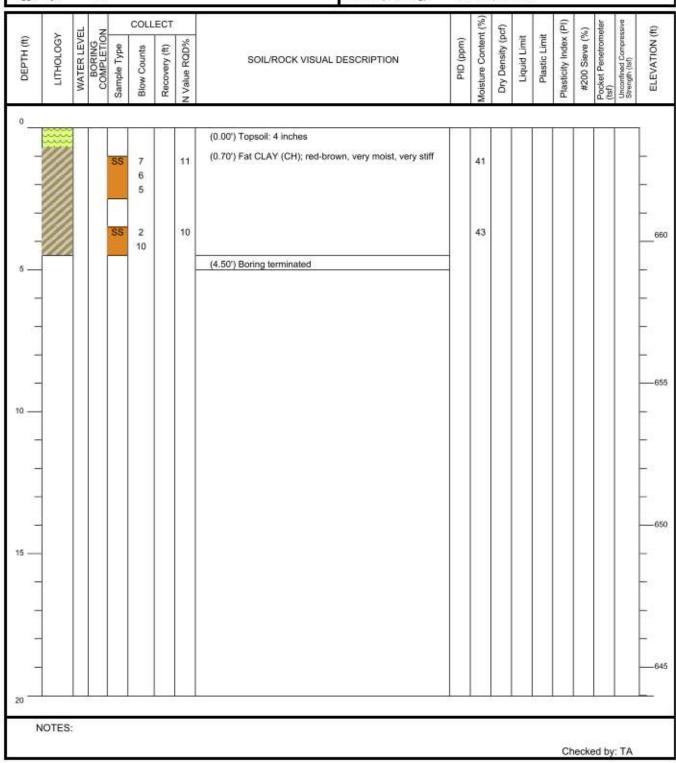
Boring Diameter (in): 3.0

Sampling Method(s): Split Spoon

DTW During Drilling (ft): N/A DTW After Drilling (ft): N/A

Ground Surface Elev. (ft): 664.0

38.21926, -86.14867 Location (Lat, Long):





Harrison REMC Headquarters, David Project:

Address: 1165 Old Forest Road, Corydon, IN **BORING LOG**

1 of 1

Boring No. Y-6

Page:

Drilling Start Date: 6/10/24 Boring Depth (ft):

Drilling End Date: 6/10/24 Drilling Company: GL

Drilling Method: **Direct Push**

Drilling Equipment: Geoprobe 7700 MR Driller:

TA Logged By:

4.75

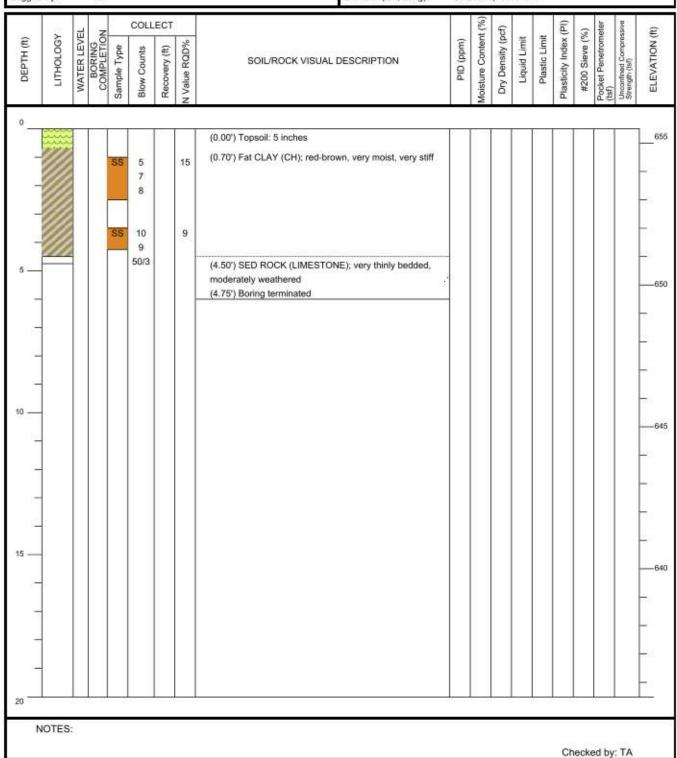
Boring Diameter (in): 3.0

Sampling Method(s): Split Spoon

DTW During Drilling (ft): N/A DTW After Drilling (ft): N/A

Ground Surface Elev. (ft): 655.5

38.21914, -86.14873 Location (Lat, Long):





Project: Harrison REMC Headquarters, David

Let

Address: 1165 Old Forest Road, Corydon, IN

BORING LOG

Boring No. Y-7 Page: 1 of 1

Drilling Start Date: 6/10/24 Boring De

Drilling End Date: 6/10/24
Drilling Company: GL

Drilling Method: Direct Push

Drilling Equipment: Geoprobe 7700

Driller: MR

Logged By: TA

Boring Depth (ft): 10.8

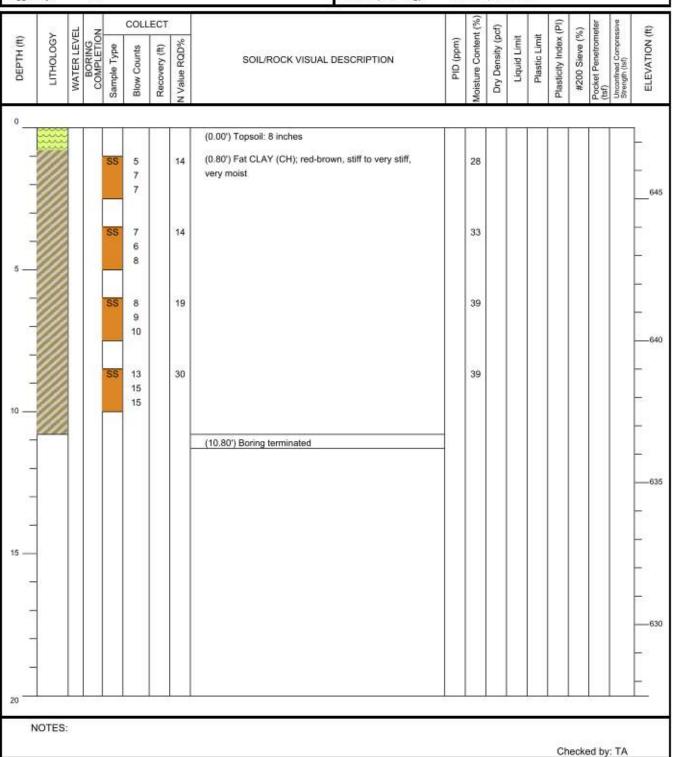
Boring Diameter (in): 3.0

Sampling Method(s): Split Spoon

DTW During Drilling (ft): N/A
DTW After Drilling (ft): N/A

Ground Surface Elev. (ft): 647.5

Location (Lat, Long): 38.21908, -86.14904





Harrison REMC Headquarters, David Project:

Address: 1165 Old Forest Road, Corydon, IN **BORING LOG**

Boring No. Y-8 Page: 1 of 1

Drilling Start Date: 6/10/24 Boring Depth (ft): Drilling End Date: 6/10/24

Drilling Company: GL

Drilling Method: **Direct Push** Drilling Equipment: Geoprobe 7700

MR Driller:

TA Logged By:

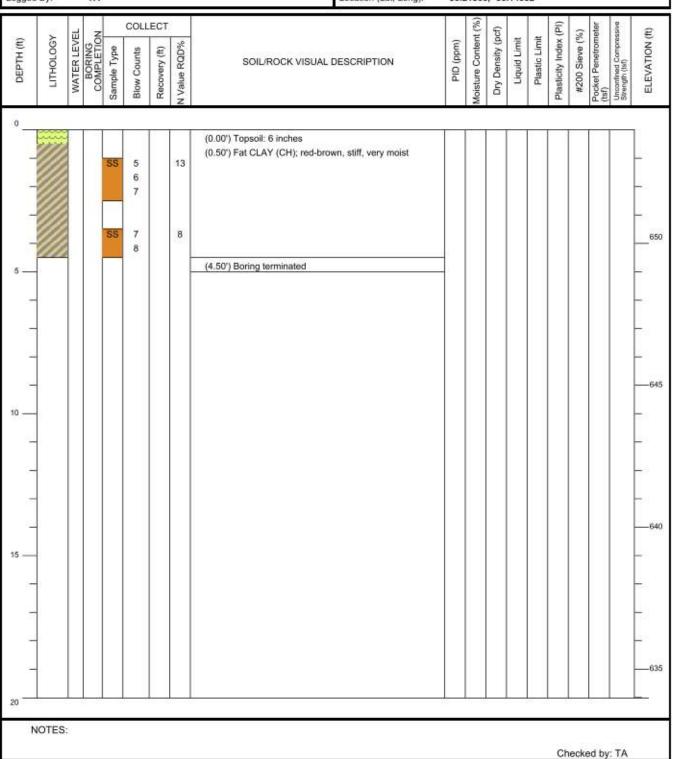
Boring Diameter (in): 3.0

Sampling Method(s): Split Spoon

DTW During Drilling (ft): N/A DTW After Drilling (ft): N/A

Ground Surface Elev. (ft): 654.0

38.21868, -86.14852 Location (Lat, Long):





Harrison REMC Headquarters, David Project:

Address: 1165 Old Forest Road, Corydon, IN **BORING LOG**

Boring No. Y-9 Page: 1 of 1

Drilling Start Date: 6/10/24

Drilling End Date: 6/10/24 Drilling Company: GL

Drilling Method: **Direct Push**

Drilling Equipment: Geoprobe 7700

MR

TA Logged By:

Driller:

Boring Depth (ft):

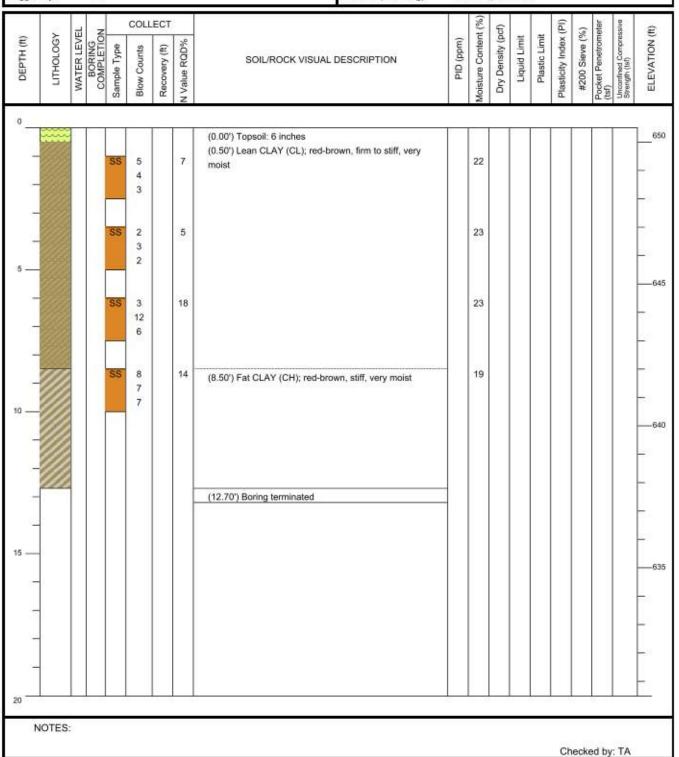
Boring Diameter (in): 3.0

Sampling Method(s): Split Spoon

DTW During Drilling (ft): DTW After Drilling (ft): N/A

Ground Surface Elev. (ft): 650.5

38.21855, -86.14891 Location (Lat, Long):





Harrison REMC Headquarters, David Project:

Address: 1165 Old Forest Road, Corydon, IN **BORING LOG**

Boring No. Y-10

Page: 1 of 1

Drilling Start Date: 6/10/24 Boring Depth (ft): Drilling End Date: 6/10/24

Drilling Company: GL

Drilling Method: **Direct Push** Drilling Equipment: Geoprobe 7700

MR Driller:

TA Logged By:

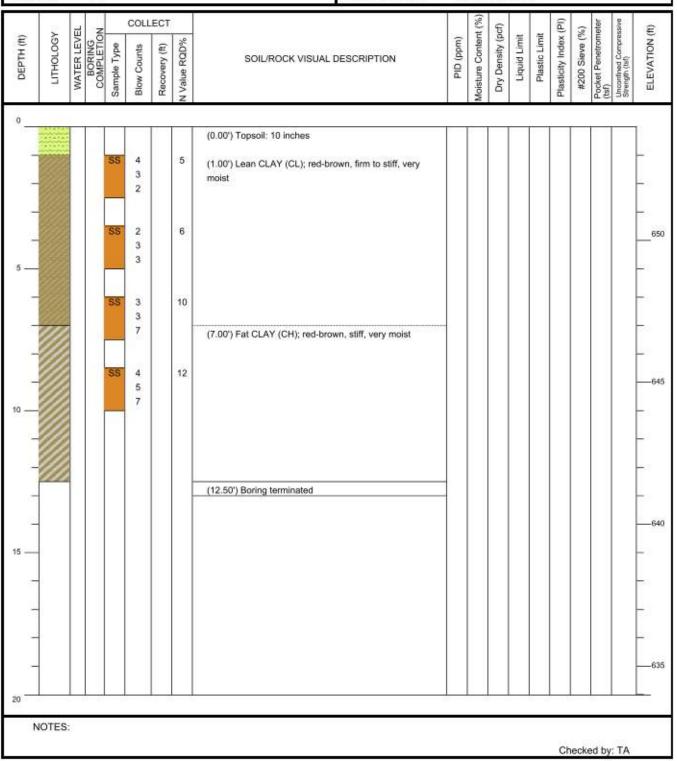
Boring Diameter (in): 3.0

Sampling Method(s): Split Spoon

DTW During Drilling (ft): N/A DTW After Drilling (ft): N/A

Ground Surface Elev. (ft): 654.0

38.21857, -86.14896 Location (Lat, Long):





BORING AND WELL LOG LEGEND

SURFACE ASPAALT CONCRETE FILL TOPSOIL AR ICE SUSCS Well-graded GRAVEL (GW) Poorly graded GRAVEL (GP) Sity CRAVEL (GR) Sity Clayey GRAVEL (GC-GM) Well-graded GRAVEL with sit (GP-GM) Well-graded GRAVEL with sit (
Wood Peat Saprolite

SECTION 02 4119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDED

A. Section Includes:

- 1. Selective Demolition work included in project.
- 2. Project demolition conditions.
- 3. Electrical, Plumbing and HVAC Demolition.
- 4. Utility demolition.
- 5. Subsurface filling.
- 6. Protection.

1.2 WORK INCLUDED

- A. The extent of demolition work shown on drawings and specified herein, including, but not limited to:
 - 1. Opening of exterior walls for new doors, windows, grilles, louvers, mechanical, and electrical and providing weather-tight enclosures.
 - 2. Opening of interior walls, ceilings and floors necessary for proper installation of new materials, equipment, mechanical or electrical items.
 - 3. Removing interior walls, ceilings, floor finishes.
 - 4. Removing doors and frames.
 - 5. Removing casework and equipment.
 - 6. Removing existing HVAC system and components, both exposed to view and concealed.
 - 7. Removing existing plumbing fixtures, piping and components, both exposed to view and concealed.
 - 8. Removing existing lighting and electrical distribution, switches, outlets, conduit and other devices both exposed to view and concealed.
- B. Interior demolition includes complete wrecking of interior partitions, finishes and structures and removal and disposal of demolished materials, as shown on drawings and herein specified.
- C. The Owner shall have the option of retaining any item removed. The Contractor shall deliver these items to the Owner's designated storage area. Any items not retained by the Owner shall be disposed of offsite by the Contractor. All items are to remain property of the Owner unless specifically designated otherwise.
- D. Some removed items are to be salvaged for re-use. Drawings indicate extent of such work.

PART 2 - PRODUCTS

A. Not Applicable

PART 3 - EXECUTION

3.1 PROJECT DEMOLITION CONDITIONS

A. Conditions of Structures:

- 1. The Owner assumes no responsibility for actual conditions of structures to be demolished.
- B. Conditions of the structure existing at time of inspection for bidding purposes will be maintained by Owner in so far as possible. However, variations within structure may occur by Owner's removal and salvage operations prior to start of demolition work.

C. Pollution Controls:

- 1. Use water sprinkling, temporary enclosures, and other suitable methods to limit dust and dirt rising and scattering in air to lowest practical level.
- 2. Comply with governing regulations pertaining to environmental protection.
- D. Do not use water when it may create hazardous or objectionable conditions such as ice, flooding, and pollution.
- E. Clean adjacent structures and improvements of dust, dirt, and debris caused by demolition operations. Return adjacent areas to condition existing prior to the start of work.

F. Partial Removal:

- 1. Items of salvable value to Contractor, and not retained by Owner, may be removed from structure as work progresses. Salvaged items must be transported from site as they are removed.
- 2. Storage or sale of removed items on site will not be permitted.
- 3. Store items noted on drawings and specified to be salvaged for use in the project, so as to prevent damage or deterioration.

G. Disposal of Demolished Materials:

- 1. Remove from site debris, rubbish, and other materials resulting from demolition operations.
- 2. Pay all fees related to removal and dumping.
- 3. Remove and dispose of interior demolition debris off job site.
- 4. Burning of removed materials from demolished structures will not be permitted.
- 5. Transport materials removed from demolished structures and dispose of off site.

H. Traffic:

- 1. Conduct demolition operations and removal of debris to ensure minimum interference with roads, streets, walks, occupied areas, and other adjacent occupied or used facilities.
- 2. Do not close or obstruct streets, walks or other occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.

3.

I. Protections:

- 1. Ensure safe passage of persons around or through area of demolition. Conduct operations to prevent injury to adjacent buildings, structures, other facilities, and persons. Provide protection in accordance with ANSI/NFPA 241.
- 2. Erect temporary covered passageways as required by the Owner or authorities having jurisdiction.
- J. Use of explosives will not be permitted.
- K. Provide temporary enclosures at doors and other penetrations in walls, necessitated by weather and demolition conditions, and where dust proof partitions are indicated. Enclosures shall be constructed with fire retardant treated lumber, insulated and painted. Joints shall be taped and caulked to prevent dust and debris from migrating beyond construction areas. Maintain enclosures in good repair and remove when no longer needed. Extend partitions to deck.
- L. Provide interior and exterior shoring, bracing, or support to prevent movement, settlement or collapse of structures to be demolished and adjacent facilities to remain.
- M. Repair any damage to property which is to remain in use, or that of any person, or persons on or off site caused by the demolition work without additional expense to Owner.
- N. Use of jackhammers during normal operating hours of the facility will not be permitted.
- O. Where a portion of construction (walls, floors, ceilings, etc.) is indicated to be removed, demolition shall include the removal of any and all items either surface-mounted on it, or concealed within it, unless otherwise indicated to remain or be salvaged for reuse.

3.2 ELECTRICAL

- A. Visit the site before submitting a bid to observe existing conditions.
- B. Work in existing building shall be scheduled well in advance with the Owner. Work shall be performed at such times and under such conditions as suit the convenience of the Owner. Plan the Work to minimize disruption of normal operations.
- C. Remove wiring devices, fixtures, components, electrical equipment, conductors, boxes and conduits not required to remain in service in remodeled areas when this Project is complete.
- D. Reconnect circuits to other panelboards when necessary to complete the renovation.
- E. Remove existing conduit and wire from areas to be remodeled, back to panelboard, cabinet or junction box. Where such Work would not be possible without disturbing areas not being renovated, consult with the Architect prior to performing the Work.
- F. When outlets are covered up or are otherwise rendered inaccessible, all wiring shall be removed to the source. If a circuit that must remain in service is interrupted, it shall be reconnected by the most inconspicuous means so that it remains operational, with the same capacity as before. All building surfaces damaged, and openings left by removal of boxes, conduit, or other equipment shall be repaired. All holes left in junction boxes, switches, panels and other equipment shall be closed.

- G. Where new openings are cut and concealed conduits or other electrical items are encountered, they shall be removed or relocated as required. Where conduit to be removed stubs through floors, walls, and ceilings, such conduit shall be removed to the point where the finished surfaces can be patched so that no evidence of the former installation remains.
- H. Where a circuit is interrupted by removal of a device or fixture from that circuit, install wire and conduit as required to restore service to the remaining devices and fixtures on that circuit. If the interrupted piping is concealed in walls or under floors, an alternate route may be required.
- I. Lighting fixtures, wiring devices, panelboards, and conductors removed shall be offered to the Owner's Representative. If he chooses to retain these items or a part of these items, turn those chosen over to him. Items rejected by Owner's Representative shall be removed from the project site by the Contractor.

3.3 PLUMBING

- A. Visit the site before submitting a bid to observe existing conditions.
- B. Work in existing building shall be scheduled well in advance with the Owner. Work shall be performed at such times and under such conditions as suit the convenience of the Owner. Plan the Work to minimize disruption of normal operations.
- C. Remove piping, fixtures, components, valves, insulation and fittings not required to remain in service in remodeled areas when this Project is complete.
- D. Reconnect piping to provide service when required to complete the renovation.
- E. Remove existing piping from areas to be remodeled, back to service branch. Where such Work would not be possible without disturbing areas not being renovated, consult with the Architect prior to performing the Work.
- F. When outlets are covered up or are otherwise rendered inaccessible, all piping shall be removed to the source. If a fixture that must remain in service is interrupted, it shall be reconnected by the most inconspicuous means so that it remains operational, with the same capacity as before. All building surfaces damaged, and openings left by removal of fixtures, piping, or other equipment shall be repaired. All holes left shall be closed.
- G. Where new openings are cut and concealed piping or other plumbing items are encountered, they shall be removed or relocated as required. Where piping to be removed stubs through floors, walls, and ceilings, such piping shall be removed to the point where the finished surfaces can be patched so that no evidence of the former installation remains.
- H. Where piping is interrupted by removal of a piping or fixture, install piping as required to restore service to the remaining fixtures on that service line. If the interrupted circuit is concealed in walls or under floors, an alternate route may be required. If the interrupted piping is concealed in walls or under floors an alternate route may be required.
- I. Plumbing fixtures, valves, and gages removed shall be offered to the Owner's Representative. If he chooses to retain these items or a part of these items, turn those chosen over to him. Items rejected by Owner's Representative shall be removed from the project site by the contractor.

3.4 HVAC

- A. Visit the site before submitting a bid to observe existing conditions.
- B. Work in existing building shall be scheduled well in advance with the Owner. Work shall be performed at such times and under such conditions as suit the convenience of the Owner. Plan the Work to minimize disruption of normal operations.
- C. Remove piping, ductwork, equipment, components, valves, insulation, fittings and controls not required to remain in service in remodeled areas when this Project is complete.
- D. Reconnect piping and ductwork to provide service when required to complete the renovation.
- E. Remove existing piping and ductwork from areas to be remodeled, back to service branch. Where such Work would not be possible without disturbing areas not being renovated, consult with the Architect prior to performing the Work.
- F. When grilles and diffusers are covered up or are otherwise rendered inaccessible, all ductwork shall be removed to the source. If an HVAC equipment item which must remain in service is interrupted, it shall be reconnected by the most inconspicuous means so that it remains operational, with the same capacity as before. All building surfaces damaged, and openings, left by removal of grilles, piping, or other equipment shall be repaired. All holes left shall be closed.
- G. Where new openings are cut and concealed piping, ductwork, or other HVAC items are encountered, they shall be removed or relocated as required. Where piping, ductwork or controls to be removed stubs through floors, walls and ceilings, such items shall be removed to the point where the finished surfaces can be patched so that no evidence of the former installation remains.
- H. Where piping or ductwork is interrupted by removal of a branch or equipment, install material as required to restore service to the remaining items on that service line. If the interrupted piping or duct is concealed in walls or under floors, an alternate route may be required.
- I. HVAC equipment, valves, and gages removed shall be offered to the Owner's Representative. If he chooses to retain these items or part of these items, turn those chosen over to him. Items rejected by Owner's Representative shall be removed from the project site by the Contractor.
- J. Equipment removed from roof shall include curbs, sleepers, flashing boxes, etc. Install new roof decking to match existing. Install roof insulation and matching membrane system to maintain any roof warranties.
- K. Equipment removed from finished interior spaces shall include patching and restoration to match all adjacent finishes.
- L. All temperature controls shall be maintained, rerouted, reconnected, or reprogrammed to maintain operation of HVAC equipment.

3.5 UTILITY DEMOLITION

A. Utility Services:

- 1. Maintain existing utilities indicated to remain, keep in service, and protect against damage during demolition operations.
- 2. Allow no interruption in service unless coordinated with Owner at least 72 hours in advance.
- B. Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to governing authorities.
- C. Disconnect and seal utilities serving each structure to be demolished, or interior area to be demolished, prior to start of demolition work.
- D. If utility service or other services to an occupied area (such as emergency power, heating, medical gas, air conditioning), are to be disconnected, provide temporary or alternative service to that area.
- E. Cap all utility lines terminated by the demolition work in a manner approved by the governmental authorities and utility companies having jurisdiction.
- F. Mark location of disconnected utilities. Identify and indicate capping location on project record documents.

3.6 SUBSURFACE FILLING

- A. Filling Basement and Voids:
 - 1. Completely fill below-grade areas and voids resulting from demolition of structures.
 - 2. Perform filled and compaction in accordance with requirements of Section 31 0000 Earthwork.

3.7 PROTECTION

- A. Provide temporary construction in accordance with requirements of Section 01 5300 Temporary Construction as required in all areas of demolition work.
- B. Provide levels of protection as deemed necessary by Owner for protection of public into space, project, and site.

END OF SECTION 02 4119

SECTION 03 0300 - STRUCTURAL EXCAVATION AND BACKFILL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Structural Excavation and Backfill includes:
 - 1. Preparing subgrades for slabs on grade.
 - 2. Excavating and backfilling for building foundations from subgrade.
 - 3. Over-excavation and structural backfill to achieve adequate support for foundations.
 - 4. Subsurface drainage backfill for foundation walls.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 1 Section "Structural Inspection."
 - 2. Division 1 Section "Temporary Facilities and Controls."
 - 3. Division 3 Section "Cast-in-Place Concrete."
 - 4. Division 31 Section "Dewatering."
 - 5. Division 31 Section "Excavation Support and Protection."
 - 6. Division 31 Section "Earth Moving."
 - 7. Division 33 Section "Subdrainage."

1.3 PAYMENT

A. General:

- 1. No additional compensation will be made for excavation and engineered backfill where work was not based on the inspection and recommendation of the Special Inspector. All quantities for unit price or other contract adjustment must be recorded by the Contractor and verified by the Inspector daily.
- 2. Depth to achieve adequate support for bearing foundations and slab on grade will be determined by the Inspector (not Contractor) during the construction operations.
- 3. No payment will be made for rejected work.
- 4. All overexcavation of soft and/or saturated soils caused by dewatering/rainwater control practices and wet/freezing weather, excavation of soils into mass undercut or mass fill performed as part of this Construction Project, and subsequent backfill, as directed by Special Inspector shall be performed at no additional cost to Owner. Contractor shall notify Construction Manager of work required, perform work where directed by Construction Manager, and coordinate with other trades who may be required to perform such work.
- 5. Any adjustments for payment to the base bid for excavation (Standard vs Special) shall be process and material dependent, not elevation dependent.
- 6. Rock Measurement: Volume of rock actually removed, measured in original position, but not to exceed the following:
 - a. 24 inchesoutside of concrete forms other than at footings.
 - b. 12 inchesoutside of concrete forms at footings.
 - c. 24 inches below bottom of footings where footings are specified to be soil-bearing.

- d. 6 inchesoutside of minimum required dimensions of concrete cast against grade.
- e. 6 inchesbeneath bottom of concrete slabs-on-grade.

B. Overexcavation and Backfill Basis of Bids:

1. Base bids on contractor's estimation of quantities using the geotechnical investigation report as a reference document which is available to bidders, but which is not part of the contract documents. The depth to achieve adequate bearing may vary and shall be discerned by the Contractor using the Geotechnical Report, their knowledge of the site, and any investigation they perform during the bid process. The Architect and Structural Engineer are not responsible or liable for the accuracy of the information presented in the Geotechnical Report. All interpretation and bid quantities are the sole risk of the Contractor.

C. Overexcavation and Backfill Basis of Payment:

- 1. Payment for overexcavation and engineered backfill to achieve adequate bearing for foundations and slabs will be made on a lump sum basis. Quantity estimation and bid amount is the sole responsibility of the bidding Contractor.
 - a. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
 - b. Should the Contractor affirm that the Geotechnical Report does not accurately portray the as-found site conditions (whether with deeper or shallower encountered bedrock or with mass unsuitable soils) and claim for additional payment based on change to the scope of work, they shall be required to present to the Architect a comparison of the quantities portrayed by the geotechnical report with that actually performed in the field, as calculated by an independent Professional (Civil) Engineer. Analysis shall be performed using 3-dimensional modeling of the excavation footprint (at both subgrade and at bearing elevation) and variable depths to portray the non-prismatic excavation volume. Actual installed quantities shall be discerned using LiDAR scanning or depth mapping at each spread footing and at 25 foot increments along continuous strip footings by a licensed Surveyor.

D. UNIT PRICES

- 1. Work of this Section may be affected by unit prices.
- 2. Unit prices for additive and deductive adjustments shall be the same.
- 3. Unit prices include labor, materials, tools, equipment, and incidentals required for soil excavation, rock excavation, trimming, shoring, dewatering, fill, and other items for a complete installation.
- 4. Unit prices for excavation shall include replacement with approved materials.
- 5. See Division 1 Section "Unit Prices" for a schedule of unit prices.
 - Standard Excavation with soil backfill.

1.4 DEFINITIONS

- A. Backfill: Soil material or controlled low-strength material (flowable fill) used to fill an excavation.
- B. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

STRUCTURAL EXCAVATION AND BACKFILL 03 0300 - 3 04/24/2025

- C. Drainage Course: Free-draining aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.
- D. Excavation: Removal of material encountered above bearing elevations and to lines and dimensions indicated.
 - 1. Bulk (Mass) Excavation: Excavation more than 10 feetin width and more than 30 feetin length.
 - 2. Over-excavation: Excavation below bearing elevations or beyond indicated lines and dimensions as directed by Special Inspector and confirmed by Architect.
 - 3. Unauthorized Excavation: Excavation below bearing elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.
 - 4. Standard Excavation: Excavation of soil, all floating boulders less than ¾ cubic yard in volume, weathered rock, obstructions, etc. which can accomplished with conventional excavator comparable to model John Deere 210.
 - 5. Special Excavation: Excavation of boulders that exceed 3/4 cubic yard in volumeor bedrock which requires systematic drilling, ram hammering, ripping, or blasting (when permitted). Excavation of Footings which require in excess of late-model, track-mounted hydraulic excavator; equipped with a 42-inch-wide, maximum, short-tip-radius rock bucket; rated at not less than 138-hp flywheel power with bucket-curling force of not less than 28,700 lbfand stick-crowd force of not less than 18,400 lbf with extra-long reach boom; measured according to SAE J-1179. Special Excavation includes both removal and disposal of rock.
- E. Fill: Soil materials used to raise existing grades.
- F. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that cannot be removed by Standard Excavation.
- G. Structures: Buildings, footings, foundations, retaining walls, slabs, or other man-made stationary features constructed above or below the ground surface as shown on the structural drawings.
- H. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.
- I. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.5 SUBMITTALS

- A. General: Furnish submittals in quantity, format, and other Conditions of the Contract and as specified in Division 1 of the Project Manual.
- B. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:
 - 1. Classification according to ASTM D 2487.
 - 2. Laboratory compaction curve according to ASTM D 698.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, GC, SW, SP, SM, SC, CH, and CL according to ASTM D 2487, or a combination of these groups; free of rock or gravel larger than 3 inchesin any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter. No concentration of large fragments is permitted unless approved by Geotechnical Engineer and Architect.
 - 1. Plasticity Index: Less than 30.
 - 2. Liquid Limit: Less than 50.
 - 3. Swell potential: Less than 50 psf.
 - 4. Maximum dry density of at least 100 pounds per cubic foot.
- C. Unsatisfactory Soils: Soil Classification Groups ML, OL, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.
 - 1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
 - 2. Shot rock, asphalt, and coal fragments.
 - 3. Organics content shall be less than 5%. Limit total depth of soil fills with organic contents over 4% to 24".
 - 4. Soils containing 40% and greater silt content will not be accepted for use in any capacity and shall be wasted off site.
- D. Drainage Course and Drainage/Wall Backfill (Crushed Stone): Narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; meeting INDOT #57 stone; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.

2.2 CONTROLLED LOW-STRENGTH MATERIAL

- A. Controlled Low-Strength Material Performance Additive:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - a. Darafill or Darafill Dry, W.R. Grace & Co.
 - b. Rheomac VMA 362, BASF Corporation Admixture Systems
- B. Prohibited Admixture: Calcium chloride thiocyanates or admixture containing more than 0.05 percent chloride ions.
- C. Controlled Low Strength Material CLSM (Flowable fill): Self-compacting, flowable concrete material. Provide blend of cement, flyash, and sand with minimum cementitious content as follows:
 - 1. Excavatable flowable fill: 100 lb cement and 250 lb fly ash per cubic yard.

STRUCTURAL EXCAVATION AND BACKFILL 03 0300 - 5 04/24/2025

2. Structural flowable fill (250 psi): 175 lb cement and 200 lb fly ash per cubic yard. Add CLSM performance additive at manufacturer's recommended dosage rate, adjusting water content to provide desired flow and strength characteristics.

2.3 GEOTEXTILES

A. Non-Woven Geotextile – Nonwoven, needle-punched geotextile made of 100% polypropylene staple filaments. Resistant to ultraviolet and biological deterioration, rotting, and naturally encountered basics and acids. Stable within a pH range of 2 to 13. Weight of 4 oz/yd. Minimum Tensile Strength of 100 lbs per ASTM D-4632, Elongation at break of 50% measured per ASTM D-4632, Puncture Strength of 65 lbs measured per ASTM D-4833, CBR puncture of 250 lbs measured per ASTM D-6241, Apparent Opening Size of 70 US Sieve measured per ASTM D-4751, Permittivity of 2.00 Sec⁻¹ measured per ASTM D-4491, Water Flow Rate of 140 g/min/f² measured per ASTM D-4491, and UV Resistance at 500 Hours of 70% measured per ASTM D-5255.

2.4 GEOGRID

- A. Geogrid Composite geosynthetic consisting of geogrid bonded to a nonwoven geotextile. Grid to be manufactured from a coextruded, composite polymer sheet which is then punched and oriented with a resulting structure consisting of continuous and non-continuous ribs forming three aperture geometries (hexagon, trapezoid, and triangle) and in unimpeded suspended hexagon.
- B. Minimum Strength Properties:
 - 1. Grab Tensile Strength: 160 lbs per ASTM D4632.
 - 2. Grab Elongation: 50% per ASTM D4632.
 - 3. Trapezoid Tear Strength: 60 lbs per ASTM D4533.
 - 4. CBR Puncture Resistance: 410 lbs per ASTM D6241.
 - 5. Permittivity: 1.5 sec⁻¹ per ASTM D4491.
 - 6. Water Flow: 110 gpm/ft² per ASTM D4491.
 - 7. Apparent Opening Size: 70 Std, US per ASTM D4751.
 - 8. UV Resistance: 70%/500 hrs per ASTM D4355.
- C. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - 1. InterAx FilterGrid NX750-FG by Tensar.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.
- B. Protect and maintain erosion and sedimentation controls during earth moving operations.
- C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 DEWATERING

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
 - 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
- C. All undercut and engineered backfill remedial work recommended by the Special Inspector and caused by inadequate dewatering and drainage practices during construction shall be provided at no additional cost to Owner.

3.3 EXCAVATION, GENERAL

- A. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
- B. Remove rock to lines and subgrades indicated to permit installation of permanent construction without exceeding the following dimensions:
 - a. 24 inchesoutside of concrete forms other than at footings.
 - b. 12 inchesoutside of concrete forms at footings.
 - c. 24 inches below bottom of footings where footings specified to be soil bearing.
 - d. 6 inches outside of minimum required dimensions of concrete cast against grade.
 - e. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
 - f. 6 inches beneath bottom of concrete slabs-on-grade.
- 2. Excavate pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; together with soil, boulders, and other materials not classified as rock or unauthorized excavation.

3.4 STRUCTURAL EXCAVATION

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
 - 1. Excavations for footings and foundations: Do not disturb bottom of excavation. Excavate soils by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
 - 2. Recompact areas loosened by excavation operations prior to reinforcing steel placement.
 - 3. Remove loose soil, debris, and excess surface water from the bearing surface prior to concrete placement.
- B. Over-excavate all soft and deleterious material below foundations as directed by Special Inspector and backfill back to foundation bearing elevation with approved fill material.
- C. For foundations classified as soil-bearing on the structural drawings, undercut and maintain similar bearing material type and depths.

STRUCTURAL EXCAVATION AND BACKFILL 03 0300 - 7 04/24/2025

- 1. Remove all rock within two-feet below bottom of foundation and replace with approved engineered soil backfill.
- 2. In mass earth fills 4 feet or deeper, overexcavate both existing and new fills below footing to an elevation where depth of fill is 4 feet or less, and backfill with approved cementitious material to footing bearing.

3.5 SUBGRADE INSPECTION

- A. Notify Architect when excavations have reached required subgrade.
- B. If Inspector determines that unsatisfactory soil is present, notify Architect and receive direction. Once received, continue excavation and replace with compacted backfill or fill material as directed.
- C. Proof-roll subgrade below the building slabs with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tonsto identify soft pockets and areas of excess yielding. A loader scraper is also permitted. Do not proof-roll wet or saturated subgrades.
 - 1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
 - 2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.
- D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.
- E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.6 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 1500 psi, may be used when approved by Architect.
 - 1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

3.7 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.8 BACKFILL, GENERAL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
 - 1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
 - 2. Surveying locations of underground utilities for Record Documents.
 - 3. Testing and inspecting underground utilities.

- 4. Removing concrete formwork.
- 5. Removing trash and debris.
- 6. Removing temporary shoring and bracing, and sheeting.
- 7. Installing permanent or temporary horizontal bracing on horizontally supported walls.
- B. Place backfill on subgrades free of mud, frost, snow, or ice.
- C. Do not backfill below footings with crushed stone where building foundations classified as soil bearing on the structural drawings.

3.9 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact engineered fill material in layers to required elevation.
- C. Place fill on subgrades free of mud, frost, snow, or ice.

3.10 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
 - Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
 - 2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight. Maintain the moisture content as such.

3.11 GEOGRID INSTALLATION

- A. After stripping deleterious debris and unsuitable material from subgrade and performing proofroll, smooth grade and compact the soils using appropriate compaction equipment. Grade or crown the surface for positive drainage away from the construction site.
- B. Install base course of stone, consolidated into place. Place rolls of geogrid into position, anchor the beginning of the roll to the underlying surface, and manually unroll the material over the prepared surface. Unroll geogrid in the direction of travel so that the roll is parallel with traffic patterns. Adjacent geogrid rolls should be shingled in the intended direction of aggregate spread. Align and pull grid taut to remove wrinkles and lay down slack with hand tension.
- C. Cut and overlap the geogrid to accommodate curves, and to conform to immovable protrusions.
- D. Lap geogrid per manufacturer's written recommendations, but not less than 1 foot.
- E. Anchor geogrid in place to maintain overlaps and alignment.
- F. Install aggregate overlay with standard, highway-legal, rubber tired trucks at slow speeds less than 5 mph avoiding turns and sudden stops where base can support vehicles without significant rutting.
- G. Spread, grade, and compact aggregate overlay.

STRUCTURAL EXCAVATION AND BACKFILL 03 0300 - 9 04/24/2025

3.12 COMPACTION OF SOIL/GRAVEL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 8 inchesin loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- B. Place backfill gravel (INDOT #57 stone) in layers not more than 8 inches in loose depth and tamp in place. Use hand-operated tampers (plate compactors) where grade differential, at time of tamping, is more than 12-inches on each side of wall or where backfill area extent or accessibility does not facilitate the use of heavy compaction equipment.
- C. Place backfill gravel and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- D. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698:
 - 1. Scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 98 percent.
 - 2. When the fill depth will exceed 10 feet, the excess lower portion shall be compacted to at least 100 percent.

3.13 CEMENTITIOUS FILL

- A. Place fill on subgrades free of mud, frost, snow, or ice.
- B. Place and consolidate in accordance to the recommendations of the Geotechnical Report.

3.14 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 - 1. Provide a smooth transition between adjacent existing grades and new grades.
 - 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inchwhen tested with a 10-footstraightedge.

3.15 SUBBASE UNDER CONCRETE SLABS-ON-GRADE

- A. Place subbase on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place and compact subbase under cast-in-place concrete slabs-on-grade as follows:
 - 1. Place subbase 6 inches or less in compacted thickness in a single layer.
 - 2. Place subbase that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inchesthick.
 - 3. Compact each layer of subbase to required cross sections and thicknesses to not less than 98 percent of maximum dry unit weight according to ASTM D 698.

3.16 FIELD QUALITY CONTROL

- A. General: The Owner will employ a testing agency that meets the requirements of ASTM E329 to perform tests and to submit test reports. Failure to detect any defective materials shall not prevent later rejection when such defect is discovered or obligate the Architect or Owner for final acceptance.
 - 1. See Section 01 4120 Structural Inspections and Contract Drawings for testing and inspection to be performed.
 - 2. Test results will be reported in writing to the Architect, Engineer, and General Contractor within 24 hours after tests.
- B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent backfill or foundation placement only after test results for previously completed work comply with requirements.
- C. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.17 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Architect.
 - 1. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 03 0300

SECTION 03 3000 - CAST-IN-PLACE CONCRETE

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section specifies cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes. This section applies to concrete work shown on the structural drawings. See Division 32 for site concrete.
- B. Cast-in-place concrete includes the following:
 - 1. Foundations and footings.
 - 2. Slabs-on-grade.
 - 3. Foundation walls.
 - 4. Grout below column base and bearing plates.
- C. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 1 Section "Structural Inspection."
 - 2. Division 1 Section "Commissioning of Vapor Barrier System".
 - 3. Division 3 Section "Structural Excavation and Backfill" for preparation and excavation of foundations and stone drainage fill.
 - 4. Division 5 Section "Structural Anchors."
 - 5. Division 5 Section "Steel Deck."
- D. Coordination: Unless other satisfactory agreements are specifically entered into by contractors concerned, all miscellaneous iron and steel, sleeves, anchors, etc., required by work of other contractors, will be furnished and installed by such other contractors with the cooperation of this contractor.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.
- B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 ACTION SUBMITTALS

- A. General: Furnish submittals in quantity, format, and other Conditions of the Contract and as specified in Division 1 of the Project Manual.
- B. Design Mixtures: For each concrete mixture with laboratory test reports for the following data. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - 1. Method used to determine the proposed mix design (per ACI 301, Section 4).
 - 2. Gradation and quantity of fine and coarse aggregates.
 - 3. Proportions of all ingredients including all admixtures added either at the time of batching or at

- the job site. Indicate amounts of mixing water to be withheld for later addition at Project site.
- 4. Water/cement ratio and water/cementitious ratio.
- 5. Slump ASTM C143.
- Certification and test results of the total water-soluble chloride ion content of the design mix FHWA RD-77 or AASHTO T 260-84.
- 7. Air content of freshly mixed concrete by the pressure method, ASTM C231, or the volumetric method, ASTM C173.
- 8. Unit weight of concrete ASTM C138.
- 9. Strength at 7- and 28-days for structural concrete—ASTM C39. Document strength on basis of previous field experience or trial mixtures, per ACI 301 Section 4. Submit strength test records, mix design materials, conditions, and proportions for concrete used for record of tests, standard calculation, and determination of required average compressive strength.
- 10. Strength at 7- and 28-days for polished concrete surfaces— ASTM C39. Document strength on basis of trial mixture (mandatory), per ACI 301 Section 4. Submit strength test records, mix design materials, conditions, and proportions for concrete used for record of tests, standard calculation, and determination of required average compressive strength.
- 11. Complete and include Structural Engineer's standard mix design submittal form for each mix. A blank copy is included at the end of this section.
- C. Steel Reinforcement Shop Drawings: Fabrication and placing drawings for reinforcement detailing, fabricating, bending, and placing concrete reinforcement. Comply with ACI SP-066(04) "ACI Detailing Manual" showing bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement. Include special reinforcing required for openings through concrete structures.
 - 1. Computer generated electronic structural construction document files (ACAD) will be made available to the Contractor. The Contractor will be required to sign the Engineer's standard release of liability form prior to receiving the drawing files. Rules for use of said files shall be as defined in the CRSI "Code of Standard Practice" Sections 4.19 and 6.4.1.
 - 2. Shop drawing resubmittals are reviewed for conformance with review marks only. Any changes or questions originating on a resubmittal shall be clearly clouded.
- D. Product Data: For proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, waterstops, vapor retarder/barrier, construction joint slip dowels, joint systems, curing compounds, and others if requested by Architect.
- E. Samples of materials as requested by Architect, including names, sources, and descriptions, as follows:
 - Reglets.
 - 2. Waterstops.
 - 3. Vapor retarder/barrier.
 - 4. Form liners.
- F. Drawings showing proposed construction and/or contraction joint locations.

1.5 INFORMATIONAL SUBMITTALS

- A. General: Furnish submittals in quantity, format, and other Conditions of the Contract and as specified in Division 1 of the Project Manual.
- B. Laboratory test reports for concrete materials or material certificates in lieu of material laboratory test reports. Material certificates shall be signed by Manufacturer and Contractor, certifying that each material item complies with or exceeds specified requirements. Provide certification from admixture manufacturers that chloride content complies with specification requirements.

- C. Survey of the as-built locations of anchor rods, foundation bolts, and other embedded items shall be submitted to the Architect, Engineer, and General Contractor/Construction Manager.
- D. Written notification that the concrete in the footings, piers, walls, or other bearing support has attained, on the basis of an appropriate ASTM standard test method of field-cured samples, a minimum of 75% of the intended minimum compressive design strength.
- E. Floor Surface Flatness and Levelness Measurements: Submit record of all F-number tests, including a plan of the specific locations tested and the test results, to the Architect for their records.
- F. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

A. Codes and Standards: Comply with provisions of the following codes, specifications, and standards, except where more stringent requirements are shown or specified. Each contractor having reference to ACI Documents shall maintain copies of same on project site.

AMERICAN CONCRETE INSTITUTE

- 1. ACI 117-10 Specifications for Tolerances for Concrete Construction and Materials.
- 2. ACI 211.1-91 Standard Practice for Selecting Proportions Normal, Heavyweight and Mass Concrete (Reapproved 2009).
- 3. ACI 301-10 Specification for Structural Concrete.
- 4. ACI 302.1R-04 Guide for Concrete Floor and Slab Construction.
- 5. ACI 304.2R-96 Placing Concrete by Pumping Methods (Reapproved 2008).
- 6. ACI 305R-10 Guide to Hot Weather Concreting.
- 7. ACI 306R-10 Guide to Cold Weather Concreting.
- 8. ACI 308R-01 Guide to Curing Concrete (Reapproved 2008).
- 9. ACI 309R-05 Guide for Consolidation of Concrete.
- 10. ACI 311.1R-07 ACI Manual of Concrete Inspection.
- 11. ACI 318-11 Building Code Requirements for Structural Concrete and Commentary.
- 12. ACI 347-04 Guide to Formwork for Concrete.
- 13. SP-66 ACI Detailing Manual.

CONCRETE REINFORCING STEEL INSTITUTE (CRSI):

- 1. CRSI Manual of Standard Practice.
- 2. CRSI RB4.1 Supports for Reinforcement Used in Concrete (2014a)
- 3. CRSI Placing Reinforcing Bars (2011)
- B. Contractor shall be responsible for conducting a survey of the as-built locations of anchor rods, foundation bolts, and other embedded items. Survey to include embed placement, bolt projection, and top of foundation elevation. Survey to be conducted by a Professional Land Surveyor.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver steel reinforcement and concrete to Project site in such quantities and at such times to ensure continuity of installation.
- B. Store materials to permit easy access for inspection and identification. Keep steel reinforcement off ground by using pallets, platforms, dunnage, or other supports and spacers.
- C. Do not store materials on structure in a manner that might cause distortion, damage, or overload to

members or supporting structures. Repair or replace damaged materials or structures as directed.

D. Store waterstops and packaged materials in sealed containers with manufacturer's labels intact. Place under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

- A. Forms for Exposed (Smooth) Finish Concrete: Exterior-grade high-density overlay (Class 1 or better), medium-density overlay (Class 1 or better with mill-release agent treated and edge sealed), or Structural1 or Class 1 (B-B or better, mill oiled and edge sealed) plywood panels complying with DOC PS1; or new metal-framed and metal faced panels; or other acceptable panel-type materials to provide continuous, straight, and smooth exposed surfaces. Furnish in largest practicable sizes to minimize number of joints.
- B. Forms for Unexposed, Rough-Formed Finish Concrete: Plywood, lumber, metal or another acceptable material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Chamfer Strips: Non-staining dressed wood, metal, PVC, or rubber strips; ¾ by ¾ inch, minimum, and as shown on Drawings; in longest practical lengths.
- D. Form-Release Agent: Commercially formulated form-release agent with maximum volatile organic compounds (VOCs) not to exceed those allowable by jurisdictional regulations that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- E. Form Ties (Standard): Factory-fabricated, adjustable-length, removable or snap-off glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of plastic concrete on forms, prevent form deflection, and to prevent spalling of concrete upon removal.
 - 1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of the exposed concrete surface.
 - 2. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.
 - 3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.
- F. Form Joint Tape: Compressible foam tape; pressure sensitive; AAMA800, "Specification 810.1, Expanded Cellular Glazing Tape"; minimum ¼ inch thick.
- G. Form Joint Sealant: Elastomeric sealant complying with ASTM C920, Type M or S, Grade NS, that adheres to form joint substrates.
- H. Sealer: Penetrating, clear, polyurethane wood form sealer formulated to reduce absorption of bleed water and prevent migration of set-retarding chemicals from wood.

2.2 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
- B. Welded Wire Fabric: ASTM A 1064, plain, fabricated from as-drawn steel wire into flat sheets.

- C. Deformed Joint Dowel Bars: ASTM A 615, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.
- D. Smooth Joint Dowel Bars: ASTM A36, plain-steel bars, cut true to length with ends square and free of burrs.
- E. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," 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 steel wire or CRSI Class 2 stainless-steel bar supports.
- F. Fabric Supports: Chairs for spacing, supporting welded wire fabric in place. Use continuous wire chairs complying with CRSI specifications.
 - For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.
 - 2. For exposed-to-view concrete surfaces where legs of supports are in contact with forms, provide supports with legs that are protected by plastic (CRSI, Class 1) or stainless steel (CRSI, Class 2).

2.3 CONCRETE MATERIALS

- A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- B. Cementitious Materials:
 - 1. Portland Cement: ASTM C 150, Type I or Type III (high early strength when specified). Fly Ash: ASTM C 618, Class F or C, except maximum loss on ignition: 3%. Slag Cement: ASTM C 989, Grade 100 or 120. Silica Fume: ASTM C 1240, amorphous silica.
 - 2. Blended Hydraulic Cement: ASTM C 595, Type IS, portland blast-furnace slag, Type IP, portland-pozzolan, Type IL, portland-limestone, or Type IT, ternary blended cement.
 - 3. Blended Hydraulic Cement: ASTM C1157 (Performance Specification for Hydraulic Cements) Type GU (General Use), Type HE (High-Early Strength).
 - 4. One brand of cement shall be used throughout Project duration unless otherwise acceptable to Engineer.
- C. Normal-Weight Aggregates: ASTM C 33 Class 3S coarse aggregate or better, graded, and as specified. Provide aggregates from a single source for exposed concrete.
 - 1. For exposed exterior surfaces, do not use fine or coarse aggregates that contain substances considered deleterious or that cause spalling or surface discoloration due to oxidation.
 - 2. Fine Aggregate to be free of materials with deleterious reactivity to alkali in cement.
- D. Water: ASTM C 1602 and potable.
- E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. Water-Reducing Admixture: ASTM C 494, Type A.
 - 2. Retarding Admixture: ASTM C 494, Type B.

CAST-IN-PLACE CONCRETE (+MIX FORM) 03 3000 - 6 04/24/2025

- 3. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
- 4. Water-Reducing and Accelerating Admixture: ASTM C 494, Type E.
- 5. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
- 6. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G.
- 7. Plasticizing and Retarding Admixture: ASTM C 1017, Type II.
- 8. Air-Entraining Admixture: ASTM C 260.
- F. Controlled Low Strength Material (CLSM) Performance Additive
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - a. Darafill or Darafill Dry, GCP Applied Technologies, Inc.
 - b. MasterMatrix VMA 362, BASF Corporation.
 - c. RUSS-FLO, RussTech Admixtures, Inc.

2.4 RELATED MATERIALS

- A. Reglets: Where sheet flashing or bituminous membranes are terminated in reglets, provide reglets of not less than 0.022-inch thick (26-gage) galvanized sheet steel. Temporarily fill reglet or cover face opening to prevent intrusion of concrete or debris.
- B. Dovetail Anchor Slots: Hot-dip galvanized sheet steel, not less than 0.034 inch thick (22 gage) with bent tab anchors. Temporarily fill slot or cover face opening to prevent intrusion of concrete or debris.
- C. Headed Steel Studs: ASTM A 108, Grade 1015 through 1020, cold finished carbon steel, AWS D1.1, Type B. Dimensions shall comply with AISC specifications.
- D. Anchor Rods, Bolts, Nuts, and Washers: As follows:
 - 1. Non-High Strength Rods (Straight, Headed or Continuously Threaded) for heavy structural steel and PEMB,: ASTM F1554 Grade 36 and heavy hex carbon-steel nuts.
 - 2. Plate Washers: ASTM A36.
- E. Construction joint slip dowels: steel rod or plate in a plastic insert to allow contraction of the concrete while preventing vertical differential displacement for the Office Building Addition only.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - a. #4x1'-6" long, Speed Dowel by Sika Greenstreak.
 - b. ¹/₄" plate, Diamond Dowel by PNA, Inc.
 - c. ¹/₄" plate, Speed Plate by Sika Greenstreak.
- F. Slab Pourstop with mechanical shear transfer: galvanized steel, vinyl, or plastic forming pourstop with integral keyway or pre-drilled holes with dowel bars at 12" on center for use with slabs on grade for Office Building Addition only.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - a. Key-Loc Joint System, Cardinal Manufacturing Company, Inc.
- G. K-Form system with 3/4" diameter by 18" smooth dowels (minimum), Victory Bear Construction Products.Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip,

bentonite-free hydrophilic polymer-modified chloroprene rubber, for adhesive bonding to concrete, 3/8 by 3/4 inch.

- 1. Manufacturers: Subject to compliance with requirements manufacturers offering products that may be incorporated into the work include, but are not limited to the following:
 - a. GCP Applied Technologies Inc.
 - b. Sika Hydrotite CJ
- H. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or non-impregnated, flexible, synthetic foam with standard bonding agent to hold in place.
- I. Sheet Vapor Retarder: Provide vapor retarder that is resistant to deterioration when tested according to ASTM E 154, as follows:
 - Polyolefin/Resin or multi-ply extrusion coated polyethylene sheet not less than 10 mils thick conforming to ASTM E 1745 Class A. Maximum water vapor permeance when tested in accordance with Test Method ASTM E154, Sections 8, 11, 12, and 13 (based on ASTM E96) or ASTM F1249 of 0.038 perms. Minimum tensile strength when tested to ASTM D882 of 45 lbsforce/inch
 - 2. Accessories: All must be from the same manufacturer of the vapor barrier material used, or must be approved by the vapor barrier manufacturer in writing and submitted to the Architect for record.
 - a. Seams: Manufacturer approved seam tape.
 - b. Sealing Permanent penetrations of vapor retarder: Manufacturer approved vaporproofing mastic or tape.
 - c. Perimeter edge/seal: Manufacturer approved tape with a textured surface that creates a mechanical seal to freshly-placed concrete, termination bar, or double-sided sealant tape.
 - d. Non-permanent penetration prevention: Manufacturer approved peel and stick stake base/foot and film safe screed system.
 - 3. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - a. Perminator Vapor-Mat with Perminator Tape Seal. W.R. Meadows, Inc.
 - b. Stego Wrap with Stego Tape Seal. Stego Industries, LLC.
 - Viper Vaporcheck II with manufacturer's recommended tape seal. Insulation Solutions, Inc.
 - Vaporblock VB10 with Vapor Bond Plus Tape Seal. Raven Industries, Engineered Films Division.
 - e. Xtreme with Xtreme Tape Seal. Tex-Trude, LP.
- J. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 according to ASTM D 2240.
- K. Bonding Agent: ASTM C 1059, Type II, nonredispersible, acrylic emulsion or styrene butadiene.
- L. Cartridge Injection Adhesive (for reinforcing dowels): two-component material for use in concrete. Anchor to be approved for use with cracked concrete per AC308.
 - 1. Acrylic resin adhesive, suitable for use on dry or damp surfaces. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:

- a. HIT HY 200 V3 System, Hilti.
- b. AC 200+, DeWalt/ Powers.
- c. AT-XP System, Simpson/Strong-Tie.
- 2. Epoxy adhesive, suitable for use on oversized, cored, and wet holes and in submerged applications. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - a. A7+ System, ITW Red Head.
 - b. HIT RE500 V3 System, Hilti.
 - c. PURE 110+, DeWalt/Powers.
 - d. SET-XP Epoxy System, Simpson/Strong-Tie.
- M. Nonmetallic, Shrinkage-Resistant Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage compensating agents, plasticizing and water-reducing agents, complying with ASTM C1107, of consistency suitable for application, and a 30-minute working time. Grout to have a minimum compressive strength at 28 days of 8,000 psi when applied in a flowable consistency.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - a. SureGrip High Performance Grout, Dayton Superior.
 - b. NS Grout, The Euclid Company.
 - c. Masterflow 928, BASF Construction Chemicals.
 - d. Sikagrout 328, SIKA.
- N. Cementitious Rubbing Grout: Polymer-modified, Portland cement based patching and rubbing grout for use in rubbing and finishing vertical and overhead formed finish concrete. Shall be color controlled for blending with the cast-in-place concrete. Rubbing Grout shall have a minimum compressive strength at 28 days of 4,000 psi.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - a. Pavecrete Plus, Lyons Manufacturing, Inc.

2.5 LIQUID FLOOR TREATMENTS

- A. Penetrating Concrete Sealer: Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.
 - 1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
 - a. BASF Corporation; Construction Systems.
 - b. ChemMasters, Inc.
 - c. Dayton Superior.
 - d. Euclid Chemical Company.
 - e. Kaufman Products, Inc.
 - f. L&M Construction Chemicals, Inc.
 - g. Metalcrete Industries.
 - h. PROSOCO, Inc.
 - i. SpecChem, LLC.

j. W. R. Meadows, Inc.

2.6 CURING MATERIALS

- A. Absorptive Cover for non-exposed concrete: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- B. Wet-curing Blanket for exposed architectural concrete: ASTM C171-03 and AASHTO M171-00 natural cellulose fabric for single use application. Rolls to be new, shrink-wrapped in poly covering until used.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - a. UltraCure NCF, Sika.
 - b. Single-Use Curing Blanket, Masco.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. General: All non-dissipating compounds shall be certified by curing compound manufacturer to not interfere with bonding of floor covering. Where liquid floor treatment or colored stain system is used, provide material recommended by the manufacturer of the treatment for use in a compatible, integrated system.
- F. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete for temporary protection from rapid moisture loss.
- G. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
- H. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating.

2.7 PROPORTIONING AND DESIGNING MIXES

- A. Prepare design mixes for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field data methods, or both, according to ACI 301. Mix proportions shall be established so that the concrete can be placed readily without segregation into forms and around reinforcement under anticipated placement conditions. Use an independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures. Trial batch and field experience tests shall have been performed within 24 months of submittal date. Use mix design submittal form included at the end of this section.
 - 1. Do not use the same testing agency for field quality control testing.
- B. Submit written reports to Architect of each proposed concrete mix type at least 15 days prior to start of Work. Do not begin concrete production until proposed mix designs have been reviewed by Architect. The approved mix designs shall be used throughout this project unless changes are approved by the Architect/Engineer prior to use.
- C. Cementitious Materials: Supplier shall coordinate surface treatment compatibility with cementitious materials. Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 - 1. Fly Ash: 20 percent for Type F or 25% for Type C except for lean or flowable backfill. Use of

CAST-IN-PLACE CONCRETE (+MIX FORM) 03 3000 - 10 04/24/2025

fly ash in concrete for use in colored concrete, polished concrete floor systems, or where incompatible with admixtures or other treatments is prohibited.

- 2. Combined Fly Ash and Pozzolan: 25 percent.
- 3. Slag Cement: 50 percent.
- 4. Combined Fly Ash or Pozzolan and Slag Cement: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
- 5. Silica Fume: 10 percent.
- 6. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
- 7. Combined Fly Ash or Pozzolans, Slag Cement, and Silica Fume: 50 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete as required for placement and workability and in all pumped concrete, architectural concrete, and concrete required to be watertight.
 - 2. Use accelerating and retarding admixtures at Contractor's discretion to control set time when required by extreme temperatures or humidity, or other adverse placement conditions. Use accelerating admixture in concrete slabs placed at ambient temperatures below 35 deg F.
 - 3. Use shrinkage-reducing admixture in all concrete for polished concrete or other exposed architectural concrete floor systems. Dosage rate to be 2% by weight cementitious material. Coordinate compatibility with other admixtures and floor treatments.
 - 4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.
- E.
- F. The minimum compressive strength measured 28 days after placement (f'c), minimum cementitious content, slump, maximum water/cementitious content ratio (W/C), and air content of the concrete for each portion of the structure shall be as follows:
 - 1. Mix Type 1. Controlled Low Strength Material CLSM (Flowable fill). Provide blend of cement, flyash, and sand with minimum cementitious content as follows:
 - a. Excavatable flowable fill: 100 lb cement and 250 lb fly ash per cubic yard.
 - b. Structural flowable fill (250 psi): 175 lb cement and 200 lb fly ash per cubic yard. Add CLSM performance additive at manufacturer's recommended dosage rate, adjusting water content to provide desired flow and strength characteristics.
 - 2. Mix Type 2. Lean Concrete Backfill and Mudmats. Normal-weight concrete.
 - a. Minimum Design Compressive Strength: 1,500 psi.
 - b. Minimum Cementitious Material: 200 lbs/cy.
 - c. Slump Limit: N/A.
 - d. Air Content: Natural.
 - 3. Mix Type **3**. Footings. Normal-weight concrete.
 - a. Minimum Design Compressive Strength: 3,000 psi.
 - b. Minimum Cementitious Material: 470 lbs/cy.
 - c. Slump Limit: Minimum of 4 inches and maximum of 6 inches, plus or minus 1 inch.
 - d. Air Content: Natural.
 - 4. Mix Type **4**. Interior Piers. Normal-weight concrete.

CAST-IN-PLACE CONCRETE (+MIX FORM) 03 3000 - 11 04/24/2025

- a. Minimum Design Compressive Strength: 4,000 psi.
- b. Minimum Cementitious Material: 505 lbs/cy.
- c. Water Reducing Admixture: Mandatory.
- d. Slump Limit: Maximum 4 inches or 8 inches after adding admixture to 2-to-3-inch slump concrete, plus or minus 1 inch.
- e. Air Content: Natural.
- 5. Mix Type 5. Interior Slab on Gradefor non-polished surfaces. Normal-weight concrete.
 - a. Minimum Design Compressive Strength: 4,000 psi.
 - b. Minimum Cementitious Material: 505 lbs/cy.
 - c. Water Reducing Admixture: Mandatory.
 - d. Slump Limit: Maximum 8 inches after adding water reducing admixture to 2-to-3-inch slump concrete, plus or minus 1 inch.
 - e. Air Content: Maximum 3 percent.
- 6. Mix Type **6**. Exterior Walls, Piers, Horizontal Concrete under roof but in open structures, and Equipment Bases. Normal-weight concrete.
 - a. Minimum Design Compressive Strength: 4,500 psi.
 - b. Minimum Cementitious Material: 550 lbs/cy. With an approved water-reducing agent, minimum cement content may be reduced by 47 pounds of cement per cubic yard.
 - c. Maximum W/C Ratio: 0.45.
 - d. Water Reducing Admixture: Optional.
 - e. Slump Limit: Maximum 4 inches or 8 inches after adding admixture to 2-to-3-inch slump concrete, plus or minus 1 inch.
 - f. Air Content: 5.5 percent for 1 ½-inch maximum aggregate.
 - 6.0 percent for 1-inch maximum aggregate.
 - 6.0 percent for ¾-inch maximum aggregate.
 - 7.0 percent for ½-inch maximum aggregate.
- G. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, as accepted by Architect. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Architect before using in Work.

2.8 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.9 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94, and furnish batch ticket information.
 - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94. Mix concrete materials in appropriate drum-type batch machine mixer.
 - 1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
 - 2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional

1 cu. yd.

3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 GENERAL

A. Coordinate the installation of joint materials, vapor retarder/barrier, and other related materials with placement of forms and reinforcing steel.

3.2 FORMWORK INSTALLATION

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied until concrete structure can support such loads.
- B. Construct formwork so concrete members and structures are of correct size, shape, lines, alignment, elevation, position, level, plumb, and dimension and indicated. Maintain formwork construction tolerances and surface irregularities within limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
 - 1. Class A, 1/8-inch tolerances for smooth-formed concrete surfaces exposed to view.
 - 2. Class D tolerances for earth formed foundation elements. Tolerance applies as a variation inward towards reinforcing only. No tolerance limit away from reinforcing applies.
 - 3. Class C, ½-inch tolerances for other concrete surfaces.
- D. Solidly but joints and provide backup at joints to prevent cement paste from leaking.
- E. Construct forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like for easy removal.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and contours in finished surfaces. Provide and secure units to support screed strips using strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspections where interior area of formwork is inaccessible before and during concrete placement. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Form openings, chases, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, and other features required in the Work. Chamfer exposed corners and edges at exterior corners and edges of permanently exposed concrete and as indicated, to produce uniform smooth, straight lines and tight edge joints.
- I. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses, and chases from trades providing such items. Accurately place and securely support items built into forms.
- J. Earthen forms may be used for footings and foundation elements when ground is stable and capable of

resisting erosion and fluid pressure of wet concrete without sloughing. All tolerances and clear covers shall be maintained. Excavation shall be clean of all loose soil and mud along bottom and sides.

- K. Use selected materials to obtain required finishes.
- L. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just before placing concrete. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- M. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.
 - 1. Do not allow excess form-coating material to accumulate in forms or come into contact with inplace concrete surfaces against which fresh concrete will be placed.
 - 2. Do not spray reinforcing with form oil.
 - 3. Coat steel forms with a nonstaining, rust-preventative material. Do not use rust-stained steel form-facing material.

3.3 INSTALLING EMBEDDED ITEMS

- A. Place and secure anchorage devices, anchor rods, and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, diagrams, templates, instructions, and directions furnished with items to be embedded.
 - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303. Column anchor rods shall be set in a rigid template and securely braced to formwork or ground prior to placing concrete. Anchor rods shall not be "wet set" in plastic concrete.
 - 2. Install dovetail anchor slots in concrete structures as indicated.
 - Install reglets to receive sheet waterproofing and to receive through-wall flashings in outer face
 of concrete frame at exterior walls, where flashing is shown at lintels, relieving angles, and other
 conditions.
 - 4. Aluminum conduit shall not be installed in concrete.

3.4 REMOVING AND REUSING FORMS

- A. Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete must first be sufficiently hard to not be damaged by form-removal operations, and provided curing and protection operations shall be maintained.
 - 1. Remove forms only if shores and other vertical supports have been arranged to permit removal without loosening or disturbing shores.
- B. Formwork supporting weight of concrete, such as beam soffits, joists, slabs, and other structural elements, may not be removed in less than 14 days and until concrete has attained at least 75 percent of its 28-day design compressive strength. Determine potential compressive strength of in-place concrete by testing field-cured specimens representative of concrete location or members.
 - 1. Cantilevered construction shall be shored for a minimum of 28 days after being placed.
- C. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent as specified for new formwork.

- D. When forms are reused, clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to avoid offsets.
 - 1. Do not use patched forms for exposed concrete surfaces except as acceptable to Architect.
 - 2. For Architectural Exposed formed surfaces, tie holes may not be plugged. Reuse tie holes or use new form for each pour.

3.5 STEEL REINFORCEMENT INSTALLATION

- A. General: Comply with Concrete Reinforcing Steel Institute's (CRSI) "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
 - Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Deliver reinforcement to job site bundled, tagged and marked. Use waterproof tags indicating bar size, length, and mark corresponding to placing drawings.
- C. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials that reduce or destroy bond with concrete.
- D. When permitted, field bend bars cold, except during cold weather when moderate heating is necessary to avoid brittle failures.
- E. Install reinforcing to mechanical splices in accordance with the manufacturer's requirements.
- F. Accurately position, support, and secure all bar reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum coverages as indicated for concrete protection.
 - 1. Arrange, space and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations.
 - 2. Walls with reinforcing mats on each face shall have bent U-bar spacers tied to each mat to hold spacing between mats. U-bar spacers shall be minimum #3 bars spaced a maximum of 6 feet on center horizontally and vertically with a row of bars placed at the top of any wall over 4 feet tall.
 - 3. All walls shall have chairs or bolsters placed between reinforcing mat(s) and both form faces spaced a maximum of 6 feet on center to maintain clear cover.
- G. Install welded- wire fabric reinforcement in longest practicable lengths on fabric supports spaced to minimize sagging. Lap edges and ends of adjoining pieces at least one full mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace outermost cross wires of lace splices with wire to prevent lifting of the ends during concrete placement.
 - 1. Chair welded wire fabric slab reinforcement with continuous chairs spaced a maximum of 32 inches on center. Provide additional chairs as required. Lift welded wire fabric back into position between chairs where depressed during concrete placement. Lifting welded wire fabric into position during concrete placement without the use of chairs is not permitted.
- H. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- I. Do not weld reinforcing bars.
- J. Construction tolerances shall be in accordance with ACI 117 and the following:
 - 1. For member depths 12" and smaller, tolerance on concrete cover shall be the smaller of -3/8" and -(1/3)*[specified cover].

CAST-IN-PLACE CONCRETE (+MIX FORM) 03 3000 - 15 04/24/2025

- 2. For member depths larger than 12", tolerance on concrete cover shall be the smaller of -1/2" and -(1/3)*[specified cover].
- 3. At formed soffits, tolerance on concrete cover shall be -1/4".
- 4. Tolerance for longitudinal location of bends and ends of reinforcement:
 - a. At discontinuous ends of brackets and corbels, $\pm 1/2$ ".
 - b. At discontinuous ends of other members, ± 1 ".
 - c. At other locations, ± 2 ".

3.6 PLACING ADHESIVE SYSTEM

- A. General: Clean all holes per manufacturer instructions to remove loose material and drilling dust prior to installation of adhesive. Holes may be dry, damp or wet. Inject adhesive into holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive. Follow manufacturer recommendations to ensure proper mixing of adhesive components. Sufficient adhesive shall be injected in the hole to ensure that the annular gap is filled to the surface. Remove excess adhesive from the surface. Shim anchors with suitable device to center the anchor in the hole. Do not disturb or load anchors before manufacturer specified cure time has elapsed.
 - Drill holes with rotary impact hammer drills using carbide-tipped bits and core drills using diamond core bits. Drill bits shall be of diameters as specified by the anchor manufacturer. Unless otherwise shown on the Drawings, all holes shall be drilled perpendicular to the concrete surface.
 - 2. Cored Holes: Where anchors are to be installed in cored holes, use core bits with matched tolerances as specified by the manufacturer. Acrylic Adhesive Anchors shall not be installed in core drilled holes.
 - 3. Embedded Items: Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Exercise care in coring or drilling to avoid damaging existing reinforcing or embedded items. Notify the Engineer if reinforcing steel or other embedded items are encountered during drilling.
 - 4. Observe manufacturer recommendations with respect to installation temperatures for cartridge injection adhesive anchors and capsule anchors.
 - 5. Perform anchor installation in accordance with manufacturer instructions.

3.7 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints in Reinforced Structure and Foundations: Locate and install construction joints so they do not impair strength or appearance of the structure, at locations indicated or otherwise as acceptable to Architect.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 2. Form continuous keyways as indicated. Embed keys at least 1-1/2 inches into concrete. Provide keyways 1/3 the member thickness, or 3 ½" minimum, in walls, footings, and between walls and footings centered in the member thickness unless shown otherwise. Provide keyways ½ member width by ½ member depth in grade beams, beams, and columns and between grade beams / beams and supporting members centered in the member unless shown otherwise.
 - 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 - 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 - 5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.

- Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Construction Joints in Slab on Grade: Provide slip dowels (as shown on drawings) for construction joints in field of slabs on grade less than 6" thickness. Provide continuous keyways at least 1 1/2 inches deep by 1 ½" wide or slip dowels (as shown on drawings) in construction joints in slabs on grade 6" or thicker. Provide continuous keyways at least 1 1/2 inches deep by one third the slab thickness centered in the construction joint of all formed concrete slabs.
 - 1. Bulkheads designed and accepted for this purpose shall be used for doweled joints. Use manufactured plastic sleeves as indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint for non-sleeved dowels.
 - 2. Prefabricated pourstop with keyway may be used for simultaneous placement of adjacent slab panel at Contractor's option, where approved by Architect. Use leave-in-place joint system that is compatible with floor finish or treatment system.
 - 3. Where construction joints at doorways that align with both faces of bearing wall are specified, utilize preformed pourstop with keyway in lieu of slip dowels.
 - 4. Where joints will be exposed to view in public spaces or warehousing areas, joints shall be straight, crisp, and with sharp edges. Slabs shall be flush across joint.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
 - 1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
 - 2. Terminate full-width joint-filler strips flush with top of slab to prevent contact or bonding between the slab and the adjoining member. Use strips with perforated strips that remove the top portion to be not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants are indicated.
 - 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
 - 4. At locations where drawings do not specifically call for premolded filler, provide bond breaker between slab and vertical surface. The vapor retarder may be turned up and used for this purpose.
 - 5. Provide ½" expansion joint between slab and all door jambs (at end of walls in opening).
 - 6. Joint fillers and sealants are specified in Division 7 Section "Joint Sealants."
- E. Contraction (Control) Joints in Slabs-on-Grade: Construct weakened-plane contraction joints, sectioning concrete into areas as indicated, and to a depth equal to at least one-fourth depth of concrete thickness as follows:
 - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groove-tool marks on concrete surfaces.
 - 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
 - 3. Contraction joints may be formed by saw cuts as soon as possible after slab finishing as may be safely done without dislodging aggregate.
 - 4. If joint pattern is not shown, provide joints not exceeding 15 feet in either direction and located to conform to bay spacing wherever possible (at column centerlines, half bays, third bays).
 - 5. Joint fillers and sealants are specified in Division 7 Section "Joint Sealants."
- F. Provide waterstops in construction joints in all basement and retaining walls (and their integral piers

and columns) below grade and as indicated.

3.8 WATERSTOP INSTALLATION

- A. Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Protect exposed waterstops during progress of the Work.
 - 1. Locate waterstop within joint relative to face and reinforcing as per manufacturer's printed instructions. Location varies with manufacturer. Location shown on drawings is diagrammatic only. Do not locate waterstop within shear key.
 - 2. Support and protect exposed waterstops during progress of Work.
 - 3. Cut ends square, using a razor knife or circular saw equipped with a carbide tipped blade. Weld splices per manufacturer's recommendations.
 - 4. Field-fabricate joints in waterstops according to manufacturer's printed instructions.
- B. Concrete surfaces to receive bonded waterstop shall be reasonably smooth with either a formed or float finish. Where such a concrete surface is scheduled to be rough to facilitate interlocking with the adjacent concrete placement, a 2" wide ribbon of flat surface shall be tooled into the concrete surface to facilitate the proper installation of waterstop. Any irregularities in the concrete surface that would interfere with the waterstop being placed in intimate contact with the concrete surface shall be ground smooth prior to installation.
- C. Install waterstop per manufacturer's recommended installation instructions with primer or adhesive as required.

3.9 VAPOR RETARDER INSTALLATION

- A. Sheet vapor retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions. Place sheeting in position with longest dimension parallel with direction of pour.
 - 1. Extend film fully over slab area to the full perimeter of the slab. Turn film up 2" onto surrounding wall/column/piers/etc. and seal to vertical element with continuous mastic or tack tape capable of adhering to concrete and masonry. Film and tape shall not extend above finished floor.
 - a. At the point of termination, seal vapor retarder to the foundation wall, footing, grade beam or slab itself. Where obstructed by impediments (such as dowels, waterstops, or any other site condition requiring early termination of the vapor retarder), use manufacturer's recommended accessories for such non-standard terminations.
 - 2. Lap joints 6 inches and seal with manufacturer's recommended mastic or pressure-sensitive tape.
 - 3. Apply seam tape to a clean and dry film only.
- B. Seal around all penetrations (including all conduit and pipes) through film with manufacturer's recommended mastic or pressure-sensitive tape. Cut slit around penetrations to place initial layer of film.
 - 1. For small penetrations, tape film directly to the penetrating element.
 - 2. For penetrations larger than 2", create collar for penetration of 12" wide by 1 ½ times the penetration's circumference with fingers cut half the width of the film. Wrap the collar around the penetration, tape the collar onto the strip of film, and tape the fingers at each edge/slit to the initial layer of film.
- C. Avoid the use of non-permanent stakes driven through film. If non-permanent stakes are driven through

film, repair and seal as recommended by film manufacturer.

D. Repair damaged areas of film material of similar (or better) permeance, puncture resistance, and tensile strength.

3.10 CONCRETE PLACEMENT

- A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other trades to permit installation of their work.
- B. General: Comply with ACI 304, "Guide for Measuring, Mixing, Transporting, and Placing Concrete," and as specified. Concrete delivery tickets shall show:
 - 1. Batch number.
 - 2. Mix by number with cement content in pounds and maximum size aggregate.
 - 3. Admixtures.
 - 4. Air content.
 - 5. Slump.
 - 6. Time dispatched and discharged.
 - 7. Date.
 - 8. Contractor.
 - 9. Ready Mix Supplier.
 - 10. Project Name and Address.
 - 11. Volume of Concrete.
- C. Do not add water to the concrete mix during delivery, at Project site, or during placement unless approved by the General Contractor's representative, noted on the delivery ticket with the amount of water, and signed by the General Contractor's representative. The maximum water/cement ratio of an approved mix design shall not be exceeded.
 - 1. When the ambient air temperature is between 80 and 90 degrees Fahrenheit, one (1) gallon of water per cubic yard of concrete may be added at the job site to compensate for water evaporation during transit.
 - 2. When the ambient air temperature exceeds 90 degrees Fahrenheit, two (2) gallons of water per cubic yard of concrete may be added at the job site to compensate for water evaporation during transit
 - 3. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Discharge concrete within 1½ hours after water has been added to the cement, unless a longer time has been authorized by the Architect/Engineer. During hot weather or other conditions contributing to a quick stiffening of the concrete, the Architect/Engineer may require discharge in less than 1½ hours.
- E. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation. Do not allow concrete to drop more than 5 feet or from a height which allows concrete to fall against reinforcing.
 - 1. Deposit concrete in forms in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints. Do not subject concrete to any procedure that will cause segregation. Deposit concrete as near as possible to the final position to avoid segregation.
 - 2. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete complying

with ACI 301.

- 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the machine. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mix to segregate.
- F. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
 - 1. Consolidate concrete during placement operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 - 2. Maintain reinforcement in proper position on chairs during concrete placement.
 - 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 - 4. Slope surfaces uniformly to drains where required.
 - 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- G. Cold-Weather Placement: When air temperature is expected to fall below 40 degrees Fahrenheit (4 deg C) within the first 72 hours after concrete placement, comply with provisions of ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 1. When mean daily air temperature is expected to fall below 40 deg F (4 deg C) for more than three successive days after concrete placement, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature at point of placement as follows:
 - a. Not less than 55 deg F (13 deg C) or more than 75 deg F (24 deg C) for concrete sections less than 12 inches in the least dimension (width or thickness).
 - b. Not less than 50 deg F (10 deg C) or more than 70 deg F (21 deg C) for concrete sections 12 inches or greater in the least dimension (width or thickness).
 - 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise accepted in mix designs.
- H. Hot-Weather Placement: When hot weather conditions exist that would impair quality and strength of concrete, place concrete complying with ACI 305.1 and as specified.
 - 1. Cool ingredients before mixing to maintain concrete temperature at time of placement to below 90 deg F (32 deg C). Mixing water may be chilled or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 - 2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedding in concrete.
 - 3. Fog spray forms, reinforcing steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without puddles or dry areas.
 - 4. Use water-reducing retarding admixture when required by high temperatures, low humidity, or other adverse placing conditions, as acceptable to Architect.
- I. Pumping Concrete: Grout used to prime a pump shall not be placed in the forms of any concrete exposed to view in the final structure. Concrete shall not be pumped through pipe made of aluminum or

CAST-IN-PLACE CONCRETE (+MIX FORM) 03 3000 - 20 04/24/2025

aluminum alloys.

3.11 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: Provide a rough-formed finish on formed concrete surfaces not exposed to view in the finished Work or concealed by other construction. This is an as-cast concrete surface having texture imparted by form-facing material used. Repair and patch tie holes, honeycombing over ½ inch in depth, and other defective areas. Remove fins and other projections exceeding ¼ inch in height by rubbing down, chipping, or grinding off.
- B. Smooth-Formed Finish: Provide a smooth-formed finish on formed concrete surfaces exposed to view in non-public rooms (storage, mechanical rooms, etc.) or to be covered with a coating or covering material applied directly to concrete. This is an as-cast concrete surface obtained with selected form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes, honeycombing over ¼" in depth, and other defective areas. Remove fins and other projections exceeding 1/8" in height by rubbing down or grinding off until completely removed and smoothed.
- C. 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.

3.12 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as specified; slab surfaces to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo; and where indicated.
 - 1. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating, using float blades or float shoes only, when surface water has disappeared, or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats or by hand-floating if area is small or inaccessible to power units. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.
- C. Trowel Finish: Apply a trowel finish to monolithic slab surfaces exposed to view and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint, or another thin film-finish coating system.
 - After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating, using float blades or float shoes only, when surface water has disappeared, or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats or by hand-floating if area is small or inaccessible to power units.
 - 2. Allow moisture film or sheen to disappear from the floated surface and allow the concrete to harden enough to prevent fine material and water from being worked into the concrete surface. Then begin first trowel-finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks and uniform in texture and appearance.
 - 3. Finish surface to specified tolerances for floor flatness and floor levelness measured according to ASTM E 1155. Minimum local values shall be 2/3 of the specified composite F-number.

Unless otherwise shown or noted on the drawings, comply with the following table:

Slabs on Grade		
Composite Flatness F(F)	Composite Levelness F(L)	Typical Use
20	15	Mechanical rooms, non-public areas, surfaces to receive thick-set tile floors, parking structure slabs
25	20	Surfaces to receive carpet, light traffic (foot) areas in office and industrial buildings
35	25	Surfaces to receive thin-set flooring, warehouse floors with moderate to heavy traffic

- D. Nonslip Broom Finish: Apply a nonslip broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.
 - 1. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.
- E. Surface Cleaning: Where concrete surface is to be left exposed or sealed with thin film or penetrating coating, burnish or burn to remove all protruding synthetic fiber reinforcing.
- F. Exposed Concrete Slabs: Slabs exposed to view in the public spaces shall be free of trowel marks and uniform in texture and appearance. Sharply defined low and high spots are prohibited and cause for rejection by Architect. Grinding and patching to correct discrepancies will be prohibited unless acceptable to Architect. Use new, clean blankets and other protections that will not discolor or dull the finish.

3.13 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, 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 shown or

required to complete Work.

- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Grouting of Column Base Plates: Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces, protect installed materials, and allow to cure.
 - 1. Comply with manufacturer's instructions for proprietary grout materials.
 - 2. Grout shall be installed and cured before any elevated concrete slab supported on said columns are placed and prior to installing structural framing in excess of the third story above.

3.14 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Compatibility: Use membrane curing compounds that will not affect surfaces to be covered with finish materials applied directly to concrete. Dosage rate and material compatibility of curing compound shall be coordinated with the Polishing Contractor for polished concrete floor systems.
- C. Cleanliness for Architecturally Exposed Concrete Slabs: Slabs to be left exposed in public places and to be sealed with densifier/sealers, hardeners, or similar shall remain clean from dirt and other agents which might discolor the finish. Install new, clean polyethylene film over slabs and below curing blankets and other protection which might discolor or stain the raw concrete.
- D. For cold-weather protection during curing, comply with ACI 306.1 and the following:
 - 1. All freshly placed concrete shall be kept from freezing for the following periods:
 - a. 3 days for all concrete with an air entraining admixture.
 - b. 4 days for all concrete without an air entraining admixture.
 - 2. A cumulative curing time of seven days at a minimum surface temperature of 50 degrees F (10 degrees C) shall be provided or until concrete has attained 75% of its design strength. This shall be followed by cooling of concrete in a gradual transition to surrounding conditions. The temperature drop during this period shall not be at a rate exceeding 2 degrees F per hour until the outside or surrounding temperature is reached.
 - 3. When concrete is placed under conditions of cold weather concreting (defined as a period when the mean daily temperature drops below 40 degrees F for more than three successive days), take additional precautions as specified in "Cold Weather Concreting" by the American Concrete Institute (ACI Report 306) when placing, curing, monitoring and protecting the fresh concrete.
- E. For hot-weather protection during curing, comply with ACI 301 and the following:
 - 1. When concrete is placed under conditions of hot weather concreting, provide extra protection of the concrete against excessive placement temperatures and excessive drying throughout the placing and curing operations. Hot weather is defined as air temperature which exceeds 80 degrees F or any combination of high temperature, low humidity and/or high wind velocity that causes a rate of evaporation in excess of 0.2 pounds per square foot per hour as determined by Figure 2.1.5 of ACI Report 305. Hot weather curing is required if these conditions occur within a 24-hour period after completion of concrete placement.
 - 2. Forms, reinforcing and the air shall be cooled by water fog spraying immediately before placing concrete.
 - 3. Immediately following screeding, protect concrete by applying the specified evaporation

retarder in accordance with the recommendations of the manufacturer.

- F. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- G. Formed Surfaces: Cure formed concrete surfaces, including walls, columns, sides and underside of beams, supported slabs, and other similar surfaces, by moisture curing with forms in place for 7 days or until forms are removed. If forms are removed within the first 7 days, continue moisture curing without forms for the balance of the 7-day curing period.
 - For vertical surfaces, after the concrete has hardened and while the forms are still in place, the form ties shall be loosened and water shall be applied to run down the inside of the form to keep the concrete wet.
 - 2. After formwork has been removed from vertical surfaces, keep surface continuously wet by water spray or water-saturated absorptive cover.
- H. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
 - 1. Cure interior and exterior slab surfaces exposed to deicing salts and slabs where the finish flooring is not compatible with curing compounds by Moisture Curing.
 - 2. Cure slab surfaces to receive hardwood flooring or sports rubber systems by Moisture Curing.
- I. Cure concrete according to ACI 308.1 by one or a combination of the following methods:
 - 1. Moisture Curing (standard surfaces): Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 - 2. Moisture Curing (Architectural surfaces): Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Install wet cure covering in widest practical width as soon as concrete has hardened sufficiently to prevent surface damage. Sides and ends to be lapped 3" minimum. Immediately repair holes and tears with additional ply.
 - b. Cover entire surface with 1/8" to 1/4" water, then slowly unroll the blanket onto the slab using the roller squeegee applicator.
 - c. Maintain in place for not less than 7 days after placement.
 - d. No portion of the blanket shall be reused once it has been put into use.
 - 3. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.

CAST-IN-PLACE CONCRETE (+MIX FORM) 03 3000 - 24 04/24/2025

- c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies does not interfere with bonding of floor covering used on Project.
- 4. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to 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.
 - a. Curing Polished Concrete Surface: Apply UV dissipative curing compound as soon as possible after the concrete receives its final finishing.
 - b. Curing Exposed Architectural Slab Surfaces: Apply curing aid as soon as possible after the concrete receives its final finishing using a short nap roller to apply a uniform film. Spray application is prohibited.
 - c. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.
- 5. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.15 LIQUID FLOOR TREATMENT APPLICATION

- A. General: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.
 - 1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
 - 2. Do not apply to concrete that is less than seven days old.
 - 3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.
- B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.
- C. Penetrating Concrete Sealer
 - 1. Apply penetrating concrete sealer to all concrete floor surfaces exposed to view in the finished structure
 - 2. Coverage rate shall be 300 square feet (maximum) per gallon.

3.16 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
- B. Defer joint filling until concrete has aged at least one month. 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 joints clean and dry.

PROJECT NO. 24-179.000 Harrison REMC - Addition and Renovation Harrison REMC

CAST-IN-PLACE CONCRETE (+MIX FORM) 03 3000 - 25 04/24/2025

D. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.17 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval. Repair architectural exposed formed and exposed slab surfaces only with specific prior approval by Architect (cutting, grinding, and patching of these surfaces will generally be prohibited).
- B. Contractor shall make mockup of any repairs for review by Architect prior to performing repairs. Coordinate placement and size with Architect prior to proceeding.
- C. Patching Mortar: Mix dry-pack patching mortar, consisting of 1-part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, and a 50:50 mixture of acrylic or styrene butadiene-based bonding admixture and water. Use only enough liquid as required for handling and placing.
- 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 to solid concrete. Limit cut depth to 3/4 inch. 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.
 - 2. Cut tie rods and bolts flush with the surface and drill out to minimum depth of 1 inch below the surface.
 - 3. Fill through wall tie holes with nonmetallic, shrinkage-resistant grout to within 1 ½" of wall face using a grout bag or other similar means to completely fill the void. Fill any remaining tie hole, including holes from snap-off type form ties, with patching mortar or cone plugs secured in place with bonding agent.
 - 4. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar matches 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.
 - 5. 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 smooth (at covered slabs only) any surface defects that would telegraph through applied floor covering system.
 - 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.

CAST-IN-PLACE CONCRETE (+MIX FORM) 03 3000 - 26 04/24/2025

- 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 to be covered with covering capable of bridging and concealing crack 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 a 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 mixture 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 to be covered with covering capable of bridging and concealing crack 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.
- 8. Repair random cracks in exposed architectural concrete slab on grade by fully removing and replacing slab between existing control or construction joints. Drill and install dowel bars between new and existing slab as directed by Engineer.
- 9. Repair random cracks in exposed architectural suspended concrete slab by fully removing and replacing slab as directed by Architect. Slab replacement shall extend to third point of framing infill bay and girder span at composite beam systems.
- F. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- G. Repair methods not specified above may be used, subject to acceptance of Architect.

3.18 QUALITY CONTROL

- A. The Owner will employ an independent testing and inspection agency that meets the requirements of ASTM E329 to perform inspections and tests and to prepare test reports. The agency will monitor concrete quality by means of site and laboratory tests. They will be authorized to reject plastic concrete not conforming to specifications. Failure to detect any defective materials shall not prevent later rejection when such defect is discovered, or obligate the Architect or Owner for final acceptance.
 - 1. See Section 01 4120 Structural Inspections and Contract Drawings for testing and inspection to be performed.
 - 2. Test results will be reported in writing to the Architect, Engineer, ready-mix producer and General Contractor within 24 hours after tests.
 - 3. Additional Tests: The testing agency will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by Architect.
- B. The General Contractor shall provide for testing of the floor slab F-number tolerances conducted in accordance with the provisions set forth by ASTM E 1155. All tests shall be performed within three working days after concrete placement and prior to any form removal. If in-place floor slabs do not comply with the minimum values shown, the Contractor shall propose remedial measures to bring the surfaces of the floors into compliance. These measures might include grinding, planning, surface repair, retopping, or removal and replacement. Remedial measures shall be approved by the Architect/Engineer prior to the Contractor's commencement of the work.
 - 1. All slab areas shall be tested for F-number tolerances for the first 10,000 square feet placed at each level. Thereafter, test an additional 1,000 square feet per 10,000 square feet of slab area at each level. Quantity of test readings for each area shall be per ASTM E1155.

CAST-IN-PLACE CONCRETE (+MIX FORM) 03 3000 - 27 04/24/2025

- C. Commissioning of Vapor Retarder/Barrier System: Comply with requirements in Section "Commissioning of Vapor Barrier System."
- D. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

3.19 PROTECTION

- A. The Contractor shall provide for protection of exposed slab surfaces both before and after treatment by liquid floor treatments, and for Architectural Finish formed surfaces. General Contractor / Construction Manager shall coordinate all other construction activities to ensure exposed concrete surfaces are not damaged or stained.
- B. Use protective methods and materials, including temporary covering, recommended in writing by installer's manufacturer. Protection membranes shall allow for the even curing and release of water vapor so as to allow even coloring of concrete. Do not lap membranes or seal with tapes at joints.
- C. Do not allow contaminants including acids, oils, resins, etc. to contact surface. Provide continuous scuff-preventing pads covered in lapped and sealed water and oil resistant film.
- D. Do not place any material onto surface that may cause etching, scuffing, chips, or scratches. Provide protection boards below scaffolding legs. Do not allow tracked vehicles on surface.

END OF SECTION 03 3000

Brown + Kubican, PSC

STRUCTURAL ENGINEERS

CONCRETE MIX DESIGN SUBMITTAL FORM

Project:	
Design Mix Information	
	Check
	n Standard Deviation Analysis Trial Mix Laboratory Test Data
Design Characteristics	
	• • • • • • • • • • • • • • • • • • • •
Materials	

	Type	Source	Specific Gravity	Weight (lb.)	Absolute Vol. (cu. ft.)
cement					
flyash					
silica fume					
coarse aggregate					
fine aggregate					
water					
other (_		
			Total	_	27.0 cu. ft.

PROJECT NO. 24-179.000 Harrison REMC - Addition and Renovation Harrison REMC CAST-IN-PLACE CONCRETE (+MIX FORM) 03 3000 - 29 04/24/2025

Water/Cementitious Ratio (W/C) = $_$ % (lbs. water /lbs. cementitious)

Admixtures

	Manufacturer	Dosage (oz./cwt)
water reducer		
air entraining agent		
high range water reducer		
non-corrosive accelerator		
other (

Slump before high range water reducer = _____inches Slump after high range water reducer = ____inches

Standard Deviation Analysis (field experience records)

Number of test cylinders evaluated: _____ Standard deviation (s): _____ k-factor:

Number of Tests	k
15	1.16
20	1.08
25	1.03
>30	1.00

Required avg. compressive strength ($\leq 5000 \text{ psi: Max [f'c} + 1.34\text{ks, f'c} + 2.33 \text{ ks} - 500]$) ($\geq 5000 \text{ psi: Max [f'c} + 1.34\text{ks, } 0.9\text{f'c} + 2.33\text{ks}]$):

Actual avg. compressive strength:_____

(Refer to ACI 301 for standard deviation calculation – attach copies of laboratory test reports)

Trial Mix Laboratory Test Data

	Mix #1 (w	r/c=)	Mix #2 (w.	/c=)	Mix #3 (w.	/c=)
Age	Date	Compressive Strength	Date	Compressive Strength	Date	Compressive Strength
7 days		psi		psi		psi
7 days		psi		psi		psi
28 days		psi		psi		psi
28 days		psi		psi		psi
28 days average	NA	psi	NA	psi	NA	psi

(Refer to ACI 301 for trial mix procedure – attach copies of laboratory test reports)

Required Attachments

	Please check
Coarse aggregate gradation report	
Fine aggregate gradation report	
Laboratory test reports (strength tests)	
Admixture compatibility certification letters	

Ready Mix Supplier	<u>r</u>			
Name and Address:		 	 	

PROJECT NO. 24-179.000
Harrison REMC - Addition and Renovation
Harrison REMC

CAST-IN-PLACE CONCRETE (+MIX FORM) 03 3000 - 31 04/24/2025

Phone:	Miles from project:	Date:	
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SECTION 04 0100 - MASONRY PROTECTION AND CLEANING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish labor, materials, equipment, special tools, supervision and services required to protect masonry materials and masonry work and to complete the cleaning of masonry work.

1.2 DELIVERY, STORAGE AND HANDLING

- A. Store masonry and mortar materials in a high, dry location and in such a manner as to prevent absorption of moisture from the ground.
 - 1. Cover materials completely with waterproof covering securely tied or weighted in place.
 - 2. Store accessory items to prevent damage from construction operations and elements.

1.3 SUBMITTALS

- A. Manufacturer's Literature:
 - 1. Manufacturer's data sheets, cutsheets and materials description.

PART 2 - PRODUCTS

2.1 CLEANING COMPOUND

- A. Provide one of the following approved products (as applicable to specific project conditions):
 - 1. Brick, Concrete Block, Tile:
 - a. "ProSoCo", Sure Klean #600.
 - b. "ProSoCo", Sure Klean #101 Lime Solvent (Red and Dark Colored Brick and Surfaces).
 - c. "ProSoCo", Sure Klean #800 Stain Remover (Buff or White Brick).
 - d. "ProSoCo", Enviro Klean Safety Klean.
 - e. "Sonneborn", Sonokleen 88.
 - f. "EaCo Chem", NMD 80.
 - 2. Pre-Cast Concrete, Poured-In-Place Concrete:
 - a. "ProSoCo", Sure Klean #600.
 - b. "ProSoCo", Sure Klean Light Duty Concrete Cleaner.
 - c. "ProSoCo", Sure Klean Heavy Duty Concrete Cleaner.
 - d. "ProSoCo", Enviro Klean Safety Klean.
 - e. "EaCo Chem". NMD 80.

- 3. Limestone, Natural Stone, Non-Cementitious Manufactured or Synthetic Stones:
 - a. "ProSoCo", Sure Klean #800 Stain Remover.
 - b. "EaCo Chem", NMD 80 (not permitted for polished stone).

2.2 MATERIALS

- A. Use cleaning product especially formulated for cleaning the particular masonry materials involved.
 - 1. Use only non-staining and non-corrosive products.

PART 3 - EXECUTION

3.1 PROTECTION

- A. When masonry work has been stopped for the day, courses shall be leveled and all joints, other than required cavities, shall be well filled with mortar.
- B. Protect masonry in place from rain with waterproof coverings securely fastened in place, until roof coverings, copings, flashing, or other permanent protection of the top of walls is in place.
- C. Protect all masonry protections from damage by use of wood covers or protective barricades.

3.2 COLD-WEATHER PROTECTION

- A. When ambient temperature is below 40°F the temperature of the masonry when laid shall not be less than 40°F.
 - 1. Thaw frozen sand before use. Do not scorch.
 - 2. The temperature of the mixed mortar to be at least 70°F but not more than 120°F.
 - 3. Do not exceed a mixing water temperature of 160°F.
 - 4. Do not use admixtures or anti-freeze compounds for the purpose of reducing the freezing temperature of mortar.
- B. When the ambient temperature is below 20°F, heat masonry units to 40°F. Maintain a temperature of at least 40°F on both sides of the wall for not less than 48 hours.

3.3 HOT WEATHER PROTECTION

- A. In hot dry weather, wet the mortar board and cover mortar to retard the drying out of the mortar.
- B. When the ambient temperature is above 80°F, mortar which dries too rapidly may be retempered with the addition of small quantities of water. Discard mortar if more than 2 hours after mixing.

3.4 CLEANING

- A. After all masonry work is completed, repair and point all defective work to the Architect's approval.
 - 1. Clean all exposed new work with masonry cleaning products used in accordance with the manufacturer's printed instructions.
 - 2. Protect all sash and other corrodible materials.

PART 4 - SUBMITTAL CHECK LIST

A. Manufacturer's Literature.

END OF SECTION 04 0100

SECTION 04 0513 - MORTAR

PART 1 - PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish labor, materials, equipment, special tools, supervision and services required to provide and complete all mortar for setting of all masonry work on this Project as indicated, noted, detailed and scheduled on the drawings and specified herein.

1.2 REFERENCES

- A. Publications of the following Institutes, Associates, Societies and Agencies are referred to in this section:
 - 1. American Society for Testing and Materials (ASTM).

1.3 SUBMITTALS

- A. Manufacturer's Literature:
 - 1. Materials description of cement.
 - 2. Manufacturer's test data for mortar mixtures.
- B. Samples:
 - 1. Manufacturer's actual sample bars of entire selection of standard mortar colors.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver mortar materials, except sand, in full, unopened bags.
 - 1. Store packaged materials off the ground and keep covered and protected from weather until used.
- B. Deliver and stockpile sand in vicinity of the approved batch mixing location.
- C. Pre-mixed sand/mortar, silo type batch plants may be used on site.
- D. Use pipe or hose to provide clean fresh water at the batch mixing location.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Masonry Cement:

- 1. Provide one of the following approved products:
 - a. "Essroc", Brixment.
 - b. "Cemex". Kosmortar.
 - c. "Lafarge", Masonry Cement.
- 2. Masonry Cement shall comply with the requirements of ASTM C91.
- 3. Portland Cement, Type 1, shall comply with the requirements of ASTM C150.
- B. Hydrated Lime:
 - 1. To comply with the requirements of ASTM C207.
- C. Aggregates to Setting Mortar:
 - 1. Shall comply with the requirements of ASTM C144.
 - 2. For joints 1/4 inch thick or less, 100% shall pass No. 8 sieve and 95% shall pass No. 16 sieve.
- D. Water:
 - 1. Clean, fresh and potable.
 - 2. Free from injurious amounts of oils, acids, alkalies, organic matter or deleterious substances.
- E. Water Repellent:
 - 1. Provide one of the following approved products:
 - a. "Grace Construction Products"; Dry-Block.
 - b. "BASF"; Rheopel Plus.
 - c. "ACM"; RainBloc.
 - d. "Krete"; HQ.
 - 2. Use for all mortar on exterior concrete masonry walls.
- F. Silo Batch Plant:
 - 1. As approved by the Architect.

2.2 MIXES

- A. Mortar Mixes:
 - 1. All components to be pre-measured, pre-packaged and pre-mixed by the manufacturer.
 - 2. Ready-mixed mortar, prepared offsite and delivered for storage in tubs, will NOT be acceptable.
- B. Type S Mortar:
 - 1. 1,800 psi minimum, high compressive strength tested in accordance with ASTM C270.
 - 2. For use at all exterior masonry walls.
 - 3. For use at all at grade and below grade masonry walls.
 - 4. For use at all interior, reinforced masonry walls.

C. Type N Mortar:

- 1. 750 psi minimum, medium compressive strength tested in accordance with ASTM C270.
- 2. For use at all interior, non-reinforced masonry walls.
- 3. For use at all exterior veneers, brick and stone.
- D. No chemical admixtures shall be added to the mortar without the express permission of the Architect.

E. Mortar Color:

- 1. Standard natural mortar, uncolored.
 - a. For use at interior and exterior CMU to be painted.
- 2. Tinted, colored mortar.
 - a. For use at exterior brick veneer
 - b. Color as selected by Architect from manufacturer's entire standard selection to match existing building.
 - c. Separate mortar colors may be selected for differing materials, or differing colors or textures of the same materials, throughout the project.

PART 3 - EXECUTION

3.1 MIXING

- A. Mix mortar mix and water proportions by volume per manufacturer's requirements.
- B. Mix mortar in an approved drum type batch mixer to a uniform color, texture and consistency.
 - 1. Measure ingredients carefully and completely empty drum between batches.
 - 2. Hand mixing will not be permitted.
- C. Add water repellent to mortar per manufacturer's instruction.

3.2 CONSISTENCY

- A. Mortar shall be consistent to the satisfaction of the mason and may be re-tempered on the boards by adding small amounts of water and remixing if stiff due to evaporation.
- B. Do not use mortar that has become stiff due to hydration or that has been mixed more than two hours.

PART 4 - SUBMITTAL CHECK LIST

- A. Manufacturer's Literature.
- B. Color samples.

PROJECT NO. 24-179.000 Harrison REMC - Addition and Renovation Harrison REMC

MORTAR 04 0513 - 4 04/24/2025

END OF SECTION 04 0513

SECTION 04 0519 - MASONRY REINFORCEMENT

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish labor, materials, equipment, special tools, supervision and services required to furnish and install all masonry reinforcement indicated, noted and detailed on the Drawings and specified herein.

1.2 REFERENCES

- A. Publications of the American Society for Testing and Materials, ASTM are referred to in this section.
- B. All work shall comply with ACI 530 and recommendations of The Masonry Society.

1.3 DELIVERY, STORAGE AND HANDLING

- A. Arrange deliveries to provide sufficient quantities of reinforcement to permit continuity of masonry work.
- B. Store reinforcement on blocks or shores to prevent contact with the ground and keep covered to prevent damage from the weather.

1.4 SUBMITTALS

- A. Manufacturer's Literature:
 - 1. Manufacturer's data sheets, cutsheets and materials description.
 - 2. Test data for strength and integrity.

B. Samples:

1. Provide actual sample of unit as requested by the Architect.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Provide products, as approved by the Architect, by one of the following acceptable manufacturers:
 - 1. Hohmann & Barnard (H&B).
 - 2. A-A Wire Products Company.
 - 3. Baltimore Birmingham.
 - 4. Wire-Bond
 - 5. Heckman Building Products, Inc.

- 6. Masonry Reinforcing Corp. of America.
- 7. National Wire Products Corp.

2.2 MATERIALS

- A. Materials shall conform to the following requirements:
 - 1. American Society for Testing and Materials (ASTM).
 - 2. "Cold-Drawn Steel Wire for Concrete Reinforcement", ASTM Designation A82.
 - 3. Mill galvanized wire in accordance with ASTM A641, Class 3 (0.80 oz./ft.2).
- B. Provide deformed bars of the size indicated on the drawings of the following grades:
 - 1. All reinforcing: ASTM A615, Grade 60.
- C. Provide all required metal accessories, including spacers, chairs, ties and other devices necessary for properly assembling, placing, spacing and supporting all reinforcement in place.

2.3 HORIZONTAL JOINT REINFORCEMENT

- A. Description:
 - 1. Hot dipped galvanized.
 - 2. Prefabricated from cold-drawn steel wire complying with ASTM A82.
 - 3. Welded wire units comprised of two No. 9 gauge deformed continuous longitudinal side rods and a continuous No. 9 gauge plain cross rods at 16" o.c. maximum, spanning between to form a truss design.
 - 4. Factory prefabricated Corners and Tees shall be used at all corners and intersecting walls and shall be of the same design, gauge, profile and finish as the continuous joint reinforcement.
- B. Size:
 - 1. Furnish in standard length sections, not less than 10'-0".
 - 2. Width to be 2 inches less than width of the wall.
- C. Provide one of the following approved products for single-wythe systems:
 - 1. "H&B", #120, Lox-All Truss Mesh.
- D. Provide one of the following approved products for multi-wythe non-adjustable systems:
 - 1. "H&B", #130, Truss-Tri-Mesh.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Clean reinforcement of loose rust, mill scale, earth, ice or other materials which will reduce bond to mortar or grout.
- B. Position reinforcement accurately at the spacing shown. Support and secure vertical bars against displacement. Provide a clear distance between bars of not less than the nominal bar diameter or 1 inch, whichever is greater.
- C. Provide continuous horizontal joint reinforcement in all reinforced masonry walls at 16 inches o.c.
- D. For pilasters, provide a clear distance between vertical bars as shown, but not less than 1-1/2 times the nominal bar diameter or 1-1/2 inches, whichever is greater. Provide lateral ties as shown.
- E. A continuous bond beam with (2) #5 bars shall be provided at the top of all walls, and at all bearing elevations, unless otherwise indicated.
- F. At beams or lintels bearing on masonry walls, fill (2) block cores solid with grout and reinforce each core with one vertical #5 bar full height of wall, unless otherwise indicated.
- G. Place (1) full height vertical #5 bar at all wall corners, ends of walls, sides of openings and wall intersections, unless otherwise indicated. Place (2) vertical #5 bars at sides of openings 10'-0" wide and greater, unless otherwise indicated.

3.2 SPLICES

- A. Splice reinforcing bars where shown. Do not splice at other points unless approved by the Architect/Engineer.
- B. Splices shall be lapped, unless otherwise indicated.
- C. In splicing vertical bars or attaching to dowels, lap ends and place bars in contact and tie with wire.
- D. Splices in vertical reinforcement shall be lapped a minimum of 48 bar diameters, unless noted otherwise.

PART 4 - SUBMITTAL CHECKLIST

- A. Manufacturer's Literature.
- B. Samples.

END OF SECTION 04 0519

SECTION 04 0523 - MASONRY ACCESSORIES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. All labor, materials, equipment, special tools, supervision, and services required to provide and complete all masonry accessories for all masonry work on this Project as indicated, noted, detailed, and scheduled on the Drawings or specified herein.

1.2 DELIVERY, STORAGE AND HANDLING

A. Storage: Store steel accessories off of the ground, on blocking, with waterproof cover.

1.3 QUALITY ASSURANCE

- A. All work shall comply with ACI-530 and recommendations of The Masonry Society.
- B. Hot dipped galvanizing after fabrication per ASTM A153 (1.5 oz./ft.).

1.4 SUBMITTALS

- A. Manufacturer's Literature:
 - 1. Manufacturer's data sheets, cutsheets and materials description.
- B. Samples:
 - 1. Provide actual sample of unit as requested by the Architect.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Provide products, as approved by the Architect, by one of the following acceptable manufacturers:
 - 1. Hohmann & Barnard (H&B).
 - 2. Masonry Technology Inc. (MTI).
 - 3. Advanced Building Products.
 - 4. Sandell Manufacturing.
 - 5. A-A Wire Products Company.
 - 6. Baltimore Birmingham.
 - 7. DUR-O-WALL, Inc.
 - 8. Heckman Building Products, Inc.

- 9. Masonry Reinforcing Corp. of America.
- 10. National Wire Products Corp.

2.2 MATERIALS

A. Weep Holes:

- 1. Provide one of the following approved products:
 - a. "H&B", #QV-Quadro Vent.
 - b. "MTI", Cavity Vent.
 - c. "Advanced Building Products", Mortar Maze.
 - d. "Sandell Manufacturing", Mortar Net Weep Vents.

B. Control Joints:

- 1. Provide one of the following approved products:
 - a. "H&B", RS Series.
 - b. "BoMetals, Inc.", BCJ Series.
- 2. Preformed elastomeric rubber, with shear keys and flanges.

C. Veneer Wall Ties:

- 1. At veneer cavity walls with wood stud, metal stud, concrete, or concrete masonry back-up (with continuous insulation):
 - a. Provide one of the following approved products:
 - 1) "Heckman Building Products", Pos-I-Tie wire ties with "Tapcon" screws.
 - b. Length as required by manufacturer for full extension into substrate material.
 - c. Hot dipped galvanized, typical.
 - d. Stainless steel, type 304, at stone veneer.
- 2. At veneer cavity walls with wood stud, metal stud, or poured concrete back-up (without continuous insulation):
 - a. Provide one of the following approved products:
 - 1) "H&B", #DW-10 with #VWT vee wall ties.
 - b. Hot dipped galvanized.

D. Stone Anchors:

- 1. Provide one of the following approved products:
 - a. "H&B", #303 corrugated veneer tie and #305 dovetail slot.
- 2. 2-piece dovetail design comprised of continuous dovetail slot and corrugated masonry tie.
- 3. Stainless steel, type 304.

E. Column Anchors:

1. Provide one of the following approved products:

- a. "H&B", #359-FH Weld-On Tie with #302W Column Web Tie.
- 2. Hot dipped galvanized.

F. Beam Anchors:

- 1. Provide one of the following approved products:
 - a. "H&B", #357.
- 2. Hot dipped galvanized.

G. Mortar/Grout Screen:

- 1. Provide one of the following approved products:
 - a. "H&B", #MGS.
- 2. 1/4" square microfiliment screen.
- 3. Polypropylene polymer, non-corrosive.

H. Rebar Positioners:

- 1. Provide one of the following approved products:
 - a. "H&B", #RB and #RB-Twin.
- 2. Z-shaped wire bridge.
- 3. 9 gauge wire.
- 4. Size for block width and core dimension as required.
- 5. Hot dipped galvanized.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Weep Holes:

- 1. Install in strict accordance with the manufacturer's published recommendations.
- 2. Provide in head joints in first course immediately above all flashing, at spacing as indicated on the drawings. If not indicated, provide at 32" o.c.
- 3. Keep area above flashing free of mortar droppings.

B. Control Joints:

- 1. Install in strict accordance with the manufacturer's published recommendations.
- 2. Provide control joints at all inside corners and where new masonry abuts existing masonry.
- 3. Lap horizontal joint reinforcing at all control joints.
- 4. Locate vertical control joints at 16'-0" o.c. maximum for all masonry.

- 5. Locate elsewhere where indicated on the Drawings.
- C. Ties and Anchors:
 - 1. Install in strict accordance with the manufacturer's published recommendations.
 - 2. Install ties into projecting eyes of truss or ladder type wall reinforcement, or into retainer area of supportive stud clip or anchor device.
 - 3. Position for proper placement in veneer wall.
- D. Rebar Positioners:
 - 1. Install in strict accordance with the manufacturer's published recommendations.
 - 2. Secure all vertical reinforcing bars in all masonry walls by use of positioners.
 - 3. Position re-bar in center of concrete block core.
 - 4. Rest bends of wire on shell of block to allow wire to span and bridge cell.

PART 4 - SUBMITTAL CHECKLIST

- A. Manufacturer's Literature.
- B. Samples.

END OF SECTION 04 0523

SECTION 04 0523.16 - MASONRY EMBEDDED FLASHING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Flexible flashing as shown for drawings and specified herein. Including, but not limited to thru-wall flashing and other flashing for masonry work.

1.2 SUBMITTALS

A. Submit manufacturer's data sheets for each product used.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS AND TYPES

- A. Provide one of the following or an approved equivalent:
 - 1. York Manufacturing "Multi-Flash 500".
 - 2. STS Coatings "Wall Guardian Copper TWF"
 - 3. Wire-Bond "Copper Seal"

2.2 MATERIAL

A. Characteristics:

- 1. Type: Copper core with polymer fabric laminated to copper face on both sides with non-asphalt adhesive.
- 2. Copper core: ASTM B370, CDA Alloy 110
- 3. Weight: 3 oz. per square foot.
- 4. Fabric: Polymer fabric; laminated both faces of copper core
- 5. Size: Manufacturer's standard width rolls

PART 3 - EXECUTION

3.1 INSTALLATION

- A. A. Whether shown on Drawings or not, install flashing at the following locations:
 - 1. Install at heads and sills of all openings in walls, base courses, sill courses, angles and wall penetrations.

- 2. Install thru-wall flashing at top course of all brick walls at retaining walls, planter walls, walls at site stairs and ramps, and all other similar conditions.
- B. Extend flashing 6" beyond opening or joint.
- C. Build in flashing with mortar as masonry work progresses.

PART 4 - SUBMITTAL CHECK LIST

A. Manufacturer's material data sheet.

END OF SECTION 04 0523.16

SECTION 04 2113 - FACE BRICK MASONRY

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish labor, materials, equipment, special tools, supervision and services required to complete brick masonry work.

1.2 QUALITY ASSURANCE

A. Qualifications:

- 1. Employ masons skilled and experienced in the setting of brick.
- 2. Only first-class brickwork will be accepted.

B. Mock-Up Panel:

- 1. Construct on site sample panel 4 foot wide x 4 foot high, of typical wall thickness and construction.
- 2. Show proposed color range, texture, bond, mortar color, mortar joint and workmanship of masonry materials.
- 3. Do not proceed with masonry work until sample panel has been approved.
- 4. Use panel as standard of comparison for all masonry work.
- 5. Do not destroy or remove panel until all masonry work is complete and accepted.

1.3 SUBMITTALS

A. Samples:

- 1. If specific brick has been specified: Masonry contractor to submit brick panels or 5-brick pallet samples for final approval by Architect. Color, texture and range of brick to be submitted as specified.
- 2. If specific brick has not been specified: Masonry contractor to select and submit brick panels or 5-brick pallet samples for final selection by Architect. Color, texture and range of brick to be submitted to be per direction of the Architect.
- 3. Brick submitted shall conform to these specifications and be within color and texture range specified.
- 4. Selected brick samples shall have mock-up panels constructed for final selection and approval.
- 5. Lay additional sample panels as directed by Architect
- 6. Architect reserves the right to select any brick from any supplier.
- B. Test reports indicating compressive strength, water absorption, saturation and suction.

1.4 DELIVERY, STORAGE AND HANDLING

A. Store brick off ground to prevent contamination by mud, dust or materials likely to cause staining or other defects.

B. Cover materials as necessary to protect from elements.

PART 2 - PRODUCTS

2.1 FACE BRICK

A. Description:

- 1. Size: Typical standard Modular units: 8 inches long x 2-1/4 inches high x not less than 3-5/8 inches deep.
- 2. Manufacturer/Color: Refer to Drawings. Brick to closely match existing building.

B. Special Shapes:

- 1. Cut standard unit with power saw or provide units manufactured to sizes or shape required.
- 2. Provide solid brick, watertable profile, finished ends, special sizes, etc. as required.
- 3. Special shape items to match selected brick in every other respect.
- C. Conform to ASTM C 216, Grade SW, Type FBS.
- D. Brick submitted shall be from brick manufacturers who are able to provide certification and physical evidence that the brick has been successfully used in projects of similar exposure for at least three complete climatic cycles without physical or visual changes.
- E. Do not exceed variations in color and texture of accepted samples and mock-up.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Verify initial absorption rate of brick is within acceptable limits.
- B. Reduce initial absorption exceeding 20 g./30sq. in/min by thoroughly wetting with clean water 24 hours prior to placement.

3.2 INSTALLATION

A. General:

- 1. Lay brick plumb and true to lines.
- 2. Cut exposed brick with masonry saw.
- 3. Anchor brick veneer to backing with metal reinforcement.
- 4. Where fresh masonry joins partially set masonry.
 - a. Remove loose brick and mortar.
 - b. Clean and lightly wet exposed surface of set masonry.

- 5. Stop off horizontal run of masonry by racking back 1/2 length of unit in each course.
- 6. Toothing is not permitted except upon written acceptance of the Architect.

B. Weep Holes:

- 1. See Section 04 0523 Masonry Accessories.
- 2. Keep weep holes and area above flashing free of mortar droppings.

C. Sealant Recesses:

- 1. Retain joints around outside perimeters of exterior doors, windows frames and other wall openings.
- 2. Depth: Uniform 3/4 inch.
- 3. Width: 3/8 inch.

D. Movement Joints:

- 1. Keep clean from all mortar and debris.
- 2. Locate as shown on drawings.

E. Sealant:

1. See Section 07 9200-Joint Sealers for all labor and material for sealing perimeter recesses and joints.

3.3 PROJECT CONDITIONS

- Staining: Prevent grout or mortar from staining the face of masonry to be left exposed or painted.
 - 1. Remove immediately grout or mortar in contact with face of masonry.
 - 2. Protect sills, ledges and projections from mortar droppings.
 - 3. Protect door jambs and corners from damages during construction.

B. Cold Weather Protection:

- 1. Preparation:
 - a. If ice or snow has formed on masonry bed, remove by carefully applying heat until top surface is dry to the touch.
 - b. Remove all masonry deemed frozen or damaged.

2. Products:

- a. When brick suction exceeds 20 g/30 sq. in./min., sprinkle with heated water.
 - 1) When units are above 32°F, heat water above 70°F.
 - 2) When units are below 32°F, heat water above 130°F.
- b. Use dry masonry units.
- c. Do not use wet or frozen units.

PROJECT NO. 24-179.000 Harrison REMC - Addition and Renovation Harrison REMC

FACE BRICK MASONRY 04 2113 - 4 04/24/2025

PART 4 - SUBMITTAL CHECK LIST

- A. Brick Samples.
- B. Test Reports.
- C. Mock-up Panel.

END OF SECTION 04 2113

SECTION 04 22 00 - CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish labor, materials, equipment, special tools, supervision and services required to provide and complete all concrete unit masonry work on this Project as indicated, noted, detailed and scheduled on the drawings and specified herein.

1.2 QUALITY ASSURANCE

- A. Comply with the provisions of the latest editions of the following Codes, Specification and Standards, except as otherwise indicated on the Drawings or specified herein.
 - 1. The Masonry Society, Masonry Designer's Guide.
 - 2. ACI 530 Building Code Requirements for Masonry Structures.
 - 3. ACI 530.1 Specifications for Masonry Structure.
 - 4. NCMA "Specification for the Design and Construction of Load-Bearing Concrete Masonry".
 - 5. "American Standard Building Code Requirements for Masonry, A41.1-1953 (R1970)".
 - 6. American Society for Testing and Materials (ASTM).
- B. Concrete masonry units used throughout the work shall be obtained from one manufacturer.
- C. Reinforced hollow load-bearing CMU shall be Grade N-I moisture controlled units conforming to ASTM C90-85. Minimum Compressive Strength required for units shall be 2,000 psi on the NET AREA of the units and 1,000 psi on the GROSS AREA. Normal weight or light weight units.
- D. Provide special shapes where required, for lintels, bond beams, pilasters, headers and other special conditions.

1.3 SUBMITTALS

A. Product Data:

- 1. Manufacturer's catalog data, cutsheets, literature, specifications and installation instructions.
- 2. Test data for unit strength.

B. Color Samples:

- 1. If color is indicated, submit actual sample of finish selected for final review and approval.
- 2. If not indicated, color to be selected by Architect from manufacturer's entire selection.
- 3. Submit actual samples for review and approval if requested.

PART 2 - PRODUCTS

2.1 CONCRETE MASONRY UNITS (CMU)

A. Size:

- 1. Standard-sized units shall be used, unless otherwise noted.
- 2. Nominal face dimensions of 16 inches long x 8 inches high.
- 3. Thickness of units shall be as indicated on drawings.
- 4. See drawings for additional requirements or clarifications for type, face, texture, finish, color, etc.

B. Properties:

- 1. Below Grade: Standard/Normal weight units with sand, gravel, crushed stone, aggregate.
- 2. Above Grade: Light weight units with expanded aggregate.
- 3. Shall comply with the requirements of ASTM C90.

C. Water Repellent:

- 1. Provide one of the following approved products:
 - a. "Grace Construction Products": Dry-Block.
 - b. "BASF"; Rheopel Plus.
 - c. "ACM"; RainBloc.
 - d. "Krete"; HQ.
- 2. Use for all exterior walls whose concrete masonry face is exposed to the exterior. Not required for masonry backup in veneer walls (brick, stone, etc.).
- D. Reinforced Load-Bearing CMU and CMU Shear Walls:
 - 1. Grade N-1 moisture controlled units.
 - 2. Minimum compressive strength of 2,000 psi on the NET AREA of the units. Minimum compressive strength of 1,000 psi on the GROSS AREA of the units. Standard/Normal weight or Light weight units.
 - 3. Shall comply with the requirements of ASTM C90-85.
 - 4. Net compressive strength: f'm = 1,500 p.s.i minimum (Prism or Unit Strength Method).

E. Color:

- 1. Standard natural, non-colored concrete masonry unit.
- F. Provide one of the following approved products:
 - 1. "4D/Schuster's (Oldcastle)"; Custom Architectural Masonry Units.
 - 2. "General Shale": Custom Architectural Masonry Units.
 - 3. "Lee Building Products"; Custom Architectural Masonry Units.
 - 4. "Masolite"; Concrete Masonry Units.

2.2 SPECIAL UNITS

- A. Provide special shapes where required throughout the work for lintels, bond beams, bullnoses, pilasters, headers and other special conditions.
- B. Same material, surface, texture, aggregate, grade and color of adjacent concrete masonry units.
- C. Brick units for bearing, leveling and filling.
- D. Bullnose units with 1 inch radius corner.
- E. U-block and bond beam units. Center-scored units with 3/8 inch vertical groove to form an 8 inch x 8 inch face pattern. Scoring pattern may be required to be on both faces of masonry unit.

2.3 PRE-CAST CONCRETE LINTELS

- A. Design and strength as approved by the Architect.
- B. Same material, surface, texture and color of adjacent concrete masonry units.
- C. Score with vertical joints to match block pattern, if desired by the Architect.

2.4 MORTAR

A. See Specification Section 04 05 13 - Mortar.

2.5 STEEL REINFORCEMENT

A. See Specification Section 04 05 19 - Masonry Reinforcement.

2.6 GROUT

- A. Grout for reinforced masonry shall have a minimum compressive strength of 2,500 psi at 28 days and shall comply with requirements of ASTM C150.
- B. Portland Cement, Type 1, and shall comply with the requirements of ASTM C150.
- C. Fine aggregates for grout shall comply with the requirements of ASTM C404.
- D. Coarse aggregates for grout shall be pea gravel, 3/8" diameter maximum.
- E. Water shall be clean, fresh and potable.

PROJECT NO. 24-179.000 Harrison REMC - Addition and Renovation Harrison REMC

CONCRETE UNIT MASONRY 04 2200 - 4 04/24/2025

PART 3 - EXECUTION

3.1 INSTALLATION

A. Bond:

1. Running bond, unless otherwise indicated.

B. Tooling:

1. Smooth concave joints for all areas.

C. Placing:

- 1. Set units plumb and true to line with level, accurately spaced and coordinated with other work.
- 2. Lay CMU units with full-face shell mortar beds.
- 3. Fill vertical head joints solidly with mortar from face of unit to a distance behind face equal to not less than the thickness of the longitudinal face shells.
- 4. Solidly bed cross-webs of starting courses in mortar.
- 5. Provide 3/8 inch joints unless otherwise shown.

D. Bond Beams:

- 1. Use special units or modify regular units to allow for placement of continuous horizontal reinforcing bars as indicated.
- 2. Place wire screening or expanded metal lath in mortar joints under bond beam courses over non-reinforced vertical cores, or provide units with solid bottoms.

E. Pilasters:

- 1. Lay wall and pilaster units together to maximum pour height shown.
- 2. Pilaster units shall provide minimum clearances and grout coverage for number and size of vertical reinforcement as indicated.

F. Bullnose Units:

- 1. Install at all exposed vertical corners, unless otherwise indicated.
- 2. Install at all exposed horizontal edges, unless otherwise indicated.

G. Square Edge Units:

- 1. Use only where specifically noted as allowed in lieu of bullnose edges.
- 2. All exposed square edge block units must be formed using a Universal Press Top (UPT) mold.
- H. Build masonry construction to the full thickness shown, except build single-wythe walls to the actual thickness of the masonry units, using unit of nominal thickness as indicated or specified.

- I. Cut masonry units with motor-driven saw designed to cut masonry, with clean, sharp, unchipped edges. Use full units without cutting wherever possible. Use dry cutting saws to cut concrete masonry units.
- J. Maintain vertical continuity of core or cell cavities which are to be reinforced or grouted, to provide minimum clearance and grout coverage for vertical reinforcing bars. Solidly bed webs in mortar where adjacent to reinforced cores.
- K. DO NOT WET concrete masonry units.
- L. Use no piece shorter than 8 inches.
- M. Bond all corners in each course.
- N. All masonry walls shall be laterally braced by the Contractor as required until all structural framing and decking have been installed in units of construction adjacent to the walls.
- O. As the work progresses, install all built-in items as specified under this or any other Section.

3.2 GROUTING

- A. Contractor may use either low-lift or high-lift grouting techniques, subject to the following requirements.
- B. All masonry units located below grade shall be grouted solid, whether indicated or not.
- C. Low Lift Grouting:
 - 1. Vertical cells to be filled shall have vertical alignment sufficient to maintain a clear, unobstructed continuous vertical fall measuring not less than 2 inches by 3 inches.
 - 2. Units must be laid to a height not to exceed 8 feet. If height exceeds 4 feet, cleanouts must be used. Stop pour at course below bond beams.
 - 3. Place vertical steel into cells with enough steel extending to provide lap splice of 48 bar diameters or as indicated on drawings.
 - 4. In grouting vertical cells, stop grout 1-1/2 inches below top of unit or over horizontal steel which shall be fully embedded in grout.
 - 5. Place grout continuously, using a chute or container with spout. Rod or vibrate grout during placing. Do not interrupt placing of grout for more than 1 hour.
 - 6. Place horizontal bond beam reinforcement as the masonry units are laid. Lap at corners and intersections. Place grout in bond beams before filling vertical cores above bond beams.
 - 7. Do not place grout until entire height of masonry to be grouted has attained sufficient strength to resist displacement of masonry units and breaking of mortar bond. Reinforce or brace cleanouts to resist grout pressure.
 - 8. Prior to grouting, inspect and clean grout spaces. Clean top surfaces of all structural members supporting masonry to ensure bond.

D. High-Lift Grouting:

1. All paragraphs and items for Low-Lift Grouting above apply to this section, with the exception of the limitation of height that units must be laid to.

- 2. Limit grout pours to sections which can be completed in one working day with not more than one hour interruption of pouring operation. Place grout in lifts which do not exceed 4 feet. Allow not less than 30 minutes nor more than one hour between lifts of a given pour. Rod or vibrate each grout lift during pouring operation.
- 3. Place grout by pumping into grout spaces. Alternate placing methods shall be approved by the Architect/Engineer.
- 4. Vertical reinforcement shall be held in position at top and bottom and at intervals not exceeding 6 feet
- 5. Minimum cell dimension shall be 3 inches for high-lift grouting.

3.3 FORMWORK AND SHORES

- A. Provide temporary formwork and shores as required for temporary support of reinforced masonry elements. Design, erect, support, brace and maintain formwork properly.
- B. Construct formwork to conform to shape, line and dimensions as shown.
- C. Forms and/or shores shall not be removed until reinforced masonry member has hardened sufficiently to carry its own weight and all other loads that may be placed on it during construction.
- D. Provide bracing adequate to resist wind loads, bracing shall remain in place until metal roof deck installation and attachment to masonry walls is completed.

3.4 REPAIR, POINTING AND CLEANING

- A. By brushing, stoning, rubbing, detergent and water, or other approved method.
- B. Remove and replace masonry units that are loose, chipped, broken or otherwise damaged. Provide new units to match adjoining and adjacent units, and install in fresh mortar or grout, pointed to eliminate evidence of replacement.
- C. During the tooling of joints, enlarge any voids or holes and completely fill with mortar. Point-up all joints to provide a neat, uniform appearance.
- D. Clean exposed CMU masonry by dry brushing at the end of each day's work and after final pointing to remove mortar spots and droppings. Comply with recommendations in NCMA TEK Bulletin No. 28.

PART 4 - SUBMITTAL CHECKLIST

- A. Product Data.
- B. Color Samples.

END OF SECTION 04 22 00

SECTION 04 4301 - LIMESTONE

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish labor, materials, equipment, special tools, supervision and services required to furnish and install all cut limestone indicated, noted and detailed on the drawings and specified herein.

1.2 QUALITY ASSURANCE

A. Comply with Industry Standards and Practices as set forth by the Indiana Limestone Institute of America, Inc.

1.3 REFERENCES

- A. Publications of the following institutes, associations, societies, and agencies are referred to is this Section.
 - 1. American Society for Testing and Materials (ASTM).
 - 2. Indiana Limestone Institute of America, Inc. (ILI).
- B. Fabricator shall be an established firm regularly engaged in the fabrication of limestone. Fabricator shall have adequate equipment and qualified personnel to fabricate quality stone products and have past experience in the fabrication of limestone for projects of a similar nature.
- C. Quarrier and fabricator of the stone shall be a member in good standing of the Indiana Limestone Institute of America, Inc.

1.4 SUBMITTALS

- A. Furnish for approval by the Architect, complete cutting and setting drawings for all cut stone work.
 - 1. Show in detail the sizes, sections and dimensions of stone, the arrangement of joints and bonding, anchoring and other necessary details.
 - 2. Strictly follow all jointing shown by the Architect on contract drawings, unless modifications are agreed upon in writing or indicated upon the approved Shop Drawings.
 - 3. If the contract drawings do not show the intent of the jointing, it will be the fabricator=s responsibility to establish the jointing in accordance with industry standards and practices.
 - 4. The general contractor shall furnish all field dimensions necessary for fabrication.
 - 5. Mark each stone on an unexposed surface and indicate its location with a corresponding mark on the settings drawings.
 - 6. Clearly indicate on the cutting and setting drawings, all provisions for the anchoring, doweling, and cramping of work, in keeping with standard practices, and for the support of stone by shelf angles and loose steel, etc., when required.

B. Furnish for approval by the Architect, two 12" x 12" samples of the limestone proposed for use in this project. Illustrate color range, texture and finish.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Materials shall conform to the following requirements:
 - 1. "Stainless and heat resisting chromium-nickel steel plate, sheet, and strip", ASTM designation A167.
 - 2. "Dimension Limestone", ASTM designation C568.
- B. Fabricate dowels, anchors, cramps, dovetails and slots from Type 18-8, 302 stainless steel conforming to ASTM designation A167.
- C. Cut stone shall be Indiana Limestone quarried in Lawrence, Monroe or Owen Counties, Indiana.
 - 1. Grade: Standard.
 - Color: Natural Buff.
 - 3. Conform to ASTM designation C568 for category II medium density stone with 4,000 psi compressive strength.

2.2 FABRICATION

- A. Cut stone accurately to shade and dimension, full to the square, with jointing as shown on the drawings.
 - 1. Dress all exposed faces and unless otherwise indicated, beds and joints shall be right angles to the face. Saw or dress backs parallel to face.
 - 2. Joints unless otherwise indicated shall have a uniform thickness of 3/8 inch.
 - 3. Cut reglets and drips where indicated on the drawings.
 - 4. Cut drips under all window and door heads, window sills, water tables, and other projecting courses.
 - 5. Provide holes and sinkages for anchors and back-check structural work.
 - 6. Provide lewis holes in stones weighing over 100 pounds and over 3-1/2 inch thick.

2.3 DELIVERY, STORAGE AND HANDLING

- A. Carefully pack all cut limestone for transportation, exercising all customary and reasonable precautions against damage in transit.
- B. Load and ship stone in sequence with erection and in quantities sufficient with construction phase.
- C. Store all stone clear of ground on non-staining skids (cypress, white pine, poplar or yellow pine without excessive amount of resin). DO NOT use preservative treated wood, chestnut, walnut, fir, oak or other woods containing tannin.
- D. Cover stone with waterproof paper or polyethylene.

PART 3 - EXECUTION

3.1 SETTING

- A. Set all limestone accurately in strict accordance with the contract and shop drawings.
- B. When necessary, before setting in the wall, thoroughly clean all exposed stone surfaces by washing with fiber brush and soap powder, followed by a thorough drenching with clear water.
- C. Drench all stone joint surfaces not thoroughly wet with clear water just prior to setting.
- D. Except as otherwise specially noted, set every stone in full beds of mortar with all vertical joints slushed full. Completely fill all anchor, dowel, and similar holes. All bed and vertical joints shall be 3/8 inch unless otherwise noted.
- E. Place lead or plastic setting pads under heavy stones, column drums, etc., in same thickness as joint, and in sufficient quantity to avoid squeezing mortar out. Do not set heavy stones or projecting courses until mortar in courses below has hardened sufficiently to avoid squeezing.
- F. Joints can be tooled when initial set has occurred, or raked out 1 inch and pointed later. If pointed with sealant, conform to manufacturer's instructions regarding raked depth and sealant applications.
- G. Securely prop or anchor projecting stones until the wall above is set.
- H. Embed in mortar only the ends of lugged sills and steps. Leave balance of joint open until finally pointed.
- I. All cornice, copings, projecting belt courses, other projecting courses, steps, and platforms (in general, all stone areas either partially or totally horizontal) should be set with unfilled vertical joints. After setting, point or install sealant.
- J. In cold weather, follow International Masonry Industry All-Weather Council recommendations for setting from 40° to 20°F, except that no additives are to be used in the setting mortar. Heated enclosures are to be used for work done below 20°F.
- K. Coat backs of all stone with cementitious dampproofing, non-staining to exposed stone surfaces.

3.2 CLEANING

- A. Wash the stone with fiber brushes, mild soap powder or detergent and clean water or approved mechanical cleaning process.
- B. Provide special consideration and protection when brickwork is cleaned above the limestone. Strong acid compounds used for cleaning brick will burn and discolor the limestone.
- C. Use of sand blasting, wire brushes or acids will only be permitted under special circumstances, approved by Architect.

3.3 PROTECTION OF FINISHED WORK

- A. During construction, carefully cover tops of walls at night, and especially during any precipitation or other inclement weather.
- B. Adequately protect walls from dropping at all times.
- C. Whenever necessary, place substantial wooden covering to protect the stone work. Use non-staining building paper or membrane under the wood. Maintain all covering until removed to permit final clearing of the stone work.

3.4 CLEANING UP

A. Upon completion, remove all materials, equipment and debris from the premises.

PART 4 - SUBMITTAL CHECK LIST

- A. Cutting and Setting Shop Drawings.
- B. Samples.

END OF SECTION 04 4301

SECTION 05 1000 - STRUCTURAL ANCHORS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes post-installed metal anchors in concrete, masonry, and steel, as shown on drawings including schedules, notes, and details showing size and location of anchors, typical connections, and types of anchors required.
 - 1. Adhesive anchors.
 - 2. Powder actuated fasteners.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 1 Section "Structural Inspection."
 - 2. Division 3 Section "Cast-in-Place Concrete."
 - 3. Division 4 Section "Unit Masonry."
 - 4. Division 5 Section "Structural Steel Framing."
 - 5. Division 5 Section "Cold-Formed Metal Framing Structural."

1.3 DEFINITIONS

A. Threaded Rod: A rod that is continuously threaded for the full length of the rod unless noted otherwise.

1.4 ACTION SUBMITTALS

- A. General: Furnish submittals in quantity, format, and other Conditions of the Contract and as specified in Division 1 of the Project Manual.
- B. Product Data for each type of product specified. Include manufacturer's specifications, load charts, and other data to show compliance with the specifications (including specified standards).

1.5 INFORMATIONAL SUBMITTALS

- A. General: Furnish submittals in quantity, format, and other Conditions of the Contract and as specified in Division 1 of the Project Manual.
- B. Installer Qualifications and Procedures: Submit a letter of procedure stating method of drilling, the product proposed for use, the complete installation procedure, manufacturer training date, and a list of the personnel to be trained on anchor installation.
- C. ICC ES Evaluation Reports/Certificates.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Anchors shall be installed by an installer with at least 1 year of experience

performing installations similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

- B. Installer Training: Conduct a thorough training with the manufacturer or the manufacturer's representative for the installer on the project. Training to consist of a review of the complete installation process for drilled-in anchors, to include but not limited to:
 - 1. Hole drilling procedure.
 - 2. Hole preparation & cleaning technique.
 - 3. Adhesive injection technique & dispenser training / maintenance.
 - 4. Rebar dowel preparation and installation.
 - 5. Proof loading/torquing.
- C. Certifications: Unless otherwise authorized by the Engineer, anchors shall have an ICC ES Evaluation Report indicating conformance with current applicable ICC ES Acceptance Criteria.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver anchors to Project site in such quantities and at such times to ensure continuity of installation.
- B. Store materials to permit easy access for inspection and identification. Protect anchors and packaged materials from erosion and deterioration.
- C. Keep anchors, rod materials, nuts and washers in original manufacturer's packaging with label intact until needed for use
- D. Store all anchoring products in strict accordance with manufacturer's recommendations. For adhesive anchors, consider temperature, exposure to sunlight, and shelf life.

1.8 SEQUENCING

A. Supply anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, templates, instructions, and directions, as required, for installation.

PART 2 - PRODUCTS

2.1 FASTENERS AND HARDWARE

- A. Anchor Rods, Bolts, Nuts, and Washers: As follows:
 - 1. Non-High Strength Rods:
 - a. ASTM F1554 Grade 36.
 - b. Straight, Headed.
 - c. Partially Threaded.
 - 2. Nuts: ASTM A563 heavy-hex carbon-steel.
 - 3. Plate Washers: ASTM A36 carbon steel.
 - 4. Washers: ASTM F436, Type 1, hardened carbon steel.
- B. Carbon-Steel Bolts and Threaded Fasteners: ASTM A 307, Grade A (ASTM F 568, Property Class 4.6), carbon-steel, hex-head bolts and threaded fasteners; carbon-steel nuts; and flat, unhardened steel washers.
 - 1. Finish: Plain, noncoated.
 - 2. Finish: Hot-dip zinc coating, ASTM A 153, Class C.
 - 3. Finish: Mechanically deposited zinc coating, ASTM B 695, Class 50.

2.2

C. Carbon Steel Continuously Threaded Rod: ASTM A36 or ASTM A193 Grade B7.

POWDER ACTUATED FASTENERS

- A. Drive Pins: Modified AISI 1060, 1062, or 1070 steel, hardness 49-61 Rockwell C, minimum tensile strength of 282 ksi, and minimum shear strength of 162 ksi; with zinc plating equivalent to ASTM B633, Type III Fe/Zn 5 (5μm min.) unless noted otherwise.
 - 1. For fastening light gauge metal to concrete or concrete masonry: Minimum 0.157" shank diameter, 1 ¼" long, with knurled shank and premounted plastic & steel washer.
 - a. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - 1) X-U 32 P8 by Hilti.
 - 2) No. 50208 by DeWalt/ Powers Fasteners.
 - 2. For fastening light gauge metal to steel: Minimum 0.157" shank diameter, 3/4" long, with knurled shank and premounted plastic & steel washer.
 - a. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - 1) X-U 19 P8 by Hilti.
 - 2) No. 50203 by DeWalt/ Powers Fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General

- Drill holes with rotary impact hammer drills using carbide-tipped bits and core drills using diamond core bits. Drill bits shall be of diameters as specified by the anchor manufacturer. Unless otherwise shown on the Drawings, all holes shall be drilled perpendicular to the concrete surface. Drill hole to the specified nominal embedment plus additional length as specified by the Anchor Manufacturer.
- 2. Cored Holes: Where anchors are to be installed in cored holes, use core bits with matched tolerances as specified by the manufacturer. Acrylic Adhesive Anchors shall not be installed in core drilled holes.
- 3. Embedded Items: Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Exercise care in coring or drilling to avoid damaging existing reinforcing or embedded items. Notify the Engineer if reinforcing steel or other embedded items are encountered during drilling. Take precautions as necessary to avoid damaging prestressing tendons, electrical and telecommunications conduit, and gas lines.
- 4. Base Material Strength: Unless otherwise specified, do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
- 5. Observe manufacturer recommendations with respect to installation temperatures for cartridge injection adhesive anchors and capsule anchors.
- 6. Perform anchor installation in accordance with manufacturer instructions.
- 7. Contractor shall coordinate all attachment to precast concrete elements with the precast manufacturer. Penetrations shall be located to not disturb or cut prestressing tendons.

 Attachment to the bottom of precast plank shall be located around tendon layout and shall

incorporate fasteners designed for use in hollow concrete and that do not penetrate the concrete more than ³/₄". Attachment to the top of precast plank shall be located around tendon layout and shall incorporate fasteners designed for use in hollow concrete.

B. Powder Actuated Fasteners: Perform anchor installation in accordance with manufacturer instructions. Adjust fastener shank diameter and length to achieve manufacturer's minimum recommended penetration of base material.

3.2 QUALITY CONTROL

- A. General: The Owner will engage an independent testing and inspecting agency to perform inspections and tests and to prepare test reports. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from requirements. Failure to detect any defective materials shall not prevent later rejection when such defect is discovered, or obligate the Architect or Owner for final acceptance.
 - 1. See Section 01 4120 Structural Inspections and Contract Drawings for testing and inspection to be performed.
 - 2. Provide access for testing agency to places where structural anchors are being installed so that required inspection and testing can be accomplished.
 - 3. The General Contractor shall provide the testing agency a complete set of approved shop drawings.
 - 4. Reports will be delivered to the Architect, Engineer, and the General Contractor within one week of inspection.
 - 5. Deviations from requirements of the contract documents will be reported in writing to the General Contractor within 24 hours.
- B. Correct deficiencies in or remove and replace anchors that inspections and test reports indicate do not comply with specified requirements.

END OF SECTION 05 1000

SECTION 05 1200 - STRUCTURAL STEEL FRAMING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes fabrication and erection of structural steel work, as shown on drawings including schedules, notes, and details showing size and location of members, typical connections, and types of steel required.
 - 1. Structural steel is that work defined in American Institute of Steel Construction (AISC) "Code of Standard Practice" and as otherwise shown on drawings.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 1 Section "Structural Special Inspection."
 - 2. Division 3 Section "Cast-in-Place Concrete."
 - 3. Division 4 Section "Unit Masonry."
 - 4. Division 5 Section "Structural Anchors."
 - 5. Division 9 Section "Painting."

1.3 DEFINITIONS

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

1.4 COORDINATION

- A. Coordinate fireproofing type and extents with architectural documents and related Building Code References to determine surface preparation and primers to be utilized. Structural drawings do not specify primer or surface preparation on individual structural elements. It is the responsibility of the fabricator to coordinate such during preparation of shop drawings.
- B. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- C. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.5 PERFORMANCE REQUIREMENTS

- A. Detail structural steel connections required by the Contract Documents to be selected or completed by the fabricator to withstand design loadings indicated.
 - Select and complete connections using typical details provided or, where no details are provided, design, detail and complete connections in accordance with AISC 360.

2. Load data are given at service-load level.

1.6 ACTION SUBMITTALS

- A. General: Furnish submittals in quantity, format, and other Conditions of the Contract and as specified in Division 1 of the Project Manual.
- B. Shop Drawings detailing fabrication and erection of structural steel components.
 - Submit a schedule of shop drawing submittal dates which allows the Architect reasonable time
 for review. Schedule shall list size and approximate number of sheets in each submittal.
 Provide a plan of the proposed quantity and sequences. Schedule and plan shall be submitted
 for comment prior to beginning shop drawing preparation.
 - 2. Piecemarks in any given sequence shall be combined such that identical pieces are submitted for review as a single mark/detail. Submittals that submit identical pieces as multiple marks will be rejected unless fabricator compensates engineer for time and materials of shop drawing review.
 - 3. Shop drawings that show the Architect's or Engineer's title block, logo and/or seal will be rejected and returned unchecked.
 - 4. Computer generated electronic structural construction document files (ACAD) will be made available to the Contractor. The Contractor will be required to sign the Engineer's standard release of liability form prior to receiving the drawing files. Rules for use of said files shall be as defined in the AISC "Code of Standard Practice for Steel Buildings and Bridges," Section 4.3.
 - 5. Provide setting drawings, templates, and directions for installation of anchor rods and other anchorages. Provide electronic (AutoCAD) drawing of anchor rods and other embedments to Contractor/Construction Manager for use in preparing a final survey of embedments.
 - 6. Provide erection details of all field connections.
 - 7. Include details of cuts, connections, splices, camber, holes, and other pertinent data in accordance with AISC Specifications and the AISC "Detailing for Steel Construction," latest edition
 - 8. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Where CJP or PJP welds are to be used, show complete weld symbol with prequalified type and joint designation. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
 - 9. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify high-strength bolted slip-critical, direct-tension, tensioned shear/bearing, or blind expansion bolted connections.
 - 10. Include erection plans and details. Note any cutting and/or welding required to be performed in the field
 - 11. Include ASTM material specifications and grade of steel.
 - 12. Indicate surface preparation for primer/coating/fireproofing and shop primer/coating to be used.
 - 13. Shop drawing resubmittals are reviewed for conformance with review marks only. Any changes or questions originating on a resubmittal shall be clearly clouded.
- C. Shop Drawings detailing fabrication and placement of loose lintels. Loose lintels in non-bearing walls and over minor openings in structural walls are not shown on the structural plans but are to be included over all openings over 16" in width shown on architectural and mechanical drawings per the lintel schedule in the structural General Notes.
 - 1. Include erection plans showing location and width of all openings.
 - 2. Include details of cuts, connections, stud anchors, slip rods, holes, and other pertinent data in accordance with AISC Specifications and the AISC "Detailing for Steel Construction," latest

edition.

- 3. Indicate welds by standard AWS symbols, and show size, length, and type of each weld.
- 4. Include ASTM material specifications and grade of steel.
- 5. Indicate surface preparation for primer/galvanizing and coating to be used.
- 6. Shop drawing resubmittals are reviewed for conformance with review marks only. Any changes or questions originating on a resubmittal shall be clearly clouded.
- D. Product Data for each primer. Include manufacturer's specifications, installation instructions, laboratory test reports, and other data to show compliance with the specifications (including specified standards).

1.7 INFORMATIONAL SUBMITTALS

- A. General: Furnish submittals in quantity, format, and other Conditions of the Contract and as specified in Division 1 of the Project Manual.
- B. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- C. Mill test reports signed by manufacturers certifying that their products, including the following, comply with requirements.
 - 1. Structural steel, including chemical and physical properties.
 - 2. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
 - 3. Direct-tension indicators.
 - 4. Twist-off tension control assembly.
 - 5.
 - 6. Weld filler materials.
- D. Present evidence that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone re-certification. Provide continuity log for each welder, signed by the employer, showing that the welder has engaged in the necessary processes of welding during each 6-month period since the qualification. In lieu of qualification tests and continuity log, submit AWS CW number.
- E. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1/D1.1M, "Structural Welding Code Steel," for each welded joint, including the power source (constant current or constant voltage).
- F. Fabricators who participate in the certified Quality Certification Program shall submit, at the completion of fabrication, a certificate of compliance stating that the work was performed in accordance with the approved construction documents.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who has completed structural steel work similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Fabricator Qualifications: Engage a firm experienced in fabricating structural steel similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to fabricate structural steel without delaying the Work.

STRUCTURAL STEEL FRAMING 05 1200 - 4 04/24/2025

- 1. Fabricator must participate in the AISC Quality Certification Program and be designated an AISC-Certified *Standard for Steel Building Structures (STD)* Plant.
- C. Comply with applicable provisions of the following specifications and documents:
 - 1. AISC 360 "Specification for Structural Steel Buildings."
 - 2. AISC 303 "Code of Standard Practice for Steel Buildings and Bridges."
 - 3. Research Council on Structural Connections' (RCSC) "The Specification for Structural Joints Using High-Strength Bolts, 2009."
 - 4. American Welding Society's (AWS) D1.1-2010 "Structural Welding Code Steel."
 - 5. ASTM A 6 "Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling."
 - 6. AGA American Galvanizers Association publication "Recommended Details for Galvanized Structures".
 - 7. AISC Steel Construction Manual, 14th Edition.
 - 8. AWS "Standard for AWS Certified Welders" AWS QC7-93.
 - 9. SSPC Steel Structures Painting Manual, Volume 1 and 2, latest edition.
 - 10. SSPC Surface Preparation Specification, SP1 through SP15.
- D. Welding Qualifications and Standards: Qualify procedures and personnel in accordance with applicable provisions of AWS D1.1 "Structural Welding Code Steel" and AISC 360.
 - 1. All shop and field welding shall be performed by personnel qualified by AWS procedure and who have engaged in the necessary processes of welding during each six-month period since the latest qualification.
 - 2. Fabricator and erector shall institute a *Welder Identification System* wherein the welder who has welded a joint or member can be identified.
- E. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings."
 - 1. The Contractor shall require reasonable representatives of every party who are concerned with the steel work to attend the Conference, including but not limited to, the following:
 - a. Contractor's Superintendent Structural Steel Fabricator Structural Steel Installer Testing and Inspection Agency Structural Engineer.
 - 2. Minutes of the meeting shall be recorded, typed and printed by the Contractor and distributed by them to all parties concerned within five days of the meeting. One copy of the minutes shall also be transmitted to the following for information purposes: Owner's Representative and Architect.

1.9 DELIVERY, STORAGE, AND HANDLING

- Deliver structural steel to Project site in such quantities and at such times to ensure continuity of installation.
- B. Store materials to permit easy access for inspection and identification. Keep steel members off ground by using pallets, platforms, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
 - Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

- C. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
 - 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
 - 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
 - 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

1.10 SEQUENCING

A. Supply anchorage items to be embedded in or attached to other construction without delaying the Work.

PART 2 - PRODUCTS

2.1 STRUCTURAL STEEL MATERIALS

- A. All structural steel shapes shall be new, unused and perfect stock, free from millscale, rust, flake, pitting, and imperfections, without bends, kinks, and distortions. Shop splicing of members will only be permitted if the member exceeds maximum mill length.
- B. Wide Flange and Tee Shapes (Designated as W, M, S, HP, WT, MT and ST): ASTM A992.
- C. Channels and Angles: ASTM A572, Grade 50.
- D. Plates and bars equal to or less than 4 inches thick: ASTM A572, Grade 50.
- E. Cold-Formed Structural Steel Sections (Round, Rectangular, and Square Tubing): ASTM A500, Grade C.
- F. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. General: For clarity in distinguishing between medium carbon steel (A325) bolts and alloy steel (A490) bolts, the structural drawings and this specification classify bolts using generic A325 and A490 designations. Contractor shall provide tension indicating device assemblies, as opposed to ordinary bolts, as required in the bolt specification below.
- B. Medium Carbon Steel High-Strength Bolts, Nuts, and Washers: ASTM A325, Type 1, heavy hex steel structural bolts; ASTM A563, Grade C, heavy-hex carbon-steel nuts; and ASTM F436, Type 1, hardened carbon-steel washers, uncoated. Use ordinary bolts, washers, and nuts only where required for installation access, where bolts are called to be galvanized, and at contractor's option for snugtight installation applications.
 - 1. Finish: Plain, uncoated, except where indicated to be galvanized.
 - 2. Galvanized Finish: Hot-dip zinc-coating, ASTM A153, Class C or mechanically deposited zinc-coating, ASTM B695, Class 50. Use galvanized bolts for all steel to be painted with zinc-rich primer, unless noted otherwise, and elsewhere as noted on drawings.
 - 3. Twist-Off-Type Tension-Control Bolt-Nut-Washer Assemblies: ASTM F1852, Type 1, heavy-hex or round head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers. Use of twist-off-type tension-control assembly is mandatory except where bolts are allowed by structural drawings to be installed snug-tight, where installation access prohibits use, and where bolts are called to be galvanized.

Use of galvanized twist-off type assemblies is not permitted.

C.

2.3 PRIMER

- A. Primer for coated steel: Fast-drying, low VOC, high-build and high-solids, lead- and chromate-free, non-asphaltic, rust-inhibiting primer. Primer to be compatible with topcoat(s) including, but not limited to, intumescent coatings, alkyd, acrylic, and high-performance coatings such as epoxy and polyurethane. Primer to be formulated for application over SSPC SP6 prepared surfaces and selected by coating manufacturer for suitability and compatibility.
- B. Zinc Rich Primer: SSPC–Paint 20 (79% minimum zinc dust in dried film).
 - 1. Use primer with organic binder where structure will be topcoated with protective finish paint. Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:
 - a. Carbozinc 621, Carboline Company, Inc.
 - b. Corothane I Galvapac, Sherwin Williams Co.
 - c. Tneme Zinc 90-97, Tnemec Company, Inc.

2.4 GALVANIZING MATERIALS

- A. Galvanizing: The zinc used for the coating shall conform to the specifications for slab zinc (Spelter) ASTM designation: B6.
- B. Galvanizing Repair Paint: High zinc dust content paint for regalvanizing welds and repair painting of galvanized steel, with dry film containing not less than 93 percent zinc dust by weight and complying with DOD-P-21035 A or SSPC-Paint 20, Type II.

2.5 ASPHALTIC COATING

- A. High build, polyamide epoxy coal tar coating suitable for use over bare or primed structural steel-SSPC 16.
 - Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:
 - a. TarGuard, Sherwin Williams Co.

2.6 FABRICATION

- A. Fabricate and assemble structural steel in shop to greatest extent possible. Fabricate structural steel according to AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," AISC 360, and other specifications referenced in this Section and in Shop Drawings.
 - 1. Camber structural steel members where indicated.
 - 2. Fabricate beams with rolling camber up.
 - Identify high-strength structural steel according to ASTM A6 and maintain markings until steel
 has been erected.
 - 4. Mark and match-mark materials for field assembly.
 - 5. Fabricate for delivery a sequence that will expedite erection and minimize field handling of

structural steel.

- 6. Complete structural steel assemblies, including welding of units, before starting shop-priming operations.
- 7. Comply with fabrication tolerance limits of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for structural steel.
- B. Fabricate steel exposed to view with exposed surfaces smooth, square, and free of surface blemishes, including pitting, rust and scale seam marks, roller marks, rolled trade names, and roughness.
 - 1. Remove blemishes by filling, grinding, or by welding and grinding, prior to cleaning, treating and shop priming.
- C. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
 - 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.
- D. Finishing: Accurately mill ends of columns and other members transmitting loads in bearing.
- E. Mechanically roll sections to induce curvature where indicated. Fabricator shall increase thickness of curved tubes as part of base bid as required to prevent "oil canning" of the tube walls or "squashing" of the section for the specified radius.
- F. Holes: Provide holes required for securing other work to structural steel framing, for attaching structural steel connections and embeds to other work, and for passage of other work through steel framing members, as shown on Shop Drawings.
 - 1. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame-cut holes or enlarge holes by burning. Drill holes in bearing plates.
 - 2. Weld threaded nuts to framing and other specialty items as indicated to receive other work.
 - 3. Provide erection holes, of minimum 3/16" diameter, in steel embed plates for temporary fastening of embeds to concrete formwork. Provide minimum 4 holes per piece. Coordinate hole size, spacing, and layout requirements with other trades contractors.
 - 4. Provide vent and drain holes in closed sections subject to galvanizing or condensation due to exposure to thermal fluctuations.
 - 5. Perimeter columns shall have holes through the column web or other devices attached to the columns at 42-45 inches above the finished floor and at the midpoint between the finished floor and the top cable to permit installation of perimeter safety cables.
- G. Assemble and weld built-up sections by methods that will maintain true alignment of axes without warp.
- H. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 1, "Solvent Cleaning."

2.7 SHOP CONNECTIONS

- A. Shop install and tighten high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A325 or A490 Bolts."
 - 1. Bolts: ASTM A325 (ASTM A325M) high-strength bolts, unless otherwise indicated.
 - 2. Connection Type: Unless snug tight connections are noted on the drawings as being permitted, all bolts shall be tightened to full pretensioning load. Bolts shall be pretensioned in a systematical progression from the most rigid point of the connections toward the free edges.

- B. When two structural members on opposite sides of a column web, or a beam web over a column, share common connection holes do not use connections that require either member to be completely disconnected (nuts removed from bolts) for installation of the succeeding member.
- C. Do not reuse bolts that have been tensioned.
- D. All bolts of same ASTM type shall be of same diameter. In addition, bolts of different ASTM type shall be of different diameter unless otherwise approved by Structural Engineer.
- E. Weld Connections: Comply with AWS D1.1 for procedures, appearance and quality of welds, and methods used in correcting welding work. Remove all cracks, pores, slag inclusions, incomplete fusions, and incomplete penetrations over ½" long in any weld and reweld.
 - Assemble and weld built-up sections by methods that will maintain true alignment of axes without warp.
 - 2. Furnish all steel members in one piece without splicing, unless otherwise noted on project drawings or approved by Structural Engineer.
 - 3. Design of Members and Connections: Typical AISC connections are to be used except where otherwise shown. Details shown are typical; similar details apply to similar conditions, unless otherwise indicated. Verify dimensions at site whenever possible without causing delay in the work. Promptly notify Architect whenever design of members and connections for any portion of structure are not clearly indicated.
 - 4. Expansion Joints: Provide expansion joints in steel shelf angles when part of structural steel frame; locate at vertical masonry expansion joints as indicated on drawings. The gap between ends of angles shall equal the width of the masonry expansion joint. The angles shall have support within 8" of the joints.
- F. Where Drawings indicate spliced and/or bent beams, provide AWS D1.1 pre-qualified full penetration welds to develop 100% of the beam's shear and moment capacity.
- G. Where Drawings or Specifications indicate slip critical joints, media blast and then protect faying surfaces to be free of scale, coatings, and overspray within the bolt pattern and not less than 1 inch from the edges of holes.
- H. Connections incorporating any of the following shall be marked with an identifying mark painted on the member.
 - 1. Connections using bolts larger than ¾ inches.
 - 2. ASTM A490 bolted connections.
 - 3. Bearing connections with bolt threads excluded from shear plane.
 - 4. Slip-critical connections.

2.8 SURFACE PREPARATION FOR COATINGS

- A. Steel fabricator shall coordinate fireproofing and finishing requirements with architectural documents.
- B. Surface Preparation: Clean surfaces to be painted. Remove dirt, loose rust, loose mill scale, and spatter, slag, or flux deposits. Wipe steel surfaces with solvent to remove rolling oils that impair primer bond. Prepare surfaces according to SSPC specifications as follows:
 - 1. SSPC-SP 1 "Solvent Cleaning," all galvanized steel, unless noted otherwise.
 - 2. SSPC-SP 2 "Hand Tool Cleaning," all steel except as otherwise specified.
 - 3. SSPC-SP 3 "Power Tool Cleaning."
 - 4. SSPC-SP 5 "White Metal Blast Cleaning."

- 5. SSPC-SP 6 "Commercial Blast Cleaning," all steel to receive zinc rich primer in the field or intumescent fireproofing. Remove all mill scale. Blast clean all surfaces using a sharp, angular abrasive for optimum surface profile (2 mils).
- 6. SSPC-SP 8 "Pickling."
- 7. SSPC-SP 10 "Near-White Blast Cleaning," all steel to receive zinc rich primer in the shop. Remove all mill scale.

2.9 SHOP PRIMING

- A. General: Structural steel shall not be exposed to open atmospheric conditions between surface preparation and priming. Priming operation shall be performed in continuous operation with surface preparation.
 - Prime any blast-cleaned, bare steel within 8 hours of surface preparation or before flash rusting occurs.
- B. Shop prime steel surfaces, except the following:
 - 1. Surfaces embedded in concrete or mortar other than column bases and steel lintels. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
 - 2. Surfaces to be field welded.
 - 3. Surfaces to be high-strength bolted with slip-critical connections.
 - 4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
 - 5. Galvanized surfaces.
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's instructions and at 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.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 - 2. Apply 2 coats of shop paint to inaccessible surfaces after assembly or erection. Change color of second coat to distinguish it from first.

D. Zinc Rich Primer

- 1. Exposed exterior structural steel for Exposed Exterior Columns shall be prime painted with the specified Zinc Rich Primer.
- 2. Prepare surfaces to be painted with inorganic binder primer according to Steel Structures
 Painting Council Specification SSPC-10 and surfaces to be painted with organic binder primer
 according to Steel Structures Painting Council Specification SSPC-SP 6. The Pictorial Surface
 Preparation Standards for Painting Steel Surfaces, SSPC-VIS 1-89, shall be the acceptance
 criteria for the degree of preparation for cleaned surfaces.
- 3. Contractor shall photograph blast cleaned structural steel members prior to priming and submit photographs to Engineer as confirmation that steel was properly cleaned.
- 4. Contractor shall coordinate finish coat system with Architect.

E. Application

- 1. Steel to be concealed by other trades or which is exposed to view more than 20 feet above or lateral to a walking surface below may have primer applied by brushing, spraying, rolling, flow coating, dipping or other suitable means, at the election of the fabricator.
- 2. Steel to be exposed to view in the finished structure less than 20 feet above or to a walking surface shall have primer applied by spraying or smooth nap roller.

2.10 GALVANIZING

- A. All welded assemblies to be galvanized shall be prepared according to Recommended Practice for Providing High Quality Zinc Coatings (Hot-Dip) on Assembled Products (ASTM A385).
- B. Steel shall be hot-dip galvanized in accordance with ASTM A123 except that galvanized steel to be finish painted shall not be quenched (including by water, chromate, oil, or other deleterious substance). Coating weight shall conform with paragraph 5.1 of ASTM A123.
- C. Hardware and threaded fasteners shall be galvanized in accordance with ASTM A153. Coating weight shall conform with Table 1 of ASTM A153.
- D. Safeguard products against steel embrittlement according to ASTM A143.
- E. Handle all articles to be galvanized in such a manner as to avoid any mechanical damage and to minimize distortion.
- F. Surface finish shall be continuous, adherent, as smooth and evenly distributed as possible and free from any defect detrimental to the stated end use of the coated article.
- G. Adhesion shall withstand normal handling consistent with the nature and thickness of the coating and normal use of the article.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Before erection proceeds, and with the steel erector present, verify elevations of concrete and masonry bearing surfaces and locations of anchorages for compliance with requirements.
- B. Do not proceed with erection until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated.
 - Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC specifications referenced in this Section.
- B. Base, Bearing, and Leveling Plates: Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.
 - 1. Column base plate anchor rods shall not be repaired, replaced, or field modified without the approval of the Structural Engineer. Prior to erection of a column the Contractor shall provide written notification to the Erector if there has been any repair, replacement or modification to

- its anchor rods.
- 2. Set base and bearing plates for structural members on wedges, shims, or setting nuts as required.
- 3. Snug-tighten [anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of base or bearing plate prior to packing with grout.
- 4. Weld plate washers all around to top of baseplate with minimum, unless otherwise noted, AISC permitted fillet weld size for thickness of parts joined at all braced frame and moment frame columns.
- 5. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces, protect installed materials, and allow to cure.
 - a. Comply with manufacturer's instructions for proprietary grout materials.
 - b. Grout shall be installed and cured before any elevated concrete slab supported on said columns are placed and prior to installing structural framing in excess of the third story above
- C. Maintain erection tolerances of structural steel within AISC 303 "Code of Standard Practice for Steel Buildings and Bridges."
- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure.
 - 2. Establish required leveling and plumbing measurements on mean operating temperature of structure. Make allowances for difference between temperature at time of erection and mean temperature at which structure will be when completed and in service.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection unless specifically approved by the Engineer.
- G. Do not enlarge unfair holes in members by burning or by using drift pins. Ream holes that must be enlarged to admit bolts.
- H. Provide all bracing, temporary bracing and accessories required for complete erection. Safety and adequacy of bracing and temporary bracing are the Installer's responsibility.
- I. After erection, remove weld flux, rust, dirt or other foreign material from areas to receive touch-up paint. Repaint areas where protective coating has been damaged or is missing with shop primer paint.

3.4 FIELD CONNECTIONS

- A. Install and tighten high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A325 or A490 Bolts."
 - 1. Bolts: ASTM A325 (ASTM A325M) high-strength bolts, unless otherwise indicated.
 - 2. Connection Type: Unless snug tight connections are noted on the Drawings as being permitted, all bolts shall be tightened to full pretensioning load.
- B. Do not reuse ASTM A490 bolts, galvanized A325 bolts or bolts that have been tensioned.

STRUCTURAL STEEL FRAMING 05 1200 - 12 04/24/2025

- C. Weld Connections: Comply with AWS D1.1 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding. Remove all cracks, pores, slag inclusions, incomplete fusions, and incomplete penetrations over ½" long in any weld and reweld.
 - 1. Comply with AISC 303 and AISC 360 for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
 - 2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.
 - 3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without warp.
 - 4. The General Contractor shall provide a full-time trained Fire-Watch Captain with appropriate fire suppression equipment during all times that welding activities occur and a minimum of 60 minutes thereafter. This person shall be in addition to the workmen.
- D. Remove all erection clips, gussets, bolts, and angles where exposed in the finished structure and where they interfere with other construction. Grind welds smooth where exposed.

3.5 QUALITY CONTROL

- A. General: The Owner will engage an independent testing and inspecting agency to perform inspections and tests and to prepare test reports. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from requirements. Failure to detect any defective materials shall not prevent later rejection when such defect is discovered, or obligate the Architect or Owner for final acceptance.
 - 1. See Section 01 4120 Structural Inspections and Contract Drawings for testing and inspection to be performed.
 - 2. Provide access for testing agency to places where structural steel work is being installed so that required inspection and testing can be accomplished.
 - 3. The General Contractor shall provide the testing agency a complete set of approved shop drawings.
 - 4. Reports will be delivered to the Architect, Engineer, Steel Fabricator and the General Contractor within one week of inspection.
 - 5. Deviations from requirements of the contract documents will be reported in writing to the General Contractor within 24 hours.
- B. Correct deficiencies in or remove and replace structural steel that inspections and test reports indicate do not comply with specified requirements.

3.6 REPAIRS AND PROTECTION

- A. Touchup Priming: Immediately after erection, clean field welds, bolted connections, abraded areas of shop primer, and exposed areas where primer is damaged or missing. Apply primer using same material as used for shop painting to comply with SSPC-PA 1 for touching up shop painted surfaces.
 - 1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning for standard primers and SSPC-SP6 Commercial Blast Cleaning for zinc-rich primers.
 - 2. Apply by brush or spray to provide a minimum dry film thickness of 1.5 mils (0.038 mm).
 - 3. Steel erector shall document with photographs and written correspondence to General Contractor/Construction Manager the condition of primer immediately following erection and Touchup Priming. All degradation of primed surfaces due to exposure, weather, or damage by other construction and trades shall be repaired by Painting Contractor through contract with the General Contractor/Construction Manager.
- B. Coordination with Other Trades: Cleaning and primer touch up/repair that may be required as a result

PROJECT NO. 24-179.000 Harrison REMC - Addition and Renovation Harrison REMC

STRUCTURAL STEEL FRAMING 05 1200 - 13 04/24/2025

of, but not limited to, the following are not included in the scope of this specification section and are included to be included under Division 9 Section "Painting."

- 1. Abrasions and rust from: bundling, banding, loading and unloading, chains, dunnage, cables and chains during erection, bridging, installation, and other jobsite handling.
- 2. Bolt heads and nuts.
- 3. Dirt.
- 4. Diesel smoke.
- 5. Road salt.
- 6. Weather conditions during storage and construction.
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and apply galvanizing repair paint according to ASTM A780. Minimum thickness requirements for the repair are those described in ASTM A123, Section 4.6.
- D. Asphaltic Coating: After erection clean column base plates, anchor rod nuts, columns and other structural steel below grade up to finished floor. Clean bare steel surfaces to remove loose rust, loose mill scale, and spatter, slag, or flux deposits in accordance with SSPC-SP 2 "Hand Tool Cleaning." Clean primed steel to be free of dirt and moisture. Apply coating by brush or spray to provide a minimum dry film thickness of 10 mils on rods, nuts, and structural steel up to bottom of slab on grade. Do not extend coating above grade.

3.7 CLEANING

A. All bare, primed, or galvanized steel to be left unpainted shall be thoroughly cleaned by solvent cleaning in accordance with latest edition of Steel Structures Painting Council Surface Preparation Specification No. 1 (SSPC-SP1). Hydrocarbon based solvents are prohibited.

END OF SECTION 05 1200

SECTION 05 3100 - STEEL DECKING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Steel roof deck.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 1 Section "Structural Inspection."
 - 2. Division 3 Section "Cast-in-Place Concrete."
 - 3. Division 5 Section "Structural Steel Framing."
 - 4. Division 9 Section "Painting."

1.3 ACTION SUBMITTALS

- A. General: Furnish submittals in quantity, format, and other Conditions of the Contract and as specified in Division 1 of the Project Manual.
- B. Product data including manufacturer's specifications and installation instructions for each type of deck, accessory, and product specified.
- C. Shop drawings showing layout and types of deck panels, anchorage details, reinforcing channels, pans, deck openings, special jointing, accessories, and attachments to other construction.
 - 1. Shop drawings which show the Architect's or Engineer's title block, logo and/or seal will be rejected and returned unchecked.
 - 2. Computer generated electronic structural construction document files (ACAD) will be made available to the Contractor. The Contractor will be required to sign the Engineer's standard release of liability form prior to receiving the drawing files. Rules for use of said files shall be as defined in the AISC "Code of Standard Practice for Steel Buildings and Bridges," Section 4 3
 - 3. Shop drawing resubmittals are reviewed for conformance with review marks only. Any changes or questions originating on a resubmittal shall be clearly clouded.

1.4 INFORMATIONAL SUBMITTALS

- A. General: Furnish submittals in quantity, format, and other Conditions of the Contract and as specified in Division 1 of the Project Manual.
- B. Product certificates signed by manufacturers of steel deck certifying that their products comply with specified requirements.
- C. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.

1.5 QUALITY ASSURANCE

- A. Codes and Standards: Comply with provisions of the following codes and standards, except as otherwise indicated.
 - American Iron and Steel Institute (AISI), "Specification for the Design of Cold-Formed Steel Structural Members."
 - 2. American Welding Society (AWS), D1.3 "Structural Welding Code Sheet Steel".
 - Steel Deck Institute (SDI), "Design Manual for Composite Decks, Form Decks and Roof Decks."
- B. Installer Qualifications: Engage an experienced Installer who has completed steel deck similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- C. Welding Standards: Comply with applicable provisions of AWS D1.1 "Structural Welding Code Steel" and AWS D1.3 "Structural Welding Code Sheet Steel."
 - 1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
- D. Fire-Test-Response Characteristics: Where indicated, provide steel deck panels identical to those tested as part of an assembly for fire resistance per ASTM E 119 by a testing and inspection agency performing testing and follow-up services, that is acceptable to authorities having jurisdiction.
 - 1. Fire-Resistance Ratings: As indicated by design designations listed in UL "Fire Resistance Directory," or by Warnock Hersey or another testing and inspecting agency.
 - 2. Labeling: Identify steel deck with appropriate markings of applicable testing and inspecting agency.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
 - 1. American Buildings Co.
 - 2. Epic Metals Corp.
 - 3. Marlyn Steel Products, Inc.
 - 4. New Millennium Building Systems, LLC.
 - 5. Robertson A United Dominion Co.
 - 6. Roof Deck, Inc.
 - 7. United Steel Deck, Inc.
 - 8. Verco Manufacturing Co.
 - 9. Vulcraft Div. Of Nucor Corp.

2.2 ROOF DECK

- A. Steel Roof Deck: Fabricate panels without top-flange stiffening grooves conforming to SDI Publication No. 28 "Specifications and Commentary for Steel Roof Deck" and the following:
 - 1. Prime-Painted Steel Sheet: ASTM A 611, Grade as required to comply with S.D.I. specifications, shop prime as follows:
 - a. Shop Primer: Grey or white baked-on, lead- and chromate-free rust-inhibitive primer, conforming to the performance requirements of Fed. Spec, TT-P-664.
 - Galvanized-Steel Sheet: ASTM A 446, Grade A, G 60 zinc coated according to ASTM A 653.
 - 3. Deck Profile: Type WR, wide rib.
 - 4.
 - 5. Design Uncoated-Steel Thickness: 0.0295 inch.

2.3 ACCESSORIES

- A. General: Provide accessory materials for steel deck that comply with requirements indicated and recommendations of the steel deck manufacturer.
- B. Mechanical Fasteners: Manufacturer's standard, corrosion-resistant, low-velocity, powder-actuated or pneumatically driven carbon steel fasteners; or self-drilling, self-threading screws.
- C. Self Drilling Steel Screws: Manufacturer's standard hexagonal washer head, self-drilling, carbon steel screws. Screws shall be zinc electroplated to 5µm (minimum) thickness in accordance with ASTM B633 SC1 Type III. Select point type and size and thread length per manufacturer's recommendations to fully engage in the base material.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - a. Hilti S-MD.
- D. Powder or Pneumatic Fasteners: Modified AISI 1070 steel, minimum hardness 54 Rockwell C, minimum tensile strength of 285 ksi, and minimum shear strength of 175 ksi; with zinc plating equivalent to ASTM B633, Type III Fe/Zn 5 (5μm min.). Fasteners shall have knurled shanks, forged ballistic point, and minimum 12 mm steel washers for bar joists and 15 mm steel washers for structural steel.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - Bar Joist and Structural Steel with thickness of 1/8" up to and including 3/8": Hilti X-HSN 24.
 - b. Structural Steel 1/4" or thicker: Hilti X-ENP-19 L15.
- E. Miscellaneous Roof Deck Accessories: Steel sheet, 0.0359-inch-thick minimum ridge and valley plates, finish strips, and reinforcing channels, of same material as roof deck.
- F. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material and thickness as deck panels, unless otherwise indicated.
- G. Steel Sheet Accessories: ASTM A 446, G 60 coating class, galvanized according to ASTM A 653.

- H. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035, with dry film containing a minimum of 94 percent zinc dust by weight. Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:
 - 1. ZRC Galvilite, ZRC Worldwide.
- I. Preset Inserts: Manufacturer's standard, UL-labeled single-piece preset inserts, fabricated from either steel sheet galvanized according to ASTM A 653, G 60 coating class, or zinc sheet, with removable covers.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting framing and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of steel deck.

3.2 PREPARATION

- A. Do not place deck panels on concrete supporting structure until concrete has cured and is dry.
- B. Locate decking bundles to prevent overloading of supporting members.

3.3 INSTALLATION, GENERAL

- A. Install deck panels and accessories according to applicable specifications and commentary of SDI Publication No. 28, manufacturer's recommendations, and requirements of this Section.
- B. Install temporary shoring before placing deck panels when required to meet deflection limitations.
- C. Place deck panels on supporting framing and adjust to final position with ends accurately aligned and bearing on supporting framing before being permanently fastened. Do not stretch or contract side lap interlocks.
- D. Place deck panels flat and square and fasten to supporting framing without warp or deflection.
- E. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to the decking.
- F. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of decking, and support of other work.
- G. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work. All welds sizes stipulated on drawings or specification shall be effective (not visible) diameter/length.
- H. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's instructions.
- I. Do not use deck units for storage or working platforms.
- J. Where options in fastening methods are given, fastening method of deck shall be compatible with supporting framing; including consideration for thickness of supporting steel.

3.4 ROOF DECK INSTALLATION

- A. Specified roof deck fastening is unless noted otherwise in the Construction Drawings.
- B. Fasten roof deck panels to steel supporting members as follows:
 - 1. Fasten to structural steel supporting members with self-drilling No. 12- diameter or larger carbon steel screws or powder actuated fasteners at each support.
 - 2. Fasten to light gauge, cold-formed steel supporting members with self-drilling No. 10-diameter or larger carbon steel screws at each support.
 - 3. Fastener Spacing: Screw or pin deck units at ends and all intermediate supports. Space fasteners a maximum of 12 inches on center, with a minimum of four fasteners per unit at each support.
- C. Side Lap Fastening: Fasten side laps between supports at intervals not exceeding 36 inches with self-drilling No. 10- diameter or larger carbon steel screws.
- D. Perimeter Edge Fastening:
 - Fasten perimeter edges of deck to steel supporting members and angles with No. 12- diameter
 or larger carbon steel screws or powder actuated fasteners spaced a maximum of 12 inches on
 center.
- E. End Bearing: Install deck ends over supporting framing with a minimum end bearing of 1-1/2 inches, with end joints as follows:
 - 1. End Joints: Lapped 2 inches minimum.
- F. Where layout of deck does not align bottom flute with edge angles / structure for complete perimeter fastening, provide continuous z-plate along deck edge and fasten to structure and deck in accordance with perimeter edge fastening requirements.
- G. Miscellaneous Roof Deck Accessories: Install ridge and valley plates, finish strips, cover plates, end closures, and reinforcing channels according to deck manufacturer's recommendations. Screw to substrate to provide a complete deck installation.

3.5 QUALITY CONTROL

- A. General: The Owner will engage an independent testing and inspecting agency to perform inspections and tests and to prepare test reports. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from requirements. Failure to detect any defective materials shall not prevent later rejection when such defect is discovered, or obligate the Architect or Owner for final acceptance.
 - 1. See Section 01 4120 Structural Inspections and Contract Drawings for testing and inspection to be performed.
 - 2. Provide access for testing agency to places where steel decking work is being installed so that required inspection and testing can be accomplished.
 - 3. The General Contractor shall provide the testing agency a complete set of approved shop drawings.
 - 4. Reports will be delivered to the Architect, Engineer, Steel Fabricator and the General Contractor within one week of inspection.
 - 5. Deviations from requirements of the contract documents will be reported in writing to the General Contractor within 24 hours.

6. Correct deficiencies in or remove and replace steel deck that inspections and test reports indicate do not comply with specified requirements.

3.6 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces with galvanized repair paint according to ASTM A 780 and the manufacturer's instructions.
- B. Touchup Painting: Wire brush, clean, and paint scarred areas, welds, and rust spots on both surfaces of installed deck panels.
 - 1. Touch up painted surfaces with same type of shop paint used on adjacent surfaces.
 - 2. Where shop-painted surfaces are exposed in-service, apply touchup paint to blend into adjacent surfaces.

END OF SECTION 05 3100

SECTION 05 4000 - COLD-FORMED METAL FRAMING - STRUCTURAL

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Exterior load-bearing wall framing.
- B. Related Sections include the following:
 - 1. Division 1 Section "Structural Inspection."
 - 2. Division 6 Section "Rough Carpentry."
 - 3. Division 9 Section "Gypsum Board Assemblies."
 - 4. Division 9 Section "Gypsum Board Shaft-Wall Assemblies."

1.3 DEFINITIONS

- A. Minimum Base Steel Thickness: Minimum base thickness of cold-formed framing delivered to the Project site shall be not less than 95 percent of the thickness used in the cold-formed framing design. Lesser thicknesses shall be permitted at bends due to cold forming.
- B. Producer: Entity that produces steel sheet coil fabricated into cold-formed members.

1.4 ACTION SUBMITTALS

- A. General: Furnish submittals in quantity, format, and other Conditions of the Contract and as specified in Division 1 of the Project Manual.
- B. Product Data: For each type of cold-formed metal framing product and accessory indicated.
- C. Shop Drawings: Show layout, spacings, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining Work.
 - 1. For cold-formed metal framing indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 2. Shop drawings which show the Architect's or Engineer's title block, logo and/or seal will be rejected and returned unchecked.
 - 3. Computer generated electronic structural construction document files (ACAD) will be made available to the Contractor. The Contractor will be required to sign the Engineer's standard release of liability form prior to receiving the drawing files. Rules for use of said files shall be as defined in the AISC "Code of Standard Practice for Steel Buildings and Bridges," Section
 - 4. Shop drawing resubmittals are reviewed for conformance with review marks only. Any changes or questions originating on a resubmittal shall be clearly clouded.

1.5 INFORMATIONAL SUBMITTALS

- A. General: Furnish submittals in quantity, format, and other Conditions of the Contract and as specified in Division 1 of the Project Manual.
- B. Mill certificates signed by steel sheet producer indicating steel sheet complies with requirements.
- C. Welding Certificates: Copies of certificates for welding procedures and personnel.
- D. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- E. Product Test Reports: From a qualified testing agency indicating that each of the following complies with requirements, based on comprehensive testing of current products:
 - 1. Expansion anchors.
 - 2. Power-actuated anchors.
 - 3. Mechanical fasteners.
 - 4. Vertical deflection clips.
 - 5. Miscellaneous structural clips and accessories.
- F. Research/Evaluation Reports: Evidence of cold-formed metal framing's compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.

1.6 QUALITY ASSURANCE

- A. Codes and Standards: Comply with provisions of the following codes, specifications, and standards, except where more stringent requirements are shown or specified. Each contractor having reference to AISI Documents shall maintain copies of same on project site.
 - 1. AISI S202-11: Code of Standard Practice.
 - 2. AISI S200-12: General Provisions.
 - 3. AISI S201-12: Product Standard.
 - 4. AISI S210-07(2012): Floor and Roof System Design.
 - 5. AISI S211-07(2012): Wall Stud Design.
 - 6. AISI S212-07(2012): Header Design.
 - 7. AISI S213-07/S1-09 (2012): Lateral Design.
 - 8. AISI S214-12: Truss Design.
- B. Manufacturer Qualifications: Member in good standing of the Steel Framing Industry Association (SFIA) or be a part of a similar organization that provides verifiable code compliance program.
- C. Installer Qualifications: An experienced installer who has completed cold-formed metal framing 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.
- D. Product Tests: Mill certificates signed by steel sheet producer indicating steel sheet complies with requirements, including base steel thickness, yield strength, tensile strength, total elongation, chemical requirements, and galvanized-coating thickness.
- E. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Steel Framing Industry Association (SFIA), or be a part of a similar organization that provides verifiable code compliance program.

- F. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code-Steel," and AWS D1.3, "Structural Welding Code-Sheet Steel."
- G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect cold-formed metal framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling as required in AISI's "Code of Standard Practice".
- B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering cold-formed metal framing that may be incorporated into the Work include, but are not limited to, the following:
 - 1. ClarkDietrich Building Systems.
 - 2. Consolidated Fabricators Corp.
 - 3. J.N. Linrose
 - 4. Scafco Corp.
 - 5. Steel Construction Systems.
 - 6. Steeler, Inc.
 - 7. Super Stud Building Products, Inc.
 - 8. United Metal Products, Inc.

2.2 MATERIALS

- A. Framing Members, General: Comply with ASTM C 955 for conditions indicated.
- B. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:
 - 1. Grade: 33 for minimum base steel thickness of 0.0428 inch and less; 50, Class 1 or 2 for minimum base steel thickness of 0.0538 inch and greater, unless noted otherwise.
 - 2. Coating: G60, unless noted otherwise.
- C. Steel Sheet for all studs, track, clips, plate, etc.: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:
 - 1. Grade: 33 for minimum base steel thickness of 0.0428 inch and less; 50, Class 1 or 2 for minimum base steel thickness of 0.0538 inch and greater.
 - 2. Coating: G60.

2.3 LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, complying with ASTM C 955, and as follows:
 - 1. Minimum Base-Steel Thickness: 0.0538 inch.

- 2. Flange Width: 1-5/8 inches.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, complying with ASTM C 955, and as follows:
 - 1. Minimum Base-Steel Thickness: 0.0538 inch.
 - 2. Flange Width: 1-1/4 inches.

2.4 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories of the same material and finish used for framing members, with a minimum yield strength of 33,000 psi.
- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
 - 1. Supplementary framing.
 - 2. Bracing, bridging, and solid blocking.
 - 3. Web stiffeners.
 - 4. End clips.
 - 5. Foundation clips.
 - 6. Anchor clips.
 - 7. Gusset plates.
 - 8. Stud kickers, knee braces, and girts.
 - 9. Joist hangers and end closures.
 - 10. Hole reinforcing plates.
 - 11. Backer plates.

2.5 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123.
- B. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.
- C. Mechanical Fasteners: Corrosion-resistant-coated, self-drilling, self-threading steel drill screws.
 - 1. Head Type: Low-profile head beneath sheathing, manufacturers' standard elsewhere.
- D. Welding Electrodes: Comply with AWS standards.

2.6 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: SSPC-Paint 20

2.7 FABRICATION

- A. Fabricate cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to manufacturer's written recommendations and requirements in this Section.
 - 1. Fabricate framing assemblies using jigs or templates.
 - 2. Cut framing members by sawing or shearing; do not torch cut.

- 3. Fasten cold-formed metal framing members by welding. Wire tying of framing members is not permitted. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
- 4. Fasten cold-formed metal framing members by welding or screw fastening, as standard with fabricator. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by not less than three exposed screw threads.
- 5. Fasten other materials to cold-formed metal framing by welding, bolting, or screw fastening, according to Shop Drawings.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.
- C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
 - 1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
 - 2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Cold-formed metal framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed metal framing according to ASTM C 1007, AISI S240 "North American Standard for Cold-Formed Steel Structural Framing", and manufacturer's written instructions, unless more stringent requirements are indicated.
- C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
 - 1. Bolt or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.
- D. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to manufacturer's written recommendations and requirements in this Section.
 - 1. Cut framing members by sawing or shearing, do not torch cut.
 - 2. Fasten cold-formed metal framing members by welding or screw fastening, as standard with

fabricator. Wire tying of framing members is not permitted.

- a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
- b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by not less than three exposed screw threads.
- E. Install framing members in one-piece lengths, unless splice connections are indicated for track or tension members.
- F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- G. Install insulation in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- H. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.
- I. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
 - 1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
- J. Mechanical fasteners shall be spaced a minimum of 3 fastener diameters apart. Screw fasteners shall be installed such that a minimum of 3 screw threads are exposed.
- K. Bearing surfaces shall be uniform.
- L. Install continuous neoprene sealer gaskets at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.3 LOAD-BEARING WALL INSTALLATION

- A. Level top of foundation wall and slab with cement grout to provide a surface level to 1/8" in 10 feet below bearing wall studs.
- B. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends.
- C. Squarely seat studs against webs of top and bottom tracks. Maximum gap between bottom of stud and track shall not exceed 1/8". Fasten both flanges of studs to top and bottom tracks. Space studs as shown on plans.
- D. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar configurations.
- E. Align floor and roof framing over studs. Where framing cannot be aligned, continuously reinforce track to transfer loads.
- F. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure as

indicated.

- G. Install headers over wall openings wider than stud spacing. Locate headers above openings as indicated. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.
 - 1. Frame wall openings with not less than a double stud at each jamb of frame as indicated on Shop Drawings.
 - 2. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.
- H. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.
 - 1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.
- I. Install horizontal bridging in stud system, spaced 48 inches apart. Fasten at each stud intersection.
 - 1. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs with a minimum of two screws into each flange of the clip angle.
 - 2. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and studtrack solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
- J. Install steel sheet diagonal bracing straps to both stud flanges, terminate at and fasten to reinforced top and bottom tracks. Fasten clip-angle connectors to multiple studs at ends of bracing and anchor to structure.
- K. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.4 QUALITY CONTROL

- A. General: The Owner will engage an independent testing and inspecting agency to perform inspections and tests and to prepare test reports. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from requirements. Failure to detect any defective materials shall not prevent later rejection when such defect is discovered, or obligate the Architect or Owner for final acceptance.
 - 1. See Section 01 4110 Structural Special Inspections and Contract Drawings for testing and inspection to be performed.
 - 2. Provide access for testing agency to places where cold-formed metal framing work is being installed so that required inspection and testing can be accomplished.
 - 3. The General Contractor shall provide the testing agency a complete set of approved shop drawings.
 - 4. Reports will be delivered to the Architect, Engineer, Metal Framing Erector, and the General Contractor within one week of inspection.
 - 5. Deviations from requirements of the contract documents will be reported in writing to the General Contractor within 24 hours.
- B. Correct deficiencies in or remove and replace cold-formed metal framing that inspections and test

COLD FORMED METAL FRAMING - STRUCTURAL 05 4000 - 8 04/24/2025

reports indicate do not comply with specified requirements.

3.5 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed coldformed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 4000

SECTION 05 4100 - SHEET STEEL SHEAR PANEL

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Sheet steel faced wallboard for use as shear panels.
- B. Related Sections include the following:
 - 1. Division 1 Section "Structural Inspection."
 - 2. Division 5 Section "Cold-formed Metal Framing."
 - 3. Division 9 Section "Gypsum Board Assemblies."

1.3 DEFINITIONS

- A. Minimum Uncoated Steel Thickness: Minimum uncoated thickness of cold-formed framing delivered to the Project site shall be not less than 95 percent of the thickness used in the cold-formed framing design. Lesser thicknesses shall be permitted at bends due to cold forming.
- B. Producer: Entity that produces steel sheet coil fabricated into cold-formed members.

1.4 SUBMITTALS

- A. General: Furnish submittals in quantity, format, and other Conditions of the Contract and as specified in Division 1 of the Project Manual.
- B. Product Data: For each type of sheet steel shear panel indicated.
- C. Shop Drawings: Show layout, panel sizes and thicknesses, and fastening and anchorage details.
 - 1. Shop drawings which show the Architect's or Engineer's title block, logo and/or seal will be rejected and returned unchecked.
 - 2. Computer generated electronic structural construction document files (ACAD) will be made available to the Contractor. The Contractor will be required to sign the Engineer's standard release of liability form prior to receiving the drawing files. Rules for use of said files shall be as defined in the AISC "Code of Standard Practice for Steel Buildings and Bridges," Section 4.3.
 - 3. Shop drawing resubmittals are reviewed for conformance with review marks only. Any changes or questions originating on a resubmittal shall be clearly clouded.
- D. Mill certificates signed by steel sheet producer indicating steel sheet complies with requirements.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed stud framed bearing wall

structures with shear panels 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.

- B. AISI, North American Specifications for the Design of Cold-Formed Steel Structural Members, 2001 Edition with 2004 Supplement.
- C. ICC-ES Evaluation Report Number ER 5762 for steel framing.
- D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Store sheet steel shear panels, protect with a waterproof covering, and ventilate to avoid condensation. Elevate one end for moisture drainage.
- C. Do not bend sheet steel or break/mar sheathing board sheet while handling. If damage to panel should occur, repair of panel shall be approved by the manufacturer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering cold-formed metal framing that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Sure-Board Series 200 (www.sureboard.com)

2.2 MATERIALS

- A. Steel Sheet: ASTM A 653CS, structural steel, zinc coated, of grade and coating as follows:
 - 1. Grade: 33.
 - 2. Gage: 22 ga (0.027") minimum base metal thickness.
 - 3. Coating: G60 per ASTM A924.
 - 4. Panel size: 48 inch width available in lengths of 8 through 12 feet.
- B. Wallboard: 1/2" Densglass sheathing to match architectural specifications.
- Adhesives: Adhesive used to attach steel sheet to the wallboard shall be water soluble, non-combustible material.

2.3 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories of the same material and finish used for framing members, with a minimum yield strength of 33,000 psi.
- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:

- 1. Supplementary framing.
- 2. Straps.

2.4 ANCHORS, CLIPS, AND FASTENERS

- A. Mechanical Fasteners: Corrosion-resistant-coated, self-drilling, self-threading steel drill screws.
 - 1. Head Type: Low-profile head beneath sheathing, manufacturers' standard elsewhere.
 - 2. Size: See plans.
 - 3. Tip: Extended tip (minimum ½") to prevent jacking of the panels.

2.5 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: SSPC-Paint 20.

2.6 FABRICATION

A. Preorder and fabricate steel sheet shear panels to total length of stud wall assembly from base of sill plate to top of head plate. Where overall length of wall exceeds maximum available length of shear panels, total height may be achieved by stacking panels provided all panel edges are blocked and fastened.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Sheet steel shear panels may be shop or field fabricated for installation, or it may be field assembled.
- B. Install sheet steel shear panels according to ASTM C 1007 and manufacturer's written recommendations, unless more stringent requirements are indicated.
- C. Fastening Methods: Fasten panels as indicated below:
 - 1. To cold-formed steel framing: screw to framing throughout.
- D. Perimeter fasteners shall be installed 3/8 inch minimum inboard from all edges of the panel.

3.3 QUALITY CONTROL

- A. General: Owner will engage an independent testing and inspecting agency to perform inspections and tests and to prepare test reports. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from requirements. Failure to detect any defective materials shall not prevent later rejection when such defect is discovered, or obligate the Architect or Owner for final acceptance.
 - 1. See Section 01 4120 Structural Inspections and Contract Drawings for testing and inspection to be performed.
 - 2. Provide access for testing agency to places where framing work is being installed so that required inspection and testing can be accomplished.

PROJECT NO. 24-179.000 Harrison REMC - Addition and Renovation Harrison REMC

SHEET STEEL SHEAR PANELS 05 4100 - 4 04/24/2025

- 3. The General Contractor shall provide the testing agency a complete set of approved shop drawings.
- 4. Reports will be delivered to the Architect, Engineer, Metal Framing Erector, and the General Contractor within one week of inspection.
- 5. Deviations from requirements of the contract documents will be reported in writing to the General Contractor within 24 hours.
- B. Correct deficiencies in or remove and replace cold-formed metal framing that inspections and test reports indicate do not comply with specified requirements.

3.4 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure sheet steel shear panels are without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 4100

SHOP FABRICATED COLD FORMED STEEL TRUSSES 05 4753 - 1 04/24/2025

SECTION 05 4753 - SHOP-FABRICATED COLD-FORMED METAL TRUSSES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes fabrication and erection of cold-formed metal trusses, truss girders, and jacks and other falsework, as shown on drawings including schedules, notes, and details showing size and location of members, typical connections, and types of trusses required.
 - 1. Shop-fabricated cold-formed metal trusses include planar structural units consisting of screw connected members which are fabricated from light gauge metal sections and which have been cut and assembled prior to delivery to the Project site.
 - 2. Truss configurations:
 - a. Scissor roof trusses.
- B. This Section includes open web cold-formed metal trusses, end anchorages, bracing and connections.
- C. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 1 Section "Structural Inspection."
 - 2. Division 5 Section "Structural Steel Framing."
 - 3. Division 5 Section "Steel Decking"
 - 4. Division 5 Section "Cold-Formed Metal Framing Structural."

1.3 DEFINITIONS

- A. Minimum Uncoated Steel Thickness: Minimum uncoated thickness of cold-formed framing delivered to the Project site shall be not less than 95 percent of the thickness used in the cold-formed framing design. Lesser thicknesses shall be permitted at bends due to cold forming.
- B. Producer: Entity that produces steel sheet coil fabricated into cold-formed members.

1.4 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Engineer cold-formed metal trusses and connections to support all superimposed dead, live and wind loads as indicated on the drawings. See drawings for loading criteria.
- B. Engineering Responsibility: Engage a manufacturer who utilizes a qualified Professional Engineer to prepare calculations and Shop Drawings for cold-formed metal trusses and their connections.
- C. Design all required permanent bracing for individual compression web members and truss chords (when in compression). The number of braces, location, type of brace and bracing fastening shall be designed and detailed on the truss design drawings. Shop drawings will be rejected if brace information is not shown.
- D. Design all required permanent bracing for the truss system under vertical gravity and wind loads. System permanent bracing includes horizontal bottom chord bracing of bottom chord (where not

SHOP FABRICATED COLD FORMED STEEL TRUSSES 05 4753 - 2 04/24/2025

braced by ceiling construction), and vertical X-bracing between truss webs. Permanent bracing shown on construction documents shall be considered a minimum. The number of braces, location, type of brace and bracing fastening shall be designed and detailed on the truss design drawings.

- E. Design trusses to withstand design loads without deflections greater than the following:
 - 1. Roof trusses: Vertical deflection of 1/360 of span due to 100% live load and 1/240 of span due to 100% total load.
 - 2. Scissor roof trusses: Horizontal deflection at supports of 3/4 inches due to 100% live load and 1 1/4 inches due to 100% total load.

1.5 ACTION SUBMITTALS

- A. General: Furnish submittals in quantity, format, and other Conditions of the Contract and as specified in Division 1 of the Project Manual.
- B. Shop Drawings detailing fabrication and erection of cold-formed metal trusses.
 - 1. Show location, pitch, span, camber, configuration, and spacing for each type of truss required; location of any required continuous bracing; shape, gauge, and material strength of each member to be used; splice details; and bearing, anchorage, and truss/rafter to truss girder connection details. Include product data sheets showing configuration and capacity of all premanufactured connection material.
 - 2. Include Shop Drawings signed and sealed by a qualified Professional Engineer responsible for their preparation. The engineer shall be licensed to practice in jurisdiction where Project is located.
 - 3. Shop drawings which show the Architect's or Engineer's title block, logo and/or seal will be rejected and returned unchecked.
 - 4. Computer generated electronic structural construction document files (ACAD) will be made available to the Contractor. The Contractor will be required to sign the Engineer's standard release of liability form prior to receiving the drawing files.
 - 5. Shop drawing resubmittals are reviewed for conformance with review marks only. Any changes or questions originating on a resubmittal shall be clearly clouded.

C. Structural Calculations.

- Show loading, section modulus, assumed allowable stress, stress diagrams and calculations, maximum axial compressive and tensile forces in truss members, calculated deflection ratio for live and total load, and similar information needed for analysis and to ensure that trusses comply with requirements.
- 2. Calculations shall be signed and sealed by a qualified Professional Engineer licensed to practice in jurisdiction where Project is located.
- 3. Architects and Engineers review of the calculations is for general conformance with the contract documents. Actual calculations are the responsibility of the cold-formed metal truss design engineer and will not be reviewed for content or accuracy by the Architect or Engineer.

1.6 INFORMATIONAL SUBMITTALS

- A. General: Furnish submittals in quantity, format, and other Conditions of the Contract and as specified in Division 1 of the Project Manual.
- B. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

SHOP FABRICATED COLD FORMED STEEL TRUSSES 05 4753 - 3 04/24/2025

- C. Product Data for each type of product specified. Include manufacturer's specifications, installation instructions, laboratory test reports, and other data to show compliance with the specifications (including specified standards).
- D. Fabricators who participate in the certified Quality Certification Program shall submit, at the completion of fabrication, a certificate of compliance stating that the work was performed in accordance with the approved construction documents.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who has completed cold-formed metal truss work similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Fabricator Qualifications: Engage a firm experienced in fabricating cold-formed metal trusses similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to fabricate cold-formed metal trusses without delaying the Work.
- C. Comply with applicable provisions of the following specifications and documents:
 - 1. Cold-formed Steel Engineers Institute (CFSEI) publications:
 - a. Field Installation Guide for Cold-Formed Steel Roof Trusses.
 - b. Design Guide for Construction Bracing of Cold-Formed Steel Trusses.
- D. Professional Engineer Qualifications: A professional engineer who is legally authorized to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for projects with cold-formed metal truss framing that are similar to that indicated for this Project in material, design, and extent.
- E. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings."

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver cold-formed metal trusses to Project site in such quantities and at such times to ensure continuity of installation.
- B. Handle and store trusses with care, and in accordance with manufacturer's instructions to avoid damage from bending, overturning, or other cause for which truss is not designed to resist or endure.
- C. Trusses shall be unloaded on level ground to avoid lateral strain. Trusses shall be protected from damage that might result from on-site activities and environmental conditions. Prevent toppling when banding is removed.
- D. Report truss damage to Architect prior to installation.
- E. Time delivery and erection of trusses to avoid extended on-site storage and to avoid delaying work of other trades.

PART 2 - PRODUCTS

2.1 MANUFACTURER

SHOP FABRICATED COLD FORMED STEEL TRUSSES 05 4753 - 4 04/24/2025

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into Work include, but are not limited to, the following:
 - 1. Alpine Engineered Products, Inc.
 - 2. Kintec, Inc.
 - 3. MiTek Industries, Inc.
 - 4. Tri-Chord, Inc.
 - 5. Progressive Systems, Inc.

2.2 METAL FRAMING ANCHORS

- A. Provide metal framing anchors fabricated from hot-dip, zinc-coated steel sheet complying with ASTM A 653, G60 coating designation, and of structural capacity, and type indicated that comply with requirements specified, including the following:
 - Current Evaluation/Research Reports: Provide products for which model code
 evaluation/research reports exist that are acceptable to authorities having jurisdiction and that
 evidence compliance of metal framing anchors for application indicated with the building code
 in effect for this Project.
 - 2. Allowable Design Loads: Provide products for which manufacturer publishes allowable design loads that are determined from empirical data or by rational engineering analysis and that are demonstrated by comprehensive testing performed by a qualified independent testing laboratory.

2.3 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123.
- B. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.
- C. Mechanical Fasteners: Corrosion-resistant-coated, self-drilling, self-threading steel drill screws.
 - 1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.
- D. Provide all fasteners required to properly and completely erect, anchor, and connect the truss work for this Project, including, but not limited to, screws, bolts, nuts, washers, and similar items, whether specifically mentioned herein or not.

2.4 FABRICATION

- A. Cut truss members to accurate lengths, angles, and sizes to produce close fitting joints with metal-to-metal bearing in assembled units.
- B. Assemble truss members in design configuration indicated using jigs or other means to ensure uniformity and accuracy of assembly with close fitting joints. Position members to produce design camber indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

SHOP FABRICATED COLD FORMED STEEL TRUSSES 05 4753 - 5 04/24/2025

- A. Before erection proceeds, and with the cold-formed metal truss erector present, verify elevations of concrete bearing surfaces and locations of anchorages for compliance with requirements.
- B. Do not proceed with erection until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep cold-formed metal trusses secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports as required when permanent connections, and bracing are in place.

3.3 ERECTION

- A. Splice trusses delivered to site in more than one (1) piece before installing.
- B. Erect and brace trusses to comply with recommendations of manufacturer and the Truss Plate Institute.
- C. Erect trusses with plane of truss webs vertical (plumb) and parallel to each other, located accurately at design spacing indicated.
- D. Hoist units in place by means of lifting equipment suited to sizes and types of trusses required, applied at designated lift points as recommended by fabricator, exercising cared not to damage truss members or joints by out-of-plane bending or other causes.
- E. Do not place concentrated loads (including roof sheathing bundles) atop trusses until all specified bracing has been installed and roof sheathing is permanently screwed in place.
- F. Install permanent bracing and related components to enable trusses to maintain design spacing, withstand live and dead loads including lateral loads, and to comply with other indicated requirements.
- G. Do not cut or remove truss members.

3.4 QUALITY CONTROL

- A. General: The Owner will engage an independent testing and inspecting agency to perform inspections and tests and to prepare test reports. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from requirements. Failure to detect any defective materials shall not prevent later rejection when such defect is discovered, or obligate the Architect or Owner for final acceptance.
 - 1. See Section 01 4120 Structural Inspections and Contract Drawings for testing and inspection to be performed.
 - 2. Provide access for testing agency to places where prefabricated cold-formed metal truss work is being installed so that required inspection and testing can be accomplished.
 - 3. The General Contractor shall provide the testing agency a complete set of approved shop drawings.
 - 4. Reports will be delivered to the Architect, Engineer, Steel Fabricator and the General Contractor within one week of inspection.
 - 5. Deviations from requirements of the contract documents will be reported in writing to the General Contractor within 24 hours.

PROJECT NO. 24-179.000 Harrison REMC - Addition and Renovation Harrison REMC

SHOP FABRICATED COLD FORMED STEEL TRUSSES 05 4753 - 6 04/24/2025

B. Correct deficiencies in or remove and replace prefabricated cold-formed truss work that inspections and test reports indicate do not comply with specified requirements.

END OF SECTION 05 4753

SECTION 05 5000 - MISCELLANEOUS METALS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Miscellaneous metals include items made from iron and steel shapes, plates, bars, strips, tubes, pipes and castings which are not a part of structural steel or other metal systems specified elsewhere.
- B. Types of work in this section include, but are not limited to the following:
 - 1. Steel Pipe Railings and Brackets.
 - 2. Loose Steel Lintels.
 - 3. Miscellaneous Framing and Supports.
 - 4. Steel Concrete Inserts.
 - 5. Pipe Bollards.
 - 6. Steel Pan Stairs.

1.2 QUALITY ASSURANCE

- A. Comply with the applicable requirements of the following manuals, specifications and codes:
 - 1. "Specification for Design, Fabrication and Erection of Structural Steel for Buildings", AISC.
 - 2. "Code for Arc and Gas Welding in Building Construction", AWS.
 - 3. "Structural Steel Detailing", AISC.

1.3 REFERENCES

- A. Publications of the following institutes, associations, societies and agencies are referred to in this Section.
 - 1. American Society for Testing and Materials, ASTM.
 - 2. National Association of Architectural Metals Manufacturers, NAAMM.
 - 3. Steel Structures Painting Council, SSPC.
 - 4. American Welding Society, AWS.
 - 5. American Institute of Steel Construction, AISC.
- B. All Miscellaneous Metals and fabricated items shall be domestic manufacture. Imported metals and products will not be approved or used.

1.4 SUBMITTALS

A. Furnish to the Architect for approval, complete shop and field erection drawings.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Fabricate and deliver miscellaneous metal items in ample time to avoid delays in the progress of any trade working on the project.
- B. Store on blocks off ground and cover to prevent rusting, denting and damage to materials or structure.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Materials shall conform with the following requirements:
 - 1. "Structural Steel", ASTM Designation A36.
 - 2. "Low and Intermediate Tensile Strength Carbon Steel Plates of Structural Quality", ASTM Designation A283.
 - 3. "Cold-Rolled Carbon Sheets, Commercial Quality", ASTM Designation A36.
- B. Structural Steel: 36,000 psi yield point rolled to the size and shapes indicated on the drawings.
- C. Welding Electrodes: Series #70, Grade AWS-2.
- D. Primer Paint: Supplier's standard shop primer paint.

2.2 MISCELLANEOUS METAL ITEMS

- A. Miscellaneous Metal Items but are not necessarily limited to the following:
 - 1. Steel angles, shelf angles, receiving angles, lintels and miscellaneous supports requiring fabrication.
 - 2. All bolts, inserts, clip angles, struts and channel framing.
 - 3. Handrails shall be steel pipe with welded joints. All welds shall be ground smooth. Provide closure plates at ends of all rails. Return all ends to wall unless otherwise detailed.

2.3 WORKMANSHIP

- A. Workmanship required in the execution of the work shall be of the best quality and subject to the approval of the Architect.
- B. Form metal work to shape and size, with sharp lines and angles. Leave clean, true lines and surfaces when shearing or punching. Weld permanent connections where practical.
- C. Holes in structural steel framing for attaching miscellaneous metal items will be provided by the miscellaneous metal erector.

2.4 FABRICATION

- A. The Contractor is responsible for verifying all dimensions of work adjoining. Inspect such work before fabrication and/or installation of items specified. Obtain measurements of adjoining work so work will fit closely to spaces provided.
- B. Provide opening angles, lintels and miscellaneous supports shown, requiring fabricating in accordance with notes and details.
- C. The fabricator shall furnish all necessary templates and patterns required by other trades. Also furnish all items except otherwise specified, pertaining to work under other sections.

2.5 SHOP PAINTING

- A. Clean all ferrous metals of all rust, scale, oil, grease or other foreign matter in accordance with SSPC Specification SP2-63.
- B. After cleaning apply one coat Type 1, oil alkyd, red oxide to minimum 2 mil dry film thickness
- C. All exterior miscellaneous steel to be hot dipped galvanized.
 - 1. Hot dip galvanizing per ASTM A123, min. 2.0 ounces per square foot.
 - 2. Touch up primer: SSPC 20, Type I inorganic zinc rich.

PART 3 - EXECUTION

3.1 FIELD MEASUREMENT

A. The Contractor is responsible for obtaining all necessary field measurements at the job site and will be held responsible for their accuracy and for the accurate fitting of this work with the work of others.

3.2 GENERAL

A. Perform all cutting, fitting and drilling necessary to properly set the work herein specified and as required for proper installation of adjacent or engaging work of all trades.

3.3 ADJUST AND CLEAN

A. Touch Up Painting:

- 1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting.
- 2. Apply to provide a minimum dry film thickness of 2.0 mils.

PROJECT NO. 24-179.000 Harrison REMC - Addition and Renovation Harrison REMC MISCELLANEOUS METALS 05 5000 - 4 04/24/2025

PART 4 - SUBMITTAL CHECK LIST

A. Shop and setting drawings.

END OF SECTION 05 5000

SECTION 06 1000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish labor, materials, equipment, special tools, supervision and services required to complete all rough carpentry work indicated, noted and detailed on drawings and specified herein including:
 - Wood treatment.
 - 2. Fasteners in treated wood.
 - 3. Blocking as required for items such as casework, cabinets, toilet accessories, lockers, and any other items requiring wood blocking for support, bracing, mounting, and securing in place.

1.2 QUALITY ASSURANCE

A. Grading Rules:

- Lumber grading rules and wood species shall conform with Voluntary Product Standard PS-20.
 Grading rules of the following associations shall also apply to materials produced under their supervision.
 - a. Northeastern Lumber Manufacturer's Association, Inc. (NELMA).
 - b. Southern Pine Inspection Bureau (SPIB).
 - c. West Coast Lumber Inspection Bureau (WCLIB).
 - d. Western Wood Product Association (WWPA).
- 2. Plywood shall conform to the following:
 - a. Softwood Plywood Product Standard PS-1.
 - b. Hardwood Plywood Product Standard PS-51.

B. Grade Marks:

- 1. Identify all lumber and plywood by official grade mark.
- 2. Lumber: Grade stamp to contain symbol of grading agency, mill number or name, grade of lumber, species or species grouping or combination designation, rules under which graded, where applicable and condition of seasoning at time of manufacture.
 - a. S-Dry: Maximum 15 percent moisture content.
 - b. MC-5 or KD: Maximum 15 percent moisture content.
 - c. Dense.
- 3. Softwood Plywood: Appropriate grade trademark of the American Plywood Association.
 - a. Type, grade, class and identification index.
 - b. Inspection and testing agency mark.
- 4. Hardwood Plywood: Appropriate grade mark of qualified inspection, testing, or grading mark.

1.3 Testing:

- 1. ASTM E 84, maximum 25 Flame Spread rating.
- B. Requirements of Regulatory Agencies:
 - 1. Fire Hazard Classification: Underwriter's Laboratories, Inc., for treated lumber and plywood.
 - 2. Preservative Treated Lumber and Plywood: American Wood Preservers Bureau, Quality Mark.
 - 3. Pressure Treated Material: American Wood Preserves Bureau Standards.
 - 4. Span Tables: National Forest Products Association.
 - 5. Working Stresses: Softwood Lumber, National Design Specification, National Forest products Association.

1.4 SUBMITTALS

- A. Submit the following:
 - 1. Treating Plant Certification: Submit certification by treating plant stating chemicals and process used, net amount of salts retained, and conformance with applicable standards.
 - 2. Preservative Treated Wood: Submit certification for water-borne preservative that moisture content was reduced to 19 percent maximum, after treatment.
 - 3. Fire Retardant Treatment: Submit certification by treating plant that fire-retardant treatment materials comply with governing ordinances and that treatment will not bleed through finished surfaces.
 - 4. Fasteners Product Data: Submit manufacturer's published literature and product data sheets.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Immediately upon delivery to job site, place materials in area protected from weather.
- B. Store materials of minimum of 6" above ground on framework or blocking and cover with protective waterproof covering, providing adequate air circulation or ventilation.
- C. Do not store seasoned materials in wet or damp areas.
- D. Protect fire-retardant materials against high humidity and moisture during storage and erection.
- E. Protect sheet materials from corners breaking and surface damage.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Lumber:

- Dimension:
 - Specified lumber dimensions are nominal.

b. Actual dimensions conform to industry standards established by the American Lumber Standards Committee and the rules writing agencies.

2. Moisture Content:

 a. 19 percent maximum at time of permanent closing of building or structure, for lumber 2" or less nominal thickness.

3. Surfacing:

a. Surface four sides (S4S), unless otherwise shown, or specified.

4. Framing Lumber:

- a. 2" to 4" thick, 2" to 4" wide.
- b. Any commercial softwood species, unless otherwise shown, or specified.

Miscellaneous Lumber:

- a. Provide wood for support or attachment of other work including cant strips, bucks, nails, blocking, furring, grounds, stripping and similar members.
- b. Provide lumber of sizes shown or specified, worked into shapes shown on Drawings.
- c. 15 maximum moisture content for lumber items not specified to receive wood preservative treatment.

6. Grades:

- a. General Framing: Standard and Better Grade.
- b. Plates, Blocking, Bracing and nailers: Utility Grade.
- c. Miscellaneous Lumber: Construction Grade.

B. Plywood:

- 1. Exterior graded plywood where indicated, or where edge or surface is permanently exposed to weather: B-B EXT-APA, graded for treatment where preservative treated plywood is indicated.
- 2. Plywood Backing Panel: For mounting electrical or telephone equipment, provide fire-retardant treated plywood panels, APA C-D PLUGGED INT with exterior glue, thickness indicated, or if not otherwise indicated, 3/4".

C. Preservative Treated Wood:

- 1. Waterbourne Salt Preservatives for Painted, Stained or Exposed Natural Wood Products:
 - a. AWPB LP-2, above ground application.
 - b. AWPB LP-22, ground contact application.

2. Treat indicated items and the following:

- a. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry, concrete, or around windows and doors.
- b. Use **MCA** (Micronized Copper Azole) preservative treatment only.

D. Fire Retardant Treatment:

- 1. Comply with AWPA Standards for pressure impregnation with fire retardant chemicals.
 - a. Flame Spread: 25 max.

- E. Fasteners in Treated Wood (SBX):
 - 1. Shall be resistant to corrosion or be protected to resist corrosion. Standard hot dipped galvanized fasteners are acceptable.

F. Fasteners in Treated Wood:

- 1. Shall be resistant to corrosion or be protected to resist corrosion.
- 2. Where sacrificial coatings are applied to fasteners, a minimum coating thickness capable of protecting the fastener for the expected service life of the structure shall be provided. Provide manufacturer's product information, test results, and certifications to substantiate these claims.
- 3. Coating weights for zinc-coated fasteners shall be in accordance with ASTM A153M or ASTM A641, Supplementary Requirements.
- 4. Fasteners shall be one of the following:
 - a. Stainless steel.
 - b. Double-dipped, Hot-dipped, zinc-coated galvanized steel.
 - c. Silicon bronze.
 - d. Copper.

PART 3 - EXECUTION

3.1 GENERAL

- A. Discard units of material with defects which might impair quality of work, and units which are too small to fabricate work with minimum joints or optimum joint arrangement.
- B. Set carpentry work accurately to required levels and lines, with members plumb and true and accurately cut and fitted.
- C. Securely attach carpentry work to substrate by anchoring and fastening as shown and as required by recognized standards. Countersink nail heads on exposed carpentry work and fill holes.
- D. Use common wire nails except as otherwise indicated. Use finishing nails for finish work. Select fasteners of size that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting of wood; pre-drill as required.

3.2 INSTALLATION

- A. Wood Grounds, Nailers, Blocking and Sleepers:
 - 1. Provide where shown and where required for screeding or attachment of other work. Form to shapes as shown and cut as required for true line and level of work to be attached.
 - 2. Attach to substrates as required to support applied loading. Countersink bolts and nuts flush with surfaces, unless otherwise shown. Build into masonry during installation of masonry work. Where

- possible, anchor to formwork before concrete placement. Do not use power driven anchors unless approved by Architect.
- 3. Provide permanent grounds of dressed, preservative treated, key-beveled lumber not less than 1-1/2" wide and of thickness required to bring face of ground to exact thickness of finish material involved. Remove temporary grounds when no longer required.
- 4. For renovation projects utilizing existing blocking, provide additional blocking as required if existing blocking is inadequate.
- B. Apply two brush coats of same preservative used in original treatment to all sawed or cut surfaces of treated lumber.

3.3 TEMPORARY WORK

A. Provide temporary stairs, ramps, runways, ladders, etc., as required for the purpose of handling materials, personnel and access to the work and temporary exits from the building.

3.4 CUTTING, FITTING AND PATCHING

A. Include all cutting, fitting and patching of work in connection with other trades which adjoin any part of this work.

PART 4 - SUBMITTAL CHECK LIST

- A. Treating plant certification.
- B. Preservative treatment certificate.
- C. Fire retardant treatment certificate.
- D. Fasteners product data.

END OF SECTION 06 1000

SECTION 06 2000 - FINISH CARPENTRY

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Solid Surface window sills throughout the project as indicated on the Drawings.
- B. Aluminum sliding window assembly.

1.2 SUBMITTALS

- A. Submit the following:
 - 1. Shop Drawings of all finish carpentry items of sufficient detail and scale to show compliance with design intent and specified quality grades.
 - 2. Samples of all finish materials for colors, patterns and finishes as specified. For colors, patterns and finishes not specified, submit samples of manufacturer's entire selection for selection by Architect.

1.3 DELIVERY, STORAGE AND HANDLING

- A. Protect products during transit, delivery, storage and handling to prevent damage, soiling and deterioration.
- B. Do not deliver finish carpentry, until painting, wet work, grinding and similar operations which could damage, soil or deteriorate products have been completed in installation areas.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Solid Surface Window Sills:
 - 1. Acceptable Manufacturers and Products:
 - a. "Dupont", "Corian".
 - b. "Wilsonart", "Gibraltar".
 - c. "Formica", "Formica Solid Surfacing".
 - d. "Meganite", "Meganite".
 - e. "Avonite Surfaces", "Avonite".
 - f. "LG Hausys", "Acrylic Solid Surface".
 - g. "Hanwha L&C", "Hanex Solid Surface".
 - 2. 3/4" total sill thickness provided from one of the following, depending on color availability:
 - a. 3/4" thick solid surface material.

- b. 1/4" thick solid surface material laminated atop 1/2" plywood or hardboard with edge bandings of 3/4" solid surface material.
- 3. Provide 1/2" thick apron below entire exposed edge of sill, 2" deep unless indicated otherwise.
- 4. All sills and aprons to have eased exposed edges.
- 5. Extend sill 1/2" beyond face of apron, unless indicated otherwise.
- 6. Color as indicated on Drawings, or to be selected by Architect from manufacturer's entire selection.
- B. Aluminum Sliding Window Assembly:
 - 1. "Knape and Vogt" P1092 ANOD 48 Roll-Ezy Aluminum Track Assembly Kit
 - 2. Provide nylon wheels and all necessary trim and accessories for a complete installation of bi-pass window unit.
 - 3. Provide "Epco" Sliding Glass Door Lock EPC-G05-C or approved equal.
 - 4. Color: Clear Anodized.
 - 5. Size of opening: as Indicated on Drawings.

C. Particle Board:

- 1. Medium Density, Type 1-M-2.
- 2. Thickness as indicated on the Drawings. If not indicated, provide 3/4" standard.

D. Miscellaneous Materials:

- 1. Provide nails, screws and other anchoring devices to provide secure, concealed attachment.
- 2. Where finish carpentry is exposed to exterior or areas of high humidity, provide fasteners with hot-dipped zinc coating (ASTM-A153).

E. Fasteners and Anchors:

- 1. Size and type as required for each use.
- 2. Provide non-ferrous or hot-dip galvanized anchors and fasteners for all exterior applications.

PART 3 - EXECUTION

3.1 PREPARATION

A. Field measure openings for proper fit of window sills.

3.2 INSTALLATION

- A. Install work in as large sizes as practical, in order to minimize the number of joints.
- B. Install work plumb, level, true and straight. Shim as required using concealed shims.
- C. Scribe and cut work to fit adjoining surfaces.

D. Anchor finish carpentry work to anchorage devices or blocking built-in or directly attached to substrates. Secure to grounds, stripping and blocking with countersunk, concealed fasteners and blind nailing as required for a complete installation. Except where pre-finished matching fastener heads are required, use fine finishing nail for exposed nailings, countersunk and filled flush with surface, so that nail is not noticeable after surface is painted or stained.

3.3 ADJUSTING AND CLEANING

A. Repair or replace defective finish carpentry work to eliminate functional and visual defects.

3.4 PROTECTION

- A. Protect all work from damage until time of substantial completion.
- B. Maintain conditions necessary to prevent deterioration of work.
- C. Repair or replace damaged work and finishes.

PART 4 - SUBMITTAL CHECK LIST

- A. Shop Drawings.
- B. Samples.

END OF SECTION 06 2000

SECTION 06 4000 - ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Architectural Woodwork as shown on the Drawings and specified herein, including:
 - 1. Custom Cabinets and Casework:
 - a. Wood Cabinets Plastic Laminate Faces.
 - b. Plastic Laminate Countertops For Custom Cabinets and Casework.
 - c. Solid Surface Countertops For Custom Cabinets and Casework.

1.2 QUALIFICATIONS

- A. Supplier's Qualifications:
 - 1. Shop of manufacturer should be certified by the Architectural Woodwork Standards (AWS), and be capable of providing proof of such certification upon request.

1.3 QUALITY ASSURANCE

- A. Comply with the latest edition of the Architectural Woodwork Standards (AWS) "Quality Standards". References to Premium, Custom, or Economy in this specification are to be as defined in this publication.
- B. Provide items and work of the quality grade indicated, or if not indicated, of Custom grade.
- C. Provide items and installation of straight, flat, level, plumb, and true quality and craftsmanship. Items provided that create an installation not acceptable for these reasons, or otherwise deemed unacceptable for purposes of aesthetics or maintenance, shall be removed and replaced by the Contractor without additional costs to the Owner. Final determination shall be made by the Architect.
- D. Any inconsistencies or irregularities in the surface or product will be cause for rejection. All rejected products shall be removed and replaced with new at no additional cost to the Owner. The evaluation of acceptance and rejection is at the sole discretion of the Architect.

1.4 SUBMITTALS

A. Samples:

- 1. Complete range of manufacturer's standard finishes where colors or finishes are not specified.
- 2. Samples of specified items only, where colors or finishes have been indicated.
- 3. Samples of each type, material, color, pattern and finish of all countertops and surfaces specified.

B. Shop Drawings:

ARCHITECTURAL WOODWORK 06 4000 - 2 04/24/2025

- 1. Field measurements shall be taken to verify that architectural woodwork, cabinets and casework will fit into designed space. Entryways, corridors, and door openings shall be verified to ensure that the equipment be manufactured in a manner to permit it to be moved through properly into place.
- 2. Show layout of architectural woodwork, cabinets and casework with product reference numbers, details of construction, dimensions, elevations, rough-ins, materials, finishes, hardware, and accessories.
- 3. Reference Architect's nomenclature of product identification as indicated on the Drawings.
- 4. Shop drawings on all architectural woodwork items, of sufficient detail and scale to determine compliance with design intent and specified quality grades.
- 5. Manufacturer's descriptive literature of specialty items not manufactured by the architectural wood worker.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Protect woodwork during transit, delivery, storage and handling to prevent damage, soiling and deterioration.
- B. Do not deliver woodwork, until painting, wet work, grinding and similar operations which could damage, soil or deteriorate woodwork have been completed in installation areas.
- C. Deliver architectural woodwork, cabinets and casework as needed for immediate installation whenever possible. Any items delivered ahead of time for installation shall be stored by Contractor until project areas are ready for installation.

1.6 PROJECT CONDITIONS

- A. Conditioning: Do not install woodwork until required temperature and relative humidity have been stabilized and will be maintained in installation areas.
- B. Maintain temperature and humidity in installation area as required to maintain a moisture content of installed woodwork within a 1.0 percent tolerance of optimum moisture content, from date of installation through remainder of construction period.

1.7 WARRANTY

A. Architectural woodwork, cabinets and casework contractor shall guarantee to replace or repair, at no expense to the Owner, all materials of this contract found to be defective within one year of acceptance (Substantial Completion), due to defective materials and/or workmanship.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Plastic Laminate:
 - 1. Acceptable Manufacturers:

- a. "Wilsonart"
- 2. Comply with NEMA LD-3 for type, thickness, color, pattern, and finish as indicated for each application.
- 3. Provide high pressure laminate in grades indicated for the following types of surfaces:
 - a. Horizontal Surfaces High-pressure decorative laminate HGS-50 (0.050").
 - b. Vertical Surfaces: High-pressure decorative laminate VGS-28 (0.028").
 - c. Exposed Cabinet Body Exterior: High-pressure decorative laminate VGS-28 (0.028").
 - d. Door and Drawer Fronts: High-pressure decorative laminate VGS-28 (0.028").
 - e. Exposed Cabinet Body Interior: High-pressure decorative laminate VGS-28 (0.028").
 - f. Semi-Exposed Cabinet Body Interior: Thermally-fused melamine laminate with CL-20 cabinet liner at surface required to achieve true balanced construction, manufacturer's standard "white" in color.
 - g. Interior Concealed Surfaces: Thermally-fused melamine laminate, manufacturer's standard "white" in color.
- 4. Balanced construction of both faces of surfaces is required.
- 5. Laminate grain patterns are to run vertically and be vertically matched within each unit.

B. Solid Surfacing Material:

- 1. Acceptable Manufacturers and Products:
 - a. "Dupont", "Corian".
- 2. 1/2" thick for countertops, installed over particleboard backer, for total thickness of 1".
- 3. 1/2" thick for edge banding, and to provide a face depth of 1", unless indicated otherwise.
- 4. 1/2" thick for backsplashes and end splashes, 4" high unless otherwise noted.
- 5. 1/2" thick for window sills, unless otherwise noted.

C. Particle Board:

- 1. 47 pound density, non-telegraphing.
- 2. 3/4" thick, medium density particleboard, Type 1-M-2.
- 3. 1/2" thick minimum, medium density particleboard, Type 1-M-2, under solid surfacing countertops.

D. Accessories:

- 1. Fillers, tops, end and side closures; finish to match adjacent cases, cabinets and countertops.
- 2. Finished back and end panels as required or indicated.
- 3. Back splashes on all countertops. End splashes only as specified.

E. Plastic Laminate Shelving:

- 1. Fully adjustable, typically.
- 2. Fixed where required for unit stability and/or positive door latching.
- 3. 1" actual thickness over 36" wide, 3/4" actual thickness less than 36" wide.

F. Edge Trim:

1. Material:

ARCHITECTURAL WOODWORK 06 4000 - 4 04/24/2025

- a. 1mm (.020" actual) rigid PVC banding, stain finish, machine applied.
- b. 3mm rigid PVC banding, stain finish, machine applied with 3mm radius edge profile.
- 2. 3mm PVC banding at edges of doors and drawers.
- 3. 3mm PVC banding at edges of countertops, including splashes, typical.
- 4. 1mm PVC banding at edges of shelves, front and back.
- 5. 1mm PVC banding at all other case and leading edges.

G. Fasteners and Anchors:

- 1. Size and type as required for each use.
- 2. Provide non-ferrous or hot-dip galvanized anchors and fasteners for all exterior applications.

H. Colors:

- 1. Colors as selected from manufacturer's entire selection, no limit on number of colors selected.
- 2. If colors are indicated on the Drawings, colors and patterns must be matched.
- 3. For purposes of color selections, countertops shall include all splashes, aprons, supports and cleats where no base units are provided, unless noted otherwise.
- 4. For purposes of color selections, all fillers and panels shall match adjacent exposed cabinet faces.

2.2 HARDWARE

A. A. Pulls for drawers and doors shall be of clean, modern design offering a comfortable hand grip and shall attach to drawer or door with machine screws on 4" centers.

Pulls shall be of extruded aluminum with satin lacquer finish.

All pulls shall be centered on all drawer fronts.

B. Latching assembly for tall case double swinging doors shall consist of an eccentric plate operating two 1/8" x 5/8" plated vertically operating locking bars. Each bar shall operate through an extruded nylon guide and, when locked, shall engage a strike plate providing positive latching for the left hand door.

The lock attached to the right hand door shall operate a bolt which, when locked, shall overlap the left hand door providing secure locking. Single doors shall be locked to case sides.

C. Hinges shall be five knuckle institutional type heavy-duty hinges, concealed.

Hinges shall be 2-1/2" chrome, satin finish.

Hinges are to be mounted to door and case with not less than three screws per wing.

- D. Catches shall be provided on swinging doors and shall be a spring-loaded nylon roller type.
- E. Provide cork, plastic, or rubber type silencers on all drawers and doors.
- F. Door and Drawer Locks:
 - 1. Locks shall be furnished on all doors and drawers where noted on Drawings.
 - 2. Locks shall be standard disc tumbler with removable core (cam style), master keyed and furnished with two keys per lock.
 - 3. Locks used for double door applications shall be capable of securing both doors simultaneously without the need for additional elbow or deadbolt catches or bolt on the passive door.

ARCHITECTURAL WOODWORK 06 4000 - 5 04/24/2025

- 4. Furnished with two keys per lock. Master key as required.
- 5. Unless otherwise specified, key casework per the following requirements:
 - a. All spaces shall have all doors and drawers keyed alike within entire room.
 - b. Provide grandmaster key to operate all locks of all master keys for all spaces.
- G. Provide epoxy coated steel drawer slides with nylon rollers and self-closing feature at all standard and file drawers. Drawer slide load capacity to be 100 lb. static load rating, minimum and 150 lb. static load rating, minimum at all file drawers. Provide with full extension of drawer body beyond the face of the cabinet; 3/4 extension slides are not acceptable.
- H. Drawer stops shall be provided on all drawers to prevent inadvertent removal. Stops shall be automatic type, zinc plated steel.
- I. Shelf supports shall be die-formed to insert into pre-drilled holes on interior of cases and cabinets. Supports shall provide shelf adjustment on 32 mm centers. Shelf supports shall be plated steel. Shelves longer than 48" shall have additional support at center and at 24" maximum spacing otherwise.
- J. Shelf brackets and standards shall be installed so as to set standards flush with the finished interior surfaces of cases and cabinets.
 Heavy-duty slotted recessed metal standards shall provide shelf adjustment on maximum 1" centers.

Shelf support brackets shall be plated steel and designed specifically for type of shelf material. Shelves longer than 48" shall have additional support at center and at 24" maximum spacing otherwise.

- K. Sliding door hardware shall be extruded aluminum channel box track design, top and bottom of all doors. Provide single channel, by-pass or pocket type track design as applicable for each application. Provide wheel hangers and quantity as required by manufacturer's literature for material type and weight of door. Provide all parts and components for full system, including such items as hangers, guides, spacers, bumper stops, and the like.
- L. Chain stops shall be provided at the top of all doors to all tall cabinets. Provide chain stops at the top of all doors to all base and wall cabinets that open directly into a wall surface or obstruction. Finish of stops to match hinges.
- M. Countertop Brackets
 - 1. "US Futaba" USF-72531 12' x 18" Bracket. Finish: White or Black
 - 2. "US Futaba" USF-72531 18" x 24" Bracket. Finish: White or Black
 - 3. "US Futaba" USF-72531 24" x 29" Bracket. Finish: White or Black

2.3 FABRICATION

- A. Custom Cabinets and Casework:
 - 1. Fabricate in compliance with AWS Premium Grade for all cases and cabinets.
 - 2. Fabricate in compliance with AWS Premium Grade for plastic laminated tops.
 - 3. Conform to Full Flush Overlay design details for all doors and drawers.
 - 4. Fabricate in shop in largest units possible.
 - 5. Machine for all hardware in shop.

B. Joinery:

- 1. Handwrap fluted dowel construction.
- 2. 8mm minimum.
- 3. Doweled and glued.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Field measure all areas to receive architectural woodwork prior to fabrication. Provide any necessary closures and trim to fit the items to enclosing walls. Provide other trades with information necessary for proper completion of related work.
- B. Not all details of millwork are shown on the Drawings. Utilize the most advantageous manufacturing processed to achieve the quality and design intent indicated.
- C. Install architectural woodwork only after flooring and wet work have been finished and proper heat and ventilation have been provided to maintain a uniform heat with not more than 50 percent relative humidity. Allow 7 days of storage of architectural woodwork in area in which it is to be installed to permit wood to reach optimum moisture content.
- D. All laminated doors and drawers to be laminated <u>all</u> sides with GP-50, 0.50" thick.

3.2 INSTALLATION

- A. Exercise care to avoid damage to finished surfaces during handling and erection. Repair all damaged surfaces and blemishes arising from such operation. Replace items which cannot be satisfactorily repaired.
- B. Install paneling in correct position with concealed mechanical fastenings. Provide a minimum of nine (9) mechanical fasteners per wall panel unit, installed in such a way as to draw the panel uniformly tight to the supporting framework.
- C. Install all scribe strips accurately fitted to adjacent surfaces and securely anchored in position.
- D. Field modify architectural woodwork to accommodate conduits, piping, etc., in a neat and workmanlike manner.
- E. Attach all casework to floors and walls and anchor by concealed bolts or wood screws into inserts on floors and grounds, blocking, and nailers on walls. Provide all grounds, blocking, and nailers as necessary for all items. Trim and finish cabinets with scribe members for a neat and finished installation. Furnish hardware as specified. Equip each cabinet door with cabinet hinges, silencers, magnetic catch and pull. Mount each drawer on drawer slides and provide with a pull and silencers. Install adjustable standards and supports for adjustable shelves.
- F. Install casework so that doors will fit openings properly and be accurately aligned. Adjust hardware to center doors and provide unencumbered operation.

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective woodwork properly to eliminate defects functionally and visually; where not possible to repair properly, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean hardware, lubricate and make final adjustments for proper operation.
- C. Clean all woodwork and cabinets on exposed and semi-exposed surfaces, inside and out. Touch-up shop-applied finishes to restore damaged or soiled areas. Clean all plastic laminate with mild abrasive cleaner and polish with "Cabinet Magic" or similar laminate polish product.
- D. Complete the finishing work specified as work of this section, to whatever extent not completed at shop or prior to installation of woodwork.

3.4 PROTECTION

A. Protect architectural woodwork so that it is without damage or deterioration at time of substantial completion.

PART 4 - SUBMITTAL CHECK LIST

- A. Samples.
- B. Shop Drawings.
- C. Manufacturer's Literature.

END OF SECTION 06 4000

SECTION 07 2100 - INSULATION

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Extent of insulation work is indicated on the Drawings and specified herein.
- B. Applications of insulation specified in this section include the following:
 - 1. Foundation Wall Insulation.
 - 2. Batt/Blanket Thermal Insulation.
 - 3. Batt/Blanket Sound Insulation.
 - 4. Interior Vapor Retarder.

1.02 QUALITY ASSURANCE

A. Thermal Conductivity:

Thicknesses shown are for thermal conductivity (k-value at 75°F) specified for each material. Provide adjusted thicknesses as directed for equivalent use of material having a different thermal conductivity. Where insulation is identified by "R" value, provide appropriate thickness.

B. Fire and Insurance Ratings:

Comply with fire-resistance, flammability and insurance ratings indicated, and comply with governing regulations as interpreted by authorities.

1.03 SUBMITTALS

A. Product Data:

- 1. Manufacturer's specifications and installation instructions for each type of insulation required.
- 2. Material Safety and Data Sheets (MSDS).

1.04 DELIVERY, STORAGE AND HANDLING

- A. Do not allow insulation materials to become wet, soiled, or covered with ice or snow. Comply with manufacturer's recommendations for handling, storage and protection during installation.
- B. Protection for Plastic Insulation:
 - 1. Do not expose to sunlight.

2. Protect against ignition at all times. Do not deliver plastic insulation materials to project site ahead of installation time. Complete installation and concealment of plastic materials as rapidly as possible in each work area.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Foundation Wall Insulation:
 - 1. Provide one of the following approved products:
 - a. "Dow Chemical Company", Styrofoam.
 - b. "Owens-Corning", Foamular.
 - 2. Rigid, closed-cell, extruded polystyrene insulation board with integral high-density skin:
 - a. 25 psi minimum compressive strength.
 - b. K-value of 0.20.
 - c. 0.5% maximum water absorption.
 - d. Minimum value "R-5" per inch thickness, or as otherwise indicated on drawings.
 - e. Meeting all requirements of ASTM C578 Type IV.
 - 3. Size:
 - a. Manufacturer's standard lengths and widths.
 - b. Thicknesses and R-Value as indicated on Drawings, or if not indicated, 2" thick, R-10.0 min.
- B. Batt/Blanket Thermal Insulation (formaldehyde, acrylic and dye free):
 - 1. Unfaced Batts:
 - a. Provide accepted products from one of the following acceptable manufacturers:
 - 1.) "Owens Corning".
 - 2.) "USG".
 - 3.) "Johns Manville".
 - 4.) "CertainTeed".
 - b. Fiberglass Batts.
 - c. Continuous rolls in width of 16" or 24", as required to accommodate building component spacing.
 - d. Thickness to completely fill stud space and also provide R-value indicated on drawings. If not indicated, provide either 3-1/2" thick R-11 minimum or 6" thick R-19 minimum.
 - e. Provide unfaced batts for all batt/blanket thermal insulation, unless otherwise indicated.
 - Kraft Faced Batts:
 - a. Use of Kraft Faced Batts is NOT permitted.
 - 3. Foil Faced Batts:
 - a. Provide accepted products from one of the following acceptable manufacturers:
 - 1.) "Owens Corning".
 - 2.) "USG".

- 3.) "Johns Manville".
- 4.) "CertainTeed".
- b. Fiberglass Batts.
- c. Continuous rolls in width of 16" or 24", as required to accommodate building component spacing.
- d. Foil scrim vapor barrier facing, Class A rated, Type FSK-25.
- e. Thickness to provide R-value indicated on drawings, or if not indicated, 3-1/2" thick, R-11.
- 4. Vinyl Faced Batts (for pre-engineered metal buildings):
 - a. Provide accepted products from one of the following acceptable manufacturers:
 - 1.) "Owens Corning".
 - 2.) "USG".
 - 3.) "Johns Manville".
 - 4.) "CertainTeed".
 - b. Fiberglass Batts.
 - c. Continuous rolls in widths from 24" to 72", as required to accommodate joist or purlin spacing.
 - d. White, vinyl polyester facing, .02 perm rating, 0-25 flame spread rating and 0-450 smoke developed rating.
 - e Thickness to provide R-value indicated on drawings. Back fill with unfaced fiberglass blankets if required to meet indicated R-values.
- C. Batt/Blanket Sound Insulation (formaldehyde, acrylic and dye free):
 - 1. Fiberglass Batts.
 - a. Provide one of the following approved products:
 - 1). "Owens Corning" Sound Attenuation Batts Fiber Glass.
 - b. Unfaced.
 - c. Continuous rolls in width of 16" or 24", as required to accommodate building component spacing.
 - d. Thickness to completely fill stud space.
 - At a minimum, provide 3-1/2" thickness to provide NRC value of 1.00 minimum.
 - e. Friction fit between studs at partition walls, or as indicated on the drawings.
 - 2. Mineral Wool Batts.
 - a. Provide one of the following approved products:
 - 1). "Owens Corning" Sound Attenuation Fire Batts (Mineral Wool).
 - 2). "Thermafiber" Safing Insulation.
 - b. Unfaced.
 - c. 48" lengths in width of 16" or 24", as required to accommodate building component spacing.
 - d. 3" thick minimum to provide NRC value of 1.05 minimum.
 - e. Friction fit between studs at rated partition walls, or as indicated on drawings.
- D. Interior Vapor Retarder:
 - 1. Provide one of the following approved products:
 - a. "Certainteed", MemBrain Smart Vapor Retarder.
 - 2. Vapor Permeance:
 - a. < 1.0 perm (ASTM E96, Dessicant Method)

- b. > 10.0 perms (ASTM E96, Water Method)
- 3. Fire Hazard (ASTM E 84)
 - a. Flame spread: 20 max.
 - b. Smoke Developed: 55 max.
- 4. Fungi Resistance
 - a. No growth (ASTM C1338)

L. Miscellaneous Materials:

- 1. Adhesive for bonding insulating to be type recommended by insulation manufacturer and complying with fire-resistance requirements.
- 2. Mechanical anchors to be type and size shown, or if not shown, as recommended by insulation manufacturer for type of application and condition of substrate.

PART 3 - EXECUTION

3.01 INSPECTION

A. Installer must examine substrate and conditions under which insulation work is to be performed and must notify Contractor in writing of unsatisfactory conditions. Do no proceed with insulation work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. General:

- 1. Comply with manufacturer's instructions for particular conditions of installation in each case. If printed instructions are not available or do not apply to project conditions, consult manufacturer's technical representative for specific recommendations before proceeding with work.
- 2. Extend insulation full thickness as shown over entire area to be insulated. Cut and fit tightly around obstructions, and fill voids with insulation.
- 3. Apply a single layer of insulation of required thickness, unless otherwise shown or required to make up total thickness.
- 4. For horizontal floor or roof applications, provide separate support system as required to hold insulation in its intended location. If not otherwise indicated, provide continuous single cables attached to bottom chord of trusses at 24" o.c. spacing to allow access to above insulation as desired. Chicken wire or other method of support shall be permitted as approved by the Architect.

B. Perimeter Insulation:

- 1. On vertical surfaces, set units in adhesive applied in accordance with manufacturer's instructions. Use type adhesive recommended by manufacturer of insulation.
- 2. At interior side of foundation walls, extend insulation continuous from top of footing to bottom of slab.
- 3. At exterior side of foundation walls, extend insulation from top of footing to grade line and cut top of insulation board along grade line as required.

SUBMITTAL CHECK LIST

1. Product Data.

END OF SECTION 07 2100

SECTION 07 2119 - MEDIUM DENSITY CLOSED CELL POLYURETHANE FOAM AIR BARRIER

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Extent of insulation work is indicated on the Drawings and specified herein.
- B. This section includes the following:
 - 1. Materials and installation methods for a spray polyurethane foam building insulation and air/vapor barrier system located in the non-accessible part of the wall.
 - 2. SRAB (sheet rubberized-asphalt barrier) self-adhered air/vapor barrier membrane in roof assemblies.
 - 3. Materials and installation to bridge and seal the following air leakage pathways and gaps:
 - a. Connections of the walls to the roof air barrier.
 - b. Connections of the walls to the foundations.
 - c. Seismic and expansion joints.
 - d. Openings and penetrations of window frames, store front, curtain wall.
 - e. Barrier precast concrete and other envelope systems.
 - f. Door frames.
 - g. Piping, conduit, duct and similar penetrations
 - h. Masonry ties, screws, bolts and similar penetrations.
 - i. All other air leakage pathways in the building envelope.
 - 4. Materials to act as flashings and counterflashings.

1.02 PERFORMANCE REQUIREMENTS

- A. Provide air/vapor barrier system constructed to perform as a continuous air/vapor barrier system, as building thermal insulation, and as a liquid water drainage plane flashed to discharge to the exterior any incidental condensation or water penetration. System shall accommodate movements of building materials by providing expansion and control joints as required, with accessory air seal materials at such locations, changes in substrate and perimeter conditions.
- B. Provide materials with an air permeability not to exceed 0.004 cubic feet per minute per square foot under a pressure differential of 0.3 in. water (1.57 psf) (0.02 L/s.m2 @ 75 Pa.) when tested in accordance with ASTM E2178-01.
- C. Material shall meet requirements of ULC S705.1 Standard for Thermal Insulation Spray Applied Rigid Polyurethane Foam, Medium Density, and shall meet or exceed the following performance requirements:
 - 1. R value: 6.0 per inch minimum.
 - 2. Density: 1.9 pounds per cubic foot.
 - 3. Smoke developed: 450 max.
 - 4. Flame spread: 25 max. (ASTM E84)

D. Fire and Insurance Ratings:

Comply with fire-resistance, flammability and insurance ratings indicated, and comply with governing regulations as interpreted by authorities.

1.03 SUBMITTALS

A. Product Data:

- 1. Submit manufacturer's product data sheets for each type of material, including manufacturer's printed instructions for evaluating, preparing, and treating substrate, temperature and other limitations of installation conditions, technical data, and tested physical and performance properties.
- 2. Submit manufacturer's installation instructions.
- 3. Provide evidence of testing by an accredited laboratory confirming material has been tested and conforms to the requirements of ASTM E2178, Standard for Air Barrier Materials.
- 4. Certification by air/vapor barrier manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs).
- 5. Certification of compatibility by air/vapor barrier manufacturer, listing all materials on the project that it connects to or that come in contact with it.
- 6. Submit two samples, 12 by 12 inch (300 by 300 mm) minimum size, of each air/vapor barrier material required for Project.
- 7. Submit test results of air permeability testing of primary air barrier material (ASTM E 2178-01)
- 8. Submit test results of assembly in accordance with ABAA test protocol.

1.04 QUALITY ASSURANCE

A. Installer Qualifications:

- 1. The air barrier contractor shall be, during the bidding period as well as for the duration of the installation, shall be approved by the manufacturer.
- 2. The applicator shall be thoroughly trained and experienced in the installation of air barriers of the types being applied.
- 3. Single-Source Responsibility: Obtain air/vapor barrier materials from a single manufacturer regularly engaged in manufacturing the product.
- 4. Provide products which comply with all state and local regulations controlling use of volatile organic compounds (VOCs).
- 5. Construct typical exterior wall panel, 4 feet long by 4 feet wide, illustrating materials interface and seals. All transition membranes and seals shall be installed per the manufacturer's system requirements.
- 6. Protect people and materials from over-spray and contact with chemicals and gases.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Do not allow insulation materials to become wet, soiled, or covered with ice or snow. Comply with manufacturer's recommendations for handling, storage and protection during installation.
- B. Protection for Plastic Insulation:

PROJECT NO. 24-179.000 MEDIUM DENSITY CLOSED CELL POLYURETHANE FOAM AIR BARRIER Harrison REMC - Addition and Renovation 07 2119 - 3 Harrison REMC 04/24/2025

- 1. Do not expose to sunlight.
- 2. Protect against ignition at all times. Do not deliver plastic insulation materials to project site ahead of installation time. Complete installation and concealment of plastic materials as rapidly as possible in each work area.
- C. Deliver materials to Project site in original packages with seals unbroken, labeled with manufacturer's name, product, date of manufacture, expiration date, and directions for storage. Store materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by air/vapor barrier manufacturer. Protect stored materials from direct sunlight.
- D. Avoid spillage. Immediately notify Owner if spillage occurs and start clean up procedures.
- E. Clean spills and leave area as it was prior to spill.

1.06 WASTE MANAGEMENT AND DISPOSAL

A. Place materials defined as hazardous or toxic waste in designated containers. Ensure emptied containers are sealed and stored safely for disposal away from children.

1.07 PROJECT CONDITIONS

- A. Environmental Conditions: Apply air/vapor barrier within range of ambient and substrate temperatures recommended by air/vapor barrier manufacturer. Do not apply air/vapor barrier to a damp or wet substrate, unless the manufacturer specifically permits that for the product.
- B. Do not apply air/vapor barrier in snow, rain, fog, or mist.
- C. Do not apply air/vapor barrier when the temperature of substrate surfaces and surrounding air temperatures are below those recommended by the manufacturer.
- D. The product shall not be installed after the expiry date printed on the label of each container.

1.08 WARRANTY

- A. Provide manufactuer's standard product warranty, for a period of 3 years from date of Substantial Completion.
- B. Provide Contractor's 2-year warranty from date of Substantial Completion, including all components of the air barrier assembly, against failures, including, but not limited to, loss of air tight seal, loss of watertight seal, loss of adhesion, loss of cohesion, and failure to cure properly.

PART 2 - PRODUCTS

1.01 MATERIALS

- A. Provide one of the following acceptable products:
 - 1. "BASF"; Spraytite, Spray Polyurethane Foam Air Barrier.
 - 2. "Icynene"; MD-C-200.
 - 3. "Gaco Western"; Gaco Wall Foam 183M.
 - 4. Xcelus; XLS 2000
- B. Furnish auxiliary materials compatible with the air/vapor barrier.
 - 1. Self-adhering modified asphalt/polyethylene flashing: Blueskin® by Henry Company, Inc.
 - 2. Primer: Water based liquid primer for concrete, masonry, gypsum sheathing, wood, metal, and painted substrates: Aquatac® as manufactured by Henry Company Inc.
 - 3. Primer: Solvent based, VOC compliant primer for concrete, masonry, gypsum sheathing, wood, metal, and painted substrates: Blueskin® Primer by Henry Company, Inc.
 - 4. Mastic, Adhesives, and Tape: Liquid mastic and adhesives, and adhesive tapes by SRAB air/vapor barrier manufacturer.
- C. Contractor to provide 1/2" drywall thermal barrier between spray foam and finished space unless applicator/manufacturer can demonstrate compliance with NFPA 286 without the drywall thermal barrier. Where product passes NFPA 286 with a thermal ignition barrier, all costs for thermal ignition barrier, including but not limited to multiple coatings required by manufacturer, to be included in the bid.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Installer must examine substrate and conditions under which insulation work is to be performed and must notify Contractor in writing of unsatisfactory conditions. Do not proceed with insulation work until unsatisfactory conditions have been corrected.
- B. Examine substrates, areas, and conditions under which air/vapor barrier systems will be applied, with Installer present, for compliance with requirements. Verify that surfaces and conditions are suitable prior to commencing work of this section. Do not proceed with installation until unsatisfactory conditions have been corrected.
 - 1. Do not proceed with installation until after minimum concrete curing period recommended by air/vapor barrier manufacturer.
 - 2. Ensure that surfaces are sound, dry, even, and free of oil, grease, dirt, excess mortar or other contaminants; concrete surfaces are cured and dry, smooth without large voids, spalled areas or sharp protrusions; masonry joints are flush and completely filled with mortar, and all excess mortar sitting on masonry ties has been removed.
 - 3. Verify substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D4263.

4. Notify Architect in writing of anticipated problems using air/vapor barrier over substrate prior to proceeding.

3.02 SURFACE PREPARATION

- A. Clean, prepare, and treat substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air/vapor barrier application.
 - 1. Prime masonry, concrete substrates with conditioning primer when installing modified asphalt membrane transition membranes.
 - 2. Prime glass-fiber surfaced gypsum sheathing an adequate number of coats to achieve required bond to transition membranes, with adequate drying time between coats.
 - 3. Prime wood, metal, and painted substrates with primer recommended by membrane manufacturer.
- B. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through air/vapor barrier and at protrusions according to air/vapor barrier manufacturer's written instructions.
- C. Mask and cover adjacent areas to protect from over spray.
- D. Ensure any required foam stop or back up material are in place to prevent over spray and achieve complete seal.
- E. Seal off existing ventilation equipment. Install temporary ducting and fans to ensure exhaust fumes. Provide for make-up air.
- F. Erect barriers, isolate area and post warning signs to advise non-protected personnel to avoid the spray area.
- G. Surfaces to receive foam insulation shall be clean, dry and properly fastened to ensure adhesion of the polyurethane foam to the substrate.
- H. Ensure that all work by other trades that may penetrate through the air barrier system is in place and complete.
- I. Ensure that surface preparation and any primers required conform to the manufacturers instructions.
- J. Prepare surfaces by brushing, scrubbing. Scraping, or grinding to remove loose mortar, dust, oil, grease, oxidation, mill scale and other contaminants which will affect adhesion and integrity of the spray polyurethane foam. Wipe down metal surfaces to remove release agents or other non- compatible coatings, using clean sponges or rags soaked in a solvent compatible with the spray polyurethane foam. Ensure surfaces are dry before proceeding.
- K. Install transition membranes to all applicable surfaces and ensure proper adhesion of the transition membranes to the substrate, capable of having spray polyurethane foam insulation.
- L. Install counter-flashings and counter-flashing membranes. All window and door openings to have counterflashing membrane.
- M. Ensure veneer anchors are in place.

3.03 INSTALLATION

- A. Spray-application of polyurethane foam shall be installed in accordance with ULC S705.2-02 and the manufacturers instructions. Apply only when surfaces and environmental conditions are within limits prescribed by the material manufacturer and the ULC S705.2 Installation standard.
- B. Apply in consecutive passes as recommended by manufacturer to thickness as indicated on drawings. Passes shall be not less than 1/2 inch and not greater than 2 inches.
- C. Do not install spray polyurethane foam within 3 inches of heat emitting devices such as light fixtures and chimneys.
- D. Finished surface of foam insulation to be free of voids and embedded foreign objects.
- E. Remove masking materials and over spray from adjacent areas immediately after foam surface has hardened. Ensure cleaning methods do not damage work performed by other sections.
- F. Trim, as required, any excess thickness that would interfere with the application of cladding/covering system by other trades.
- G. Clean and restore surfaces soiled or damaged by work of the section. Consult with section of work soiled before cleaning to ensure methods used will not damage the work. Do not permit adjacent work to be damaged by work of this section. Damage to work of this section caused by other sections shall be repaired by this section at the expense of the subcontractor causing the damage.
- H. Complete connections to other components or repair any gaps, holes or other damage using material which conforms to ULC S710.1
- I. Maximum variation from indicated thickness: minus (-) 1/4 inch; plus (+) 1/2 inch.

3.04 PROTECTION

- A. Protect the spray polyurethane foam from ultraviolet radiation when installed on the exterior of a building.
- B. Cover the spray polyurethane foam with a thermal barrier when installed on the interior of the building.

SUBMITTAL CHECK LIST

Product Data.

END OF SECTION 07 2119

SECTION 07 2216.04 - POLYISOCYANURATE ROOF INSULATION

PART 1 - GENERAL

1.01 WORK INCLUDED

Furnish labor, materials, equipment, special tools, supervision and services required to complete all roof insulation work indicated, noted, detailed and scheduled on the drawings and specified herein.

1.02 SUBMITTALS

- A. Submit for approval by the Architect, manufacturer's literature.
- C. Furnish certificate that insulation and roofing meet UL Class A assembly rating and Factory Mutual Class 1, I-90 classifications.

1.03 DELIVERY, STORAGE AND HANDLING

- A. Store under water resistant cover protected from weather and direct sunlight, and store above ground or roof deck on wood pallets.
- B. Handle boards carefully to prevent broken corners or split boards.
- C. Do not store boards on roof in such a manner as to overload capacity of structural components.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Provide one of the following approved products:
 - 1. "Firestone"; ISO 95+ Polyisocyanurate Insulation.
 - 2. "GenFlex"; ISO.
 - 3. "Versico Incorporated"; MP-H POLYISO.
- B. Polyisocyanurate Board Insulation:
 - 1. Reference Standards:
 - a. FS HH-I-1972/Gen.
 - b. FS HH-I-1972/2.
 - c. FS HH-I-1973/3.
 - d. ASTM C 209 Water Absorption.
 - e. ASTM E 96 Water Vapor Transmission of Materials.
 - f. ASTM D 1621 Compressive Strength.
 - g. ASTM D 1622 Density.

- h. ASTM D 2126 Dimensional Stability.
- i. ASTM E 84 Flame Spread.

2. Quality Control:

a. Verify insulation furnished is compatible with and suitable for the specified roofing system, including roofing conditions and installation procedures.

3. Description:

- a. Rigid cellular thermal insulation with glass-fiber reinforced polyisocyanurate closed-cell foam core and asphalt/glass fiber felt facing laminated to both sides.
- b. Complying with Federal Specification HH-I-1972/2.
- c. 20 psi minimum.
- d. Aged R-value of 5.56 per inch, minimum, at 75°F respectively.
- e. Nominal Size 48 inches x 48 inches.

4. Thickness:

a. Thickness as indicated on the Drawings (not including tapered saddles and crickets). If not indicated, provide 4 inches (with a minimum R-19).

5. Layers:

- a. Unless indicated otherwise, insulation is to be installed in two layers.
- b. One layer of insulation is allowed at the following conditions:
 - 1) Where total insulation thickness is 2 inches or less.
 - 2) Where an overlayment board is specified as part of the roof system, provided that the joints are staggered between the insulation board and the overlayment board.

C. Mechanical Anchors:

- 1. Reference Standards:
 - SAE 1022, Heat Treated.

2. Type:

- a. As recommended by insulation manufacturer for deck type, and complying with fire and insurance requirements.
- b. Fastener plates are to be a flat profile to minimize telegraphing through roof.

3. Description:

- a. Heavy-duty threaded fastener with 3-coat waterborne fluorocarbon polymer coating and drill point tip capable of penetrating 20-gauge steel.
- b. Fastener shall meet minimum thread size of .260 inches and 13 threads per inch.
- c. Length shall be sufficient to penetrate deck a minimum of 3/4 inch for steel.
- D. Mechanical fasteners shall be type, size, spacing and pattern as recommended by manufacture to meet Factory Mutual Class 1, 1-90 classification, and as approved by roof manufacturer for roof warranty requirements.

E. Adhesive Anchoring:

1. Where required, use high velocity insulation adhesive as recommended by membrane manufacturer and meeting FM 1-90.

PART 3 - EXECUTION

3.01 PREPARATION

A. Deck shall be rigid, tight, dry, smooth, clean and free from defects and damage.

3.02 APPLICATION

- A. Install roof insulation with joints staggered. Install and fasten at a rate to meet specified uplift requirements. Fasteners must meet an average pullout of 300 lbs. No gaps between boards, nailers and penetrations greater than 1/8 inch permitted.
- B. Do not install insulation which has been allowed to become wet, or has had any contact with water. Remove all insulation which becomes wet. Remove broken, delaminated and damaged insulation.
- C. Insulation on metal deck shall be installed with long edge parallel to the flutes.
- D. No more insulation shall be installed than can be covered with roofing and completed before the end of the day's work or before the onset of inclement weather.

3.03 FASTENING REQUIREMENTS - MECHANICALLY FASTENED INSULATION SYSTEM

- A. Design for Exposure Category C, 90 mph, 3 second gust. Provide calculations showing compliance with ASCE 7-98, SPRI, and FM requirements for wind uplift.
- B. Insulation Attachment Top Layer:
 - 1. Full depth of all layers of approved rigid insulation.
 - 2. Top Layer Attachment: Mechanically Attached.

3.03 CLEAN-UP

A. At completion of roofing insulation work remove all trash and debris from roof and site.

SUBMITTAL CHECK LIST

- 1. Manufacturer's Literature.
- 2. UL and FM Certificates.

END OF SECTION 07 2216.04

SECTION 07 2500 - WEATHER BARRIERS

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Weather Barrier Membrane / Air Infiltration Barrier.
- B. Seam Tape.
- C. Flashing.
- D. Fastener.

1.02 REFERENCES

A. ASTM International

- 1. ASTM C920; Standard Specification for Elastomeric Joint Sealants
- 2. ASTM C1193; Standard Guide for Use of Joint Sealants
- 3. ASTM D882; Test Method for Tensile Properties of Thin Plastic Sheeting
- 4. ASTM D1117; Standard Guide for Evaluating Non-woven Fabrics
- 5. ASTM E84; Test Method for Surface Burning Characteristics of Building Materials
- 6. ASTM E96; Test Method for Water Vapor Transmission of Materials
- 7. ASTM E1677; Specification for Air Retarder Material or System for Framed Building Walls
- 8. ASTM E2178; Test Method for Air Permeance of Building Materials
- 9. ASTM E2357; Standard Test Method for Determining Air Leakage of Air Barrier Assemblies
- B. AATCC American Association of Textile Chemists and Colorists
 - 1. Test Method 127 Water Resistance: Hydrostatic Pressure Test

C. TAPPI

- 1. Test Method T-410; Grams of Paper and Paperboard (Weight per Unit Area)
- 2. Test Method T-460; Air Resistance (Gurley Hill Method)

1.03 SUBMITTALS

- A. Refer to Section 01 3300-Submittal Procedures
- B. Product Data: Submit manufacturer current technical literature for each component.
- C. Samples: Weather Barrier Membrane, minimum 8-1/2 inches by 11 inch.
- D. Quality Assurance Submittals

- 1. Design Data, Test Reports: Provide manufacturer test reports indicating product compliance with indicated requirements.
- 2. Manufacturer Instructions: Provide manufacturer's written installation instructions.
- 3. Manufacturer's Field Service Reports: Provide site reports from authorized field service representative, indicating observation of weather barrier assembly installation.

E. Closeout Submittals

- 1. Refer to Section 01 7800 Closeout Submittals.
- 2. Weather Barrier Warranty: Manufacturer's executed warranty form with authorized signatures and endorsements indicating date of Substantial Completion.

1.04 QUALITY ASSURANCE

A. Qualifications

- 1. Installer shall have experience with installation of weather barrier assemblies under similar conditions.
- 2. Installation shall be in accordance with weather barrier manufacturer's installation guidelines and recommendations.
- 3. Source Limitations: Provide weather barrier and accessory materials produced by single manufacturer.

B. Mock-up

- 1. Install mock-up using approved weather barrier assembly including fasteners, flashing, tape and related accessories per manufacturer's current printed instructions and recommendations.
 - a. Mock-up size: 10 feet by 10 feet
 - b. Mock-up Substrate: Match wall assembly construction, including window opening.
 - c. Mock-up may remain as part of the work if approved by Architect.
 - d. Re-work and re-construct mock-up as necessary to meet Architect approval.
- 2. Contact manufacturer's designated representative prior to weather barrier assembly installation, to perform required mock-up visual inspection and analysis as required for warranty.

C. Pre-installation Meeting

- 1. Refer to Section 01 3119 Project Meetings.
- 2. Hold a pre-installation conference, two weeks prior to start of weather barrier installation. Attendees shall include Contractor, Architect, Construction Manager, Installer, Owner's Representative, and Weather Barrier Manufacturer's Designated Representative.
- 3. Review all related project requirements and submittals, status of substrate work and preparation, areas of potential conflict and interface, availability of weather barrier assembly materials and components, installer's training requirements, equipment, facilities and scaffolding, and coordinate methods, procedures and sequencing requirements for full and proper installation, integration and protection.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Refer to Section 01 6500 Product Delivery and Handling.
- B. Deliver weather barrier materials and components in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Store weather barrier materials as recommended by weather barrier manufacturer.
- D. Provide tarps as required. Manufacturer's shrink wrap alone is not sufficient protection.

1.06 <u>SCHEDULING</u>

- A. Review requirements for sequencing of installation of weather barrier assembly with installation of windows, doors, louvers and flashings to provide a weather-tight barrier assembly.
- B. Schedule installation of exterior cladding such that weather barrier is not directly exposed to elements for more than 60 days. Where cladding is delayed, provide inspection and repair of exposed weather barrier as required.

1.07 WARRANTY

- A. Refer to Section 01 7800-Closeout Submittals.
- B. Special Warranty
 - 1. Special weather-barrier manufacturer's warranty for weather barrier for a period of ten (10) years from date of final weather barrier installation.
 - 2. Pre-installation meetings and jobsite observations by weather barrier manufacturer for warranty is required prior to assembly installation.
 - 3. Warranty Areas: Entire building.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. DuPont; 4417 Lancaster Pike, Chestnut Run Plaza 728, Wilmington, DE 19805; 1-800-44-TYVEK (8-9835); http://www.construction.tyvek.com

2.02 MATERIALS

Basis of Design: spunbonded polyolefin, non-woven, non-perforated, weather barrier is based upon DuPont™ Tyvek® CommercialWrap® and related assembly components.

Performance Characteristics:

- 1. Air Penetration: 0.001 cfm/ft2 at 75 Pa, when tested in accordance with ASTM E2178. Type I per ASTM E1677. ≤0.04 cfm/ft2 at 75 Pa, when tested in accordance with ASTM E2357.
- 2. Water Vapor Transmission: 28 perms, when tested in accordance with ASTM E96, Method B.
- 3. Water Penetration Resistance: Minimum 280 cm when tested in accordance with AATCC Test Method 127.
- 4. Basis Weight: Minimum 2.7 oz/yd2, when tested in accordance with TAPPI Test Method T-410.
- 5. Air Resistance: Air infiltration at >1500 seconds, when tested in accordance with TAPPI Test Method T-460.
- 6. Tensile Strength: Minimum 38/35 lbs/in., when tested in accordance with ASTM D882, Method A.
- 7. Tear Resistance: 12/10 lbs., when tested in accordance with ASTM D1117.
- 8. Surface Burning Characteristics: Class A, when tested in accordance with ASTM E84. Flame Spread: 10, Smoke Developed: 10.

2.02 ACCESSORIES

- A. Seam Tape: As recommended by the weather barrier manufacturer.
- B. Fasteners. Provide the following as required for each type of construction:
 - 1. Steel Frame Construction:
 - 1-5/8 inch rust resistant screw with 2-inch diameter plastic cap or manufacturer approved 1-1/4" or 2" metal gasketed washer
 - 2. Wood Frame Construction: Nail Caps: #4 nails with large 1-inch plastic cap fasteners, or 1-inch plastic cap staples with leg length sufficient to achieve a minimum penetration of 5/8-inch into the wood stud.
 - 3. Masonry Construction: Masonry tap-con fasteners with Caps: 2-inch diameter plastic cap fasteners.

C. Sealants

- 1. Provide sealants that comply with ASTM C920, elastomeric polymer sealant to maintain watertight conditions
- 2. Products: Sealants recommended by the weather barrier manufacturer.

D. Adhesives:

- 1. Provide adhesive recommended by weather barrier manufacturer.
- 2. Products: Adhesives recommend by the weather barrier manufacturer.

E. Primers:

- 1. Provide flashing manufacturer recommended primer to assist in adhesion between substrate and flashing.
- 2. Products: Primers recommended by the flashing manufacturer.

F. Flashing

- 1. Flexible membrane flashing materials for window openings and penetrations recommended by manufacturer.
- 2. Straight flashing membrane materials for flashing windows and doors and sealing penetrations such as masonry ties, etc. recommended by manufacturer.
- 3. Thru-Wall flashing membrane materials for flashing at changes in direction or elevation (shelf angles, foundations, etc.) and at transitions between different assembly materials.
- 4. Preformed Inside and Outside Corners and End Dams: Preformed three-dimensional shapes to complete the flashing system used in conjunction with Thru-Wall Flashing.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify substrate and surface conditions are in accordance with weather barrier manufacturer recommended tolerances prior to installation of weather barrier and accessories.

3.02 INSTALLATION – WEATHER BARRIER

- A. Install weather barrier over exterior face of exterior wall substrate in accordance with manufacturer recommendations
- B. Install weather barrier prior to installation of windows and doors.
- C. Start weather barrier installation at a building corner, leaving 6-12 inches of weather barrier extended beyond corner to overlap.
- D. Install weather barrier in a horizontal manner starting at the lower portion of the wall surface with subsequent layers installed in a shingling manner to overlap lower layers. Maintain weather barrier plumb and level.
- E. Sill Plate Interface: Extend lower edge of weather barrier over sill plate interface 3-6 inches. Secure to foundation with elastomeric sealant as recommended by weather barrier manufacturer.
- F. Window and Door Openings: Extend weather barrier completely over openings.
- G. Overlap weather barrier
 - 1. Exterior corners: minimum 12 inches.
 - 2. Seams: minimum 6 inches.

- H. Weather Barrier Attachment. Provide the following as required for each type of construction::
 - 1. Steel or Wood Frame Construction: Attach weather barrier to study through exterior sheathing. Secure using weather barrier manufacturer recommend fasteners, space 12-18 inches vertically on center along stud line, and 24 inch on center, maximum horizontally.
 - Masonry Construction: Attach weather barrier to masonry. Secure using weather barrier manufacturer recommend fasteners, space 12-18 inches vertically on center and 24 inches maximum horizontally. Weather barrier may be temporarily attached to masonry using recommended adhesive, placed in vertical strips spaced 24 inches on center, when coordinated on the project site.
- I. Apply flashing to weather barrier membrane prior to installing cladding anchors.

3.03 <u>SEAMING</u>

- A. Seal seams of weather barrier with seam tape at all vertical and horizontal overlapping seams.
- B. Seal any tears or cuts as recommended by weather barrier manufacturer.
- C. Where furring for cladding or other construction is installed over the weather barrier, all fasteners through the weather barrier are to be applied over 12" long pieces of seam tape, or installed as otherwise required by manufacturer to maintain warranty.
- 3.04 OPENING PREPARATION (for use with non-flanged windows all cladding types)
 - A. Flush cut weather barrier at edge of sheathing around full perimeter of opening.
 - B. Cut a head flap at 45-degree angle in the weather barrier at window head to expose 8 inches of sheathing. Temporarily secure weather barrier flap away from sheathing with tape.
- 3.05 <u>FLASHING</u> (for use with non-flanged windows all cladding types)
 - A. Cut flexible flashing a minimum of 12 inches longer than width of sill rough opening.
 - B. Cover horizontal sill by aligning flexible flashing edge with inside edge of sill. Adhere to rough opening across sill and up jambs a minimum of 6 inches. Secure flashing tightly into corners by working in along the sill before adhering up the jambs.
 - C. Fan flexible flashing at bottom corners onto face of wall. Firmly press in place. Mechanically fasten fanned edges.
 - D. Apply 9-inch wide strips of flashing at jambs. Align flashing with interior edge of jamb framing. Start flashing at head of opening and lap sill flashing down to the sill.
 - E. Spray-apply primer to top 6 inches of jambs and exposed sheathing.
 - F. Install flexible flashing at opening head using same installation procedures used at sill. Overlap jamb flashing a minimum of 2 inches.

- G. Coordinate flashing with window installation.
- H. On exterior, install backer-rod in joint between window frame and flashed rough framing. Apply sealant at jambs and head, leaving sill unsealed. Apply sealants in accordance with sealant manufacturer's instructions and ASTM C1193.
- I. Position weather barrier head flap across head flashing. Adhere using flashing over the 45-degree seams.
- J. Tape top of window in accordance with manufacturer recommendations.
- K. On interior, install backer rod in joint between frame of window and flashed rough framing. Apply closed cell spray foam sealant around entire window perimeter and at all field mulled joints to create air seal. Apply sealant in accordance with sealant manufacturer's instructions and ASTM C1193.

3.06 OPENING PREPARATION (for use with flanged windows)

- A. Cut weather barrier in an "I-cut" or modified "I-cut" pattern as recommended by window manufacturer. "X-cut" patterns are not acceptable.
 - 1. Cut weather barrier horizontally along the bottom and top of the window opening.
 - 2. From the top center of the window opening, cut weather barrier vertically down to the sill...
 - 3. Fold side and bottom weather barrier flaps into window opening and fasten.
- B. Cut a head flap at 45-degree angle in the weather barrier at window head to expose 8 inches of sheathing. Temporarily secure weather barrier flap away from sheathing with tape.

3.07 <u>FLASHING</u> (for use with flanged windows)

- A. Cut flexible flashing a minimum of 12 inches longer than width of sill rough opening.
- B. Cover horizontal sill by aligning flexible flashing edge with inside edge of sill. Adhere to rough opening across sill and up jambs a minimum of 6 inches. Secure flashing tightly into corners by working in along the sill before adhering up the jambs.
- C. Fan flexible flashing at bottom corners onto face of wall. Firmly press in place. Mechanically fasten fanned edges if necessary.
- D. On exterior, apply continuous bead of sealant to wall or backside of window mounting flange across jambs and head. Do not apply sealant across sill.
- E. Install window according to manufacturer's instructions.
- F. Apply strips of flashing at jambs overlapping entire mounting flange. Extend jamb flashing 1-inch above top of rough opening and below bottom edge of sill flashing.

- G. Apply strip of flashing as head flashing overlapping the mounting flange. Head flashing should extend beyond outside edges of both jamb flashings.
- H. Position weather barrier head flap across head flashing. Adhere flashing over the 45-degree seams.
- I. Tape head flap in accordance with manufacturer recommendations.
- J. On interior, install backer rod in joint between frame of window and flashed rough framing. Apply closed cell spray foam sealant around entire window perimeter and at all field mulled joints to create air seal. Apply sealant in accordance with sealant manufacturer's instructions and ASTM C 1193.

3.08 THRU-WALL FLASHING INSTALLATION

- A. Apply primer per manufacturer's written instructions.
- B. Install preformed corners and end dams bedded in sealant in appropriate locations along wall.
- C. Starting at a corner, remove release sheet and apply membrane to primed surfaces in lengths of 8 to 10 feet.
- D. Extend membrane through wall and leave ¼ inch minimum exposed to form drip edge.
- E. Roll flashing into place. Ensure continuous and direct contact with substrate.
- F. Lap ends and overlap preformed corners 4 inches minimum. Seal all laps with sealant.
 - (Specifier Note: DELETE paragraph below if a metal drip edge is not required.)
- G. Trim exterior edge of membrane 1-inch and secure metal drip edge per manufacturer's written instructions.
 - (Specifier Note: DELETE option below when not required for project.)
- H. Terminate membrane on vertical wall. [Terminate into reglet, counterflashing or with termination bar.]
- I. Apply sealant bead at each termination.

3.09 THRU-WALL FLASHING / WEATHER BARRIER INTERFACE AT BASE OF WALL

- A. Overlap thru-wall flashing with weather barrier by 6-inches.
- B. Mechanically fasten bottom of weather barrier through top of thru-wall flashing.
- C. Seal vertical and horizontal seams with tape or sealing membrane.

3.10 THRU-WALL FLASHING / WEATHER BARRIER INTERFACE AT SHELF ANGLE

A. Seal weather barrier to bottom of shelf angle with sealing membrane.

- B. Apply thru-wall flashing to top of shelf angle. Overlap thru-wall flashing with weather barrier by 6-inches.
- C. Seal bottom of weather barrier to thru-wall flashing with tape or sealing membrane.

3.11 THRU-WALL FLASHING / WEATHER BARRIER INTERFACE AT WINDOW HEAD

- A. Cut flap in weather barrier at window head.
- B. Prime exposed sheathing.
- C. Install lintel as required. Verify end dams extend 4 inches minimum beyond opening.
- D. Install end dams bedded in sealant.
- E. Adhere 2 inches minimum thru-wall flashing to wall sheathing. Overlap lintel with thru-wall flashing and extend ¼ inch minimum beyond outside edge of lintel to form drip edge.
- F. Apply sealant along thru-wall flashing edges.
- G. Fold weather barrier flap back into place and tape bottom edge to thru-wall flashing.
- H. Tape diagonal cuts of weather barrier.
- I. Secure weather barrier flap with fasteners.

3.08 FIELD QUALITY CONTROL

A. Notify manufacturer's designated representative to obtain required periodic observations of weather barrier assembly installation.

3.09 PROTECTION

- A. Protect installed weather barrier from damage.
- B. Repair any portions of weather barrier damaged by exposure to elements. If underlying construction is damaged from exposure to elements, repair or replace. If any material which can support growth of mold is damaged by exposure to elements, material must be removed.

END OF SECTION 07 2500

SECTION 07 4213 - METAL WALL PANEL

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Metal wall panel assembly as indicated on Drawings and specified herein.
 - 1. Includes preformed sheet metal panels, related accessories, trim, corners, miscellaneous flashing and attaching devices for a complete watertight installation.
- B. Metal Wall Panel systems specified herein include:
 - 1. Metal Wall Panel (Concealed Fasteners Flush).

1.02 QUALITY ASSURANCE

- A. American Iron and Steel Institute AISI. "Light Gauge Cold-Formed Steel Design Manual".
- B. American Society of Testing Materials ASTM

A-116 Structural, Physical Quality of Galvanized Steel Sheet.

A-525 General Requirements for Galvanized Steel Sheet.

D-1056 Flexible Cellular Material.

B-209 Smooth or Stucco Embossed Prefinished Aluminum.

E-330-84 Test Method for Structural Performance by Uniform Static Air Pressure Difference.

C. SMACNA - Architectural Sheet Metal Manual.

1.03 SUBMITTALS

- A. Manufacturer's Literature:
 - 1. Published materials description and specifications for each type panel specified.
 - 2. Manufacturer's installation instructions for each type panel specified.
- B. Samples:
 - 1. 12" x 12" section of metal panel.
 - 2. Full size sample of clip and batten.
 - Samples showing manufacturer's full range of colors.
 Submit additional or larger samples of selected colors upon request.

C. Shop Drawings:

- Detailed drawings showing layout of panels, anchoring details, joint details, trim, flashing, and accessories.
- 2. Show details of weatherproofing, terminations and penetrations of metal work.
- 3. Show methods of installation and anchorage to accommodate thermal movement.

D. Warranty:

- 1. Submit copy of manufacturer's warranty.
- 2. Submit additional warranties as required by this Section.

1.04 DELIVERY, STORAGE AND HANDLING

A. Do not deliver roof materials to site until ready for installation. Comply with manufacturer's recommendations for handling storage and protection during installation.

1.05 WARRANTY

- A. Provide manufacturer's one year guarantee against defects in materials and workmanship, as delivered.
- B. Provide installers, separate two-year guarantee against defects in installed materials and workmanship, including water integrity. Guarantee shall begin with the date of Substantial Completion.
- C. Provide written warranty, signed by manufacturer stating painted wall panel finish will not check, flake, peel or chip for a period of fifteen (15) years, minimum.
 - 1. Film will not fade, peel or crack, ASTM D-1737.
 - 2. Abrasion resistance: will withstand 30 liters of falling sand before appearance of base metal, ASTM D-968.
 - 3. No checking, blistering or adhesion loss when tested for 5000 hours per ASTM G-23-69.
 - 4. Hardness: F-2H per ASTM D-3363.
 - 5. Humidity: less than 5% #8 blisters when tested for 1000 hours per ASTM D-2247 (100% humidity at 100°F).
 - 6. Salt-spray: maximum 3/16" creep and less than 5 #6 blisters when tested for 1000 hours per ASTM B117 (5% salt fog at 95°F).
- D. Provide written warranty, signed by manufacturer stated painted finish will not chalk or fade for a period of ten (10) years, minimum.
 - 1. Maximum chalk rating of 6 as measured by ASTM D659-44.
 - 2. Finish will not change color more than 1 degree in excess of 6 NBS units as measured by ASTM D-2244.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Metal Wall Panel (Concealed Fasteners - Flush):

- 1. Provide one of the following approved products:
 - a. "Metal Sales Manufacturing Corp."; Flush Face Series-12; #TLC-2.
 - b. "Fabral Metal Wall and Roof Systems"; Architectural Commercial Siding; Select Series 12-R2
 - c. "Metecno-Morin"; Concealed Fastener Panels; #F-12-2.
 - d. "Centria"; IW Series; #11-A.
 - e. "Firestone Building Products Company"; UNA-CLAD UC-500.
 - f. "MBCI"; Artisan Series #L12.
 - g. "Pac-Clad / Petersen Aluminum Corp."; Flush Panel 12".
 - h. "Dimensional Metals, Inc. (DMI)"; Flush Panel FP-10.

2. Panels:

- a. Roll formed G-90 galvanized steel.
- b. 12" panel width coverage.
- c. Concealed fastened panel.

3. Profile:

- a. 1" to 1-1/2" nominal panel height.
- b. Flush face solid surface.
- c. Two indented pencil ribs equally spaced in the width of the panel face.

4. Fasteners:

- a. Direct fastening through fastening leg at end of panel.
- b. Screws into structure to be #10-16x1" pancake head driller screws.
- c. Fasten per manufacturer's recommendation or at 48" o.c., minimum.
- d. Adjacent panel installed in tongue-and-groove type fashion to cover and conceal fastener.

B. Gauges:

- 1. 22 gauge minimum for panels up to 20' lengths.
- 2. 20 gauge minimum for panels exceeding 20' lengths.

C. Finish:

- 1. Exposed side: Kynar 500 (PVDF) with 10-year warranty.
- 2. Back side: Acrylic wash coat, 0.3 0.4 mil dry film thickness.
- Color as indicated on the Drawings. If not indicated, to be selected from manufacturer's entire selection, including premium colors. Various manufacturer's may need to custom match a color, if a specific manufacturer's color is indicated on the Drawings or specified herein, or to match an existing product.

D. Flashing and Trim:

- 1. Material:
 - a. C-90 galvanized steel.
 - b. Minimum 26 gauge.
- 2. Finish:
 - a. Kynar 500 (PVDF) with 10-year warranty.
 - b. Color to match wall panel.
- 3. Anchors:
 - Stainless steel.
 - b. Other nonferrous or coated galvanically compatible material as recommended by the metal wall panel manufacturer and as approved by the Architect.
- 4. Expansion and Control Joints:
 - a. As recommended by metal wall panel manufacturer.
- 5. Length:
 - a. Provide lengths as indicated on the Drawings.
 - b. If not indicated, provide minimum 10'-0" length with 6" splice plate to allow thermal movements.

E. Foam Closure:

- 1. Black closed cell foam meeting ASTM D1056. Closures to be supported and protected from weathering by a metal channel matching the flashing.
- 2. Provide tape and sealants with an indicated service life of 20 years.
- 3. Provide closures and pan-ends of panels at all exposed ends and corner conditions.

PART 3 - EXECUTION

3.01 INSPECTION

A. Examine conditions under which roofing is to be installed.

Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install wall panel system reversed to match existing, in accordance with manufacturer's instructions.
- B. System shall be capable of accommodating out-of-square and out-of-plumb conditions normally encountered in building construction.
- C. Remove strippable, protective vinyl film immediately after installation.

PROJECT NO. 24-179.000 Harrison REMC - Addition and Renovation Harrison REMC

METAL WALL PANELS 07 4213 - 5 04/24/2025

SUBMITTAL CHECK LIST

- 1. Manufacturer's Literature.
- 2. Samples.
- 3. Shop Drawings.
- 4. Warranty.

END OF SECTION 07 4213

SECTION 07 4293.01 - METAL SOFFIT PANEL

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Prefinished metal soffit panel as indicated on the Drawings and specified herein. Includes preformed sheet metal panels, related accessories, trim, corners, miscellaneous flashing and attaching devices for a complete watertight installation.

1.02 QUALITY ASSURANCE

- A. American Iron and Steel Institute AISI. "Light Gauge Cold-Formed Steel Design Manual".
- B. American Society of Testing Materials ASTM

A-116 Structural, Physical Quality of Galvanized Steel Sheet.

A-525 General Requirements for Galvanized Steel Sheet.

D-1056 Flexible Cellular Material.

B-209 Smooth or Stucco Embossed Prefinished Aluminum.

E-330-84 Test Method for Structural Performance by Uniform Static Air Pressure Difference.

C. SMACNA - Architectural Sheet Metal Manual.

1.03 SUBMITTALS

A. Product Data:

1. Manufacturer's published product data, cutsheets, specifications and installation instructions

B. Shop Drawings:

- 1. Showing soffit plan, trim and flashing details.
- 2. Show methods of installation, furring, anchorage to accommodate support and thermal movement.

C. Samples:

- 1. 12" x 12" section of metal panel.
- 2. Color samples of manufacturer's entire standard selection.

1.04 DELIVERY, STORAGE AND HANDLING

A. Do not deliver soffit materials to site until ready for installation. Comply with manufacturer's recommendations for handling storage and protection during installation.

1.05 WARRANTY

- A. Provide manufacturer's one year guarantee against defects in materials and workmanship, as delivered.
- B. Provide installers, separate two-year guarantee against defects in installed materials and workmanship, including water integrity. Guarantee shall begin with the date of substantial completion.
- C. Provide written warranty, signed by manufacturer stating painted soffit panel finish will not check, flake, peel or chip for a period of 15 years from date of substantial completion.
- D. Provide written warranty, signed by manufacturer stated painted finish will not chalk or fade for a period of ten (10) years.
 - 1. Maximum chalk rating of 6 as measured by ASTM D659-44.
 - 2. Finish will not change color more than 1 degree in excess of 6 NBS units.

PART 2 - PRODUCTS

2.01 MATERIAL

- A. Metal Soffit Panel (Solid):
 - 1. Provide one of the following approved products:
 - a. "Metal Sales Manufacturing Corp.", Soffit-Panel.
 - b. "Firestone Building Products Company"; UNA-CLAD UC-500.
 - 2. Panels:
 - a. Roll formed G-90 galvanized steel.
 - b. 24 gauge.
 - c. Concealed fastened panel.
 - d. 12" panel coverage width.
 - 3. Profile:
 - a. 1" panel depth.
 - b. Surface with one or two indented pencil V-grooves equally spaced in the width of the panel face.
 - c. Solid surface panel face.
 - 4. Fasteners:
 - a. Direct fastening through fastening leg at end of panel.
 - b. Screws into structure to be #10-16x1" pancake head driller screws.
 - c. Fasten per manufacturer's recommendation or at 48" o.c., minimum.

d. Adjacent panel installed in tongue-and-groove type fashion to cover and conceal fastener.

B. Finish:

- 1. Exposed side: Kynar 500 (PVDF) with 10-year warranty.
- 2. Back side: Acrylic wash coat, 0.3 0.4 mil dry film thickness.
- 3. Color: As selected by Architect from manufacturer's entire standard selection.
- 4. Custom colors may be required as selected by Architect or to match an existing product.

C. Flashing and Trim:

- 1. Material:
 - a. C-90 galvanized steel.
 - b. Minimum 26 gauge.
- 2. Finish:
 - a. Kynar 500 (PVDF) with 10-year warranty.
- 3. Anchors:
 - a. Stainless steel.
 - b. Other nonferrous or coated galvanically compatible material as recommended by the metal soffit panel manufacturer and as approved by the Architect.
- 4. Eschutcheon plates for trim around penetrations.
- 5. Expansion and Control Joints: As recommended by metal soffit panel manufacturer.
- 6. Length:
 - a. Provide lengths as indicated on the Drawings.
 - b. If not indicated, provide minimum 10'-0" length with 6" splice plate to allow thermal movements.

2.02 METAL SUPPORT, FURRING AND ACCESSORY MATERIALS

A. Metals and Finishes:

- 1. Manufacturer's standard steel products unless indicated as zinc alloy or other metal.
- 2. Provide manufacturer's standard galvanized finish on steel products.
- 3. Exterior components: Hot-dip galvanized finish; ASTM A 525 G90 for 18 gauge and lighter formed metal products, ASTM A 123 galvanized after fabrication for 16 gauge and heavier products.
- 4. Exterior Exposed Plastering Accessories: Provide zinc alloy accessories for exterior work.

B. Wire Ties:

1. Galvanized soft steel wire, 8 gauge min. for hanger wire.

C. Main Runners:

1. 1-1/2 inch Cold Rolled Channels, min. 0.475 lbs./ft.

PROJECT NO. 24-179.000 Harrison REMC - Addition and Renovation Harrison REMC

METAL SOFFIT PANEL 07 4293.01 - 4 04/24/2025

D. Furring:

1. 3/4 inch Cold Rolled Channels, min. 0.3 lbs./ft.

PART 3 - EXECUTION

3.01 INSPECTION

A. Examine conditions under which soffit is to be installed.

Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Anchorages:

- 1. Coordinate work with structural ceiling work in ensure that inserts and other structural anchorage provisions have been installed to receive soffit hangers.
- 2. Furnish inserts, steel deck hanger clip and similar devices to other trades for installation well in advance of time needed for coordination with other work.
- 3. Install furring, hangers, wires, and supports systems as required between and in addition to structural framing members.

3.03 INSTALLATION OF METAL SUPPORT SYSTEMS

A. General Isolation

- 1. Where work abuts overhead structure, isolate the work from structural movement sufficiently to prevent transfer of loading into the work from the building structure. Install slip or cushion type joints to absorb deflections but maintain lateral support.
- B. Main runners: 3'-0" o.c. maximum spacing.
- C. Furring: 2'-0" o.c. maximum spacing.
- D. Hanger wire: space to support max. 16 sq. ft. of ceiling area.
- E. Splices:
 - 1. Min. 12 inches for main runners.
 - 2. Min. 8 inches for furring.
 - 3. Tie with double loop 16 gauge wire at each end of splice.

3.04 INSTALLATION OF METAL SOFFIT PANEL

A. General:

- 1. Prior to installation, verify all dimensions and existing conditions.
- 2. Examine, clean and repair, if necessary any adjoining work to assure proper installation of soffit.
- B. System shall be capable of accommodating out-of-square and out-of-plumb conditions normally encountered in building construction.
- C. Install escutcheon plates and other trim around conduits, piping, vents and other penetrations to provide a finished appearance and weathertight closure.
- D. Install panels and accessories in strict accordance with manufacturer's published instructions.

3.05 CLEANING AND PROTECTION

A. Clean all aluminum work after installation and protect from damage until time of substantial completion.

SUBMITTAL CHECK LIST

- 1. Product Data.
- 2. Shop Drawings.
- 3. Samples.

END OF SECTION 07 4293.01

SECTION 07 6000 - FLASHING, SHEET METAL AND ROOF ACCESSORIES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. The extent of each type of flashing and sheet metal work is indicated on the drawings and by provisions of this section.
- B. The types of work specified in this section include, but are not limited to, the following:
 - 1. Metal edge flashing and coping.
 - 2. Metal wall flashing and expansion joint.
 - 3. Exposed metal trim/fascia units.
 - Miscellaneous sheet metal accessories.
 - 5. Metal gutters.
 - 6. Metal downspouts.
 - 7. Sheet metal flashing at windows and exterior doors.
- C. Gutters and downspouts may be either aluminum or galvanized steel as approved by the Architect.

The intent is that all metal work shall have the same and consistent finish so as to appear as a cohesive installation. Coordinate with coping, fascia, soffits, flashings, trim, etc.

1.02 QUALITY ASSURANCE

A. Sheet metal flashing and trim shall conform with recommended practices contained in "Architectural Sheet Metal Manual", Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA).

1.03 SUBMITTALS

A. Shop Drawings:

Show typical details of formed configuration, seams, joints, thicknesses, dimensions, fastening and anchoring methods.

- B. Samples:
 - 1. 6 inch x 6 inch piece of metal and each type fastener.
 - 2. Colors to be selected from manufacturer's entire standard selection.

1.04 JOB CONDITIONS

A. Coordinate work of this section with interfacing and adjoining work for proper sequencing of each installation. Insure best possible weather resistance and durability of the work and protection of materials and finishes.

FLASHING, SHEET METAL AND ROOF ACCESSORIES 07 6000 - 2 04/24/2025

B. Do not proceed with the installation of flashing and sheet metal work until curb and substrate construction, cant strips, blocking and other construction to receive the work is completed.

1.05 WARRANTY

A. The Project warranty provided by the Contractor shall include agreeing to repair or replace sheet metal and flashing which has failed to fulfill performance requirements of waterproofing due to defective materials, workmanship or improper installation, during the warranty period.

1.06 FINISHES

- A. As shown on the Drawings or as selected from manufacturer's entire selection.
- B. All colors and finishes are to be as selected by Architect.
- C. Custom color may be required to produce a match to that selected or to match existing building materials.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Stainless Steel:
 - 1. ASTM A 167, soft temper, Type 304.
 - 2. 26 gauge (.018 inches) sheet.
 - 3. Finish 2D, dull; ASTM A 480.
- B. Galvanized Steel:
 - 1. ASTM A 525, coating G90.
 - 2. Thickness (minimum):
 - a. 18 gauge.
 - b. 26 gauge flashing.
 - c. 24 gauge gutters.
 - d. 22 gauge, downspouts.

C. Aluminum:

- 1. ASTM B 209, Alloy 5005-H134.
- 2. Thickness (minimum):
 - a. .032 inches, or as otherwise indicated on Drawings.
 - b. .032 inches, gutters.
 - c. .032 inches, downspouts.
- 3. Finish: Fluoropolymer enamel.

FLASHING, SHEET METAL AND ROOF ACCESSORIES 07 6000 - 3 04/24/2025

D. Fasteners:

- 1. Stainless Steel nails, flat-head.
- 2. Galvanized steel, hot dipped, flat head.
- 3. Hard copper, brass or bronze, flat-head, 12 gauge for copper and lead coated copper.

E. Cleats:

- 1. 2 inches wide, 3 inches long piece of sheet metal.
- 2. 16 oz., unless otherwise specified.

F. Bituminous Paint:

1. Asphalt emulsion, ASTM D 1187, Type A.

G. Sealant:

1. One-part butyl rubber sealant, FS TT-S-00657, Type 1.

H. Metal Accessories:

1. Provide sheet metal clips, straps, anchoring devices and similar accessory units as required for installation of work, matching or compatible with material being installed, non-corrosive, size and gauge required for performance.

I. Coil Stock:

1. "Alcoa Aluminum" with Almalure 2000, 2-coat acrylic topcoat resin.

2.02 FABRICATION

A. Form metal flashing and trim to configurations indicated on the Drawings, free from defects which impair strength or mar appearance.

B. Seams:

- 1. Make seam in direction of flow.
- 2. Seams must be soldered or locked, unless otherwise approved.
- 3. Gutter and downspout seams may be lapped.
- 4. Standing seams shall finish not less than 1" high unless otherwise specified.
- 5. Flat-Lock Seams, Soldered and unsoldered: Finish not less than 3/4" wide.
- 7. Lap Seams, Unsoldered: Overlap 3" unless otherwise noted.
- 8. Loose-Lock Seams, Unsoldered: 3" common, or hook, seam, filled with sealant.
- C. All exposed edges not seamed shall be hemmed, bent back 1/2 inch to unexposed side.

FLASHING, SHEET METAL AND ROOF ACCESSORIES 07 6000 - 4 04/24/2025

D. Furnish edge strips where sheet metal extends over edges and where necessary to secure sheet metal work at fascia, gravel stops, etc. Form edge strips of compatible material.

PART 3 - EXECUTION

3.01 GENERAL

- A. Examine all surfaces to receive the metal flashing and trim. Verify all dimensions of in-place and subsequent construction. Installation of metal flashing and trim constitutes acceptance of the existing conditions.
- B. Surfaces to which sheet metal is to be applied shall be smooth, sound, clean, dry and free from defects that might affect the application.
- C. Erect all members plumb, level and in line securely anchored and properly related to other parts of the Work.
- D. Protect metal surfaces which are to be in contact with dissimilar metals, with wood or other absorptive material, with roofing felt, building paper or a coat of bituminous paint specified to prevent galvanic or corrosive action. Protection shall not extend onto exposed surfaces.

3.02 INSTALLATION

A. Base Flashing:

1. On roofing where shown, extend flashing up vertical surfaces not less than 8 inches unless otherwise shown, and 4 inches horizontally out on the roof.

B. Insert Flashing:

1. Preform, interlock and bed insert flashing, extend horizontally from face of wall to backing, extend vertically and insert in reglet: Secure as hereinafter specified.

C. Counterflashing:

1. Overlap base flashing 4 inches.

D. Securing Flashing and Reglets:

- 1. Open Slot Reglets:
 - Turn sheet metal into open slot reglets and secure with lead or copper plugs at approximately
 12 inches o.c.

2. Friction Type Reglets:

a. Turn sheet metal into friction type reglets and secure by indenting slot 12 inches o.c. with a dull punch or by means of "thumbnail" notches in sheet metal at 12 inches o.c.

FLASHING, SHEET METAL AND ROOF ACCESSORIES 07 6000 - 5 04/24/2025

E. Cleats:

 Where required to retain flashing, provide cleats specified, spaced not more than 12 inches o.c. Secure one end with two nails and fold clip back over nail heads. Lock free end of cleat into seam or into folded edge of sheet metal.

F. Roof Penetration Flashing:

- 1. Base Flashing:
 - a. Extend flange onto roof 6 inches minimum away from penetration.
 - b. Extent Flange upward around penetration to at least 2 inches above floor line.
 - c. Fold back upper an side roof flange edges 1/2 inch minimum.
 - d. Solder lap joints.
- 2. Counterflashing:
 - Provide sealant around penetrations through flashing.

G. Reglets:

1. Install in accurate location, straight in-line, with leakproof joints.

H. Drip Edge:

- 1. Extend 4 inches wide up from eave edge full eave length.
- 2. Set into asphalt flashing cement, full width.
- 3. Secure with aluminum annular ring nails 12 inches o.c.
- I. Base Flashing at shingle roof slope along vertical surface:
 - 1. Extend up vertical surface 8 inches minimum and onto roofing 4 inches minimum.
 - 2. Solder lap vertical seams; miter and solder lap corners.
 - 3. At sloped roof extend flashing from 2 inches above top edge to base shingle to 1-1/2 inches above butt edge of covering edge of shingle, extending 5 inches up vertical surface.
 - 4. Install flashing under each shingle course.
- J. Apron flashing at roof sloping away from vertical surface:
 - 1. Extend up vertical surface to first masonry joint (if applicable), and onto roofing minimum 4 inches.
 - 2. Hem bottom edge 1/2 inch.
 - 3. Lap seam vertical joints minimum 3 inches and apply sealant engaging hemmed edged.
 - 4. Miter and solder joints: extend minimum 3 inches around corners.
 - 5. Install bottom edge tight against roofing.
 - 6. Counter flash top edge.

K. Cricket Flashing:

- 1. Form to slope away from vertical surface.
- 2. Extend up vertical surface minimum 4 inches and 8 inches onto roof surface, with edges folded back 1/2 inch.
- 3. Solder lap joints: cleat to substrate.

L. Rake Flashing:

- 1. Extend horizontal flange 3 inches under roofing and nail to substrate.
- 2. Extend vertical face of fascia.
- 3. Lap seam joint in direction of flow.

M. Gutters:

- 1. 6", F-Style profile, unless otherwise indicated.
- 2. Continuous 10'-0" lengths with 6" splice plate to allow thermal movements.
- 3. Lap joints 1 inch minimum and rivet.
- 4. Fabricate outer edge 1/2 inch minimum lower than back edge.
- 5. Stiffen outer edge with hemmed return.
- 6. Secure end caps with 1 inch minimum width flanges riveted and sealed.
- 7. Secure gutter with matching metal straps spaced 2 feet apart maximum.
- 8. Locate and shape outlet thimble to fit downspouts and extend 2 inches below gutter soffit.
- 9. Rivet and seal thimble flanges to gutter bottom.

N. Downspouts:

- 1. 3" x 4", plain square profile, unless otherwise indicated.
- 2. Form with flat sheet material, plain rectangular size indicated.
- 3. Fabricate longitudinal joints with flat lock seams.
- 4. Telescope upper sections onto lower sections 1-1/2 inches minimum.
- Rivet and solder.
- 6. Attach to wall with 1 inch wide straps matching downspout material, 1 gauge heavier.
- 7. Locate straps at downspout tops, bottoms, and at 10 feet maximum centers.
- 8. Secure straps to wall with fastener heads covered with strap tabs.
- 9. Fit strainers tightly in each downspout.

3.03 CLEANING AND PROTECTION

- A. Remove all scraps and dirt as work progresses.
- B. Protect flashing and sheet metal work during construction to ensure that work will be without damage or deterioration, other than natural weathering, at time of substantial completion.

SUBMITTAL CHECK LIST

- 1. Shop Drawings.
- 2. Samples.

END OF SECTION 07 6000

SECTION 07 6113.02 - METAL ROOFING

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnish labor, materials, equipment, special tools, supervision and services required to complete the standing seam metal roofing work indicated, noted and detailed on the Drawings and specified herein.
- B. The roofing assembly generally includes, and not by way of limitation, preformed sheet metal panels, related accessories, valleys, hips, ridges eaves, corners, rakes, trims, underlayment, drainage and ventilation mat and miscellaneous flashing and attaching devices, for a complete watertight installation.
- C. Includes snow guard system attached to roof panel battens.

1.02 QUALITY ASSURANCE

- A. American Iron and Steel Institute (AISI) Light Gauge Cold-Formed Steel Design Manual.
- B. American Society of Testing Materials (ASTM):
 - 1. A-116 Structural, Physical Quality of Galvanized Steel Sheet.
 - 2. A-525 General Requirements for Galvanized Steel Sheet.
 - 3. D-1056 Flexible Cellular Material.
 - 4. B-209 Smooth or Stucco Embossed Prefinished Aluminum.
 - 5. E-330-84 Test Method for Structural Performance by Uniform Static Air Pressure Difference.
- C. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) -

Architectural Sheet Metal Manual.

1.03 SUBMITTALS

- A. Manufacturer's Literature:
 - 1. Published materials description and specifications for each type roof specified.
 - 2. Manufacturer's installation instructions for each type roof specified.
- B. Samples:
 - 1. 12" x 12" section of metal panel.
 - 2. Full size sample of clip and batten.
 - 3. Full size sample of snow guard system attached to a standing seam batten, with pipe attached.
 - 4. Samples showing manufacturer's full range of colors. Submit additional or larger samples of selected colors upon request.

C. Shop Drawings:

- 1. Detailed drawings showing roof plan, layout of panels, anchoring details, joint details, trim, flashing, gutters and accessories.
- 2. Show details of weatherproofing, terminations and penetrations of metal work.
- 3. Show methods of installation and anchorage to accommodate thermal movement.

D. Warranty:

- 1. Submit copy of manufacturer's warranty.
- 2. Submit additional warranties as required by this Section.

1.04 DELIVERY, STORAGE AND HANDLING

A. Do not deliver roof materials to site until ready for installation. Comply with manufacturer's recommendations for handling storage and protection during installation.

1.05 WARRANTY

- A. Provide roofing/fascia installers, separate two-year guarantee against defects in installed materials and workmanship, including water integrity. Guarantee shall begin with the date of Substantial Completion.
- B. Manufacturer shall provide a 20 year "NDL" (No Dollar Limit) Watertightness Warranty covering the materials and labor for the metal roof system. The Warranty shall not be pro-rated over the term of the warranty and shall not be limited to the original installation cost. Guarantee shall begin with the date of Substantial Completion.
- C. Provide written warranty, signed by manufacturer stating painted roof panel finish will not check, flake, peel or chip for a period of fifteen (15) years, minimum.
 - 1. Film will not fade, peel or crack, ASTM D-1737.
 - 2. Abrasion resistance: will withstand 30 liters of falling sand before appearance of base metal, ASTM D-968.
 - 3. No checking, blistering or adhesion loss when tested for 5000 hours per ASTM G-23-69.
 - 4. Hardness: F-2H per ASTM D-3363.
 - 5. Humidity: less than 5% #8 blisters when tested for 1000 hours per ASTM D-2247 (100% humidity at 100°F).
 - 6. Salt-spray: maximum 3/16" creep and less than 5 #6 blisters when tested for 1000 hours per ASTM B117 (5% salt fog at 95°F).
- D. Provide written warranty, signed by manufacturer stated painted finish will not chalk or fade for a period of ten (10) years, minimum.
 - 1. Maximum chalk rating of 6 as measured by ASTM D659-44.
 - 2. Finish will not change color more than 1 degree in excess of 6 NBS units as measured by ASTM D-2244.

E. Wind Rating:

1. UL 580 positive and negative pressure wind, passing a Class 90 rating.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Provide one of the following approved products:
 - 1. "Metal Sales Manufacturing Corporation", Vertical-Seam.
 - 2. "Petersen Aluminum", Snap-Clad.
 - 3. "MBCI", Lok-Seam.
 - 4. "Firestone Metal Products", Una-Clad UC4WTS.
 - 5. "Drexel Metals Corporation", DMC 175S.
 - 6. "DMI", Interlock.

2.02 METAL ROOF PANEL SYSTEM

- A. Non-Structural Standing Seam Metal Roof Panel:
 - 1. Material:
 - a. Roll formed, 24 gauge, G-90 hot-dipped galvanized steel.
 - b. Lengths to be continuous for full lengths, eave or gutter to ridge.
 - c. SHALL NOT OIL CAN. Oil canning WILL BE a cause for rejection, regardless of manufacturer's product literature or statements otherwise. Manufacturer shall submit heavier gauges, narrower widths or stiffening ribs as applicable for requirements of project to eliminate oil canning.
 - 2. Width:
 - a. 12 inch to 18 inch panel coverage, nominal to manufacturer's standard products, unless otherwise indicated.
 - 3. Ribs:
 - a. 1-1/2 inch minimum dimension, 2 inch maximum dimension.
 - b. Ribs to have continuous anchor reveals to allow anchor clips to resist positive and negative loading and allow expansion and contraction of panels due to thermal changes.
 - c. Factory-applied sealant to be installed at seam, which will not come in contact with the anchor clip and will not limit thermal movement of panel.
 - 4. Seam:
 - a. Continuous interlock with overlapping panel seam design.
 - b. Seams are snapped together as an integral interlocking system without the need for a mechanical seaming tool.

- Profile:
 - a. To be selected by Architect from manufacturer's entire selection of available profiles.
- 6. Anchor Clips:
 - a. Entirely concealed with concealed fasteners, where provided.
 - b. 16 gauge, G-90 hot-dipped galvanized steel.
 - c. Allow for thermal expansion and contraction between panels.
- 7. Fasteners:
 - a. Entirely concealed.
 - b. Stainless steel sheet metal screws.
- 8. Finish:
 - a. Top side: Kynar 500 Fluorocarbon coating applied on a continuous coil coating line. Dry film thickness of 0.70 to 0.90 mil over 0.25 to 0.35 prime coat. Total thickness to be 0.95 to 1.25.
 - b. Bottom side: Acrylic wash coat, 0.3 -0.4 mil dry film thickness.
 - c. Color to be selected from manufacturer's entire selection, including premium colors. Various manufacturer's may need to custom match a color, if a specific manufacturer's color is indicated on the Drawings or specified herein, or to match an existing product.

B. Flashing and Trim:

- 1. Material:
 - a. C-90 galvanized steel.
 - b. Minimum 24 gauge.
- 2. Finish:
 - a. Kynar 500 coating with 20-year warranty.
 - b. Color to match roof panel.
- 3. Anchors:
 - a. Stainless steel.
 - b. Other nonferrous or coated galvanically compatible material as recommended by the metal wall panel manufacturer and as approved by the Architect.
- 4. Expansion and Control Joints:
 - a. As recommended by metal roof manufacturer.
- 5. Length:
 - a. Continuous 10'-0" lengths with 6" splice plate to allow thermal movements.

C. Gutters:

- 1. As specified in Section 07 6000 Flashing, Sheet Metal and Roof Accessories.
- 2. Color to match roof panel.

D. Foam Closure:

- 1. Black closed cell foam meeting ASTM D1056. Closures to be supported and protected from weathering by a metal channel matching the roof flashing.
- 2. Provide tape and sealants with an indicated service life of 20 years.
- 3. Provide closures and pan-ends of panels at all exposed edges and ridge conditions.

2.03 STRUCTURAL PERFORMANCE

- A. Uniform load capacity shall be determined by testing in accordance with the principals of ASTM E 330 Adapted to testing of formed sheet panels by additions to specific sections as follows:
 - 1. Roof test specimens shall be representative of the main body of the roof, free from influence of perimeter conditions. The setup shall be continuous over one or more supports and contain at least five panel widths for standing seam roofing.
 - No roof attachments are permitted at the sides other than the standard gable or rake condition. For uplift tests, at least one end seal shall be flexible and in no way restrain the crosswise distortion of panels. One end may simulate an eve condition if at least 12 feet away from the mid-roof clip under elevation.
 - 3. Roofing panels and accessories are to be production material of the same type and thickness proposed for use on the project.
 - 4. Longitudinal seals or plastic film shall not span any crevice or cracks that may tend to separate under pressure.

2.04 UNDERLAYMENT

- A. Provide one of the following approved products:
 - 1. "Grace Building Products"; Ice and Water Shield.
 - 2. "Soprema"; Lastobond.
 - 3. "Mid-States Asphalt"; Quik-Stick HT.
 - 4. "InterWrap"; Titanium UDL.
 - 5. "DMI"; Ultra HT Wind and Water Seal.
- B. Provide beneath entire finished roof surface.

2.05 DRAINAGE AND VENTILATION MAT

- A. Provide one of the following approved products:
 - 1. "Bonar, Inc."; Enkamat ASV 7010.
 - 2. "Rheinzink"; Air-Z.
- B. Provide beneath entire finished roof surface, atop the underlayment, whether indicated on the Drawings or not.
- C. Mat consisting of a nylon core of fused, entangled filaments.

2.06 SNOW GUARD SYSTEM

- A. Provide one of the following approved products:
 - 1. "Alpine SnowGuards", SnowMax.
 - 2. "S-5!"; ColorGard.

B. Description:

- 1. Clamp to the seam, single cross member aluminum snowguard system for standing seam roofs.
- 2. Block and flag assembly brackets attach directly over the standing seam batten and are secured via set screws.
- 3. Spacing of brackets to be per the manufacturer's requirements for retained snow loads and warranty, but no further than 48 inches o.c.
- 4. Single, flat, 2" high cross member spanning perpendicular to the standing seam battens and attaching to each bracket.
- 5. Provide prefinished color strip infill panel to insert into the visible face of the cross member. Color to match roofing panel.
- 6. System shall engage the seam for a secure installation, but not penetrate the roof panel or any other component of the roof system.
- 7. Provide all required fasteners and components complete.

C. Additional Requirements:

- 1. Provide the appropriate snowguard, block and flag assembly, brackets, fasteners, clamps, tubing, couplings, plugs, caps, flags, collars, components and accessories as required for the roof system.
- 2. Verify compatibility of the clamps and brackets with the size, shape, profile and configuration of the roof panels and battens for a proper installation.
- 3. Manufacturer of roofing system shall approve the snow guard system as not voiding any of the warranty requirements of the roofing system.

D. Finish:

- 1. All components to be powder coated finish, all exposed surfaces, items and components.
- 2. Color to match roof system panels.

PART 3 - EXECUTION

3.01 INSPECTION

A. Examine conditions under which roofing is to be installed. Do no proceed with installation until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install roof system in accordance with manufacturer's instructions and approved shop drawing details.

- B. System shall be capable of accommodating out-of-square and out-of-plumb conditions normally encountered in building construction.
- C. Do not use seaming tools that will damage panel finish.
- D. Remove strippable, protective vinyl film immediately after installation.

3.03 CLEANING

- A. Clean grease, finger marks or stains from the panels per manufacturer's recommendations.
- B. Remove all scrap and construction debris associated with roofing from the site.

SUBMITTAL CHECK LIST

- 1. Manufacturer's Literature.
- 2. Samples.
- 3. Shop Drawings.
- 4. Warranty.

END OF SECTION 07 6113.02

SECTION 07 8400 - FIRESTOPPING

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Firestopping for fire-rated construction, this includes:
 - 1. All openings in fire rated wall assembles, both blank (empty) and those accommodating penetrating items such as cables, conduits, pipes ducts, etc.

1.02 REFERENCES

- A. American Society for Testing and Material Standards (ASTM):
 - 1. ASTM E814-88: Standard Test method for Fire Tests of Through-Penetration Firestops.
- B. Underwriters Laboratories, Inc. (UL):
 - 1. UL 1479 Fire Tests of Through Penetration Firestops (Consult UL Fire Resistance Directory).

1.03 QUALITY ASSURANCE

- A. Firestopping systems (materials and design) shall conform to both Flame (F) and Temperature (T) ratings as required by local building code and as tested by nationally accepted test agencies per ASTM E814 or UL 1479 fire tests in a configuration that is representative of field conditions. The F rating must be a minimum of one (1) hour but not less than the fire resistance rating of the assembly being penetrated. T rating when required by code authority shall be based on measurement of the temperature rise on penetrating item(s). The fire test shall be conducted with a minimum positive pressure differential of 0.01 inches of water column.
- B. Firestopping materials and systems must be capable of closing or filling through-openings created by:
 - 1. The burning or melting of combustible pipes, cable jacketing, or pipe insulating materials, or
 - 2. Deflection of sheet metal due to thermal expansion (electrical & mechanical duct work).
- C. Firestopping material shall be asbestos free and shall not incorporate nor require the use of hazardous solvents.
- D. Firestopping materials shall not shrink upon drying as evidenced by cracking or pulling back from contact surfaces.
- E. Do not use any firestopping products which after curing dissolve in water.
- F. All firestopping materials shall be manufactured by one manufacturer (to the maximum extent possible).

- G. Installation of Firestopping systems shall be performed by a contractor (or contractors) trained or approved by the Firestop manufacturer.
- H. Installation of firestopping systems shall be performed by a contractor (or contractors) trained or approved by the firestopping manufacturer.
- I. Equipment used shall be in accordance with the Manufacturer's written installation instructions.

1.04 SUBMITTALS

A. Manufacturer's Data Sheets:

- 1. Submit manufacturer's product literature for each type of firestopping material to be installed. Literature shall indicate product characteristics, typical uses, performance and limitation criteria and test data.
- 2. Material Safety Data Sheets (MSDS) for each firestop product.
- 3. Submit manufacturer's installation procedures for each type of product.

B. Shop Drawings:

- 1. Show typical installation details for the methods of installation.
- 2. Indicate which firestop materials will be used, where, and thickness for different hourly ratings.

C. UL Test Data:

- 1. Submit UL test data sheet and assembly information.
- 2. Identify by UL number the system for which the product comprises or is a part of.
- 3. Identify approved tested hourly rating.
- 4. Identify flame (F) and temperature (T) ratings.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver material in the manufacturer's original, unopened containers or packages with the manufacturer's name, product identification, lot number, UL label and mixing and installation instructions as applicable.
- B. Store materials in the original, unopened containers or packages, or under conditions recommended by the manufacturer.
- C. All firestopping materials shall be installed prior to expiration of shelf life.

1.06 PROJECT CONDITIONS

A. Conform to Manufacturer's printed instructions for installation and when applicable, curing in accordance with temperature and humidity. Conform to ventilation and safety requirements.

1.07 SEQUENCING

- A. Coordinate this work as required with the work of other trades.
- B. Firestopping shall precede gypsum board finishing.

1.08 PROTECTION

A. Where firestopping is installed at locations which will remain exposed in the completed work, provide protection as necessary to prevent damage to adjacent surfaces and finishes, and protect as necessary against damage from other construction activities.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Firestopping materials and systems shall meet the requirements specified herein.
- B. Architect must approve in writing any alternates to the materials and systems specified herein.
- C. All firestop products and systems shall be designed and installed so the basic sealing system will allow the full restoration of the thermal and fire resistance properties of the barrier being penetrated with minimal repair if penetrants are subsequently removed.

2.02 ACCEPTABLE MANUFACTURERS

- A. Provide products, as approved by the Architect, by one of the following approved manufacturers:
 - 1. "Specified Technologies Inc." (STI)
 - 2. "Dow Corning Corp." (Dow)
 - 3. "3M Fire Protection Products" (3M)

2.03 MATERIALS

- A. Firestop Mortar:
 - 1. "STI", SpecSeal Mortar.
- B. Firestop Sealants and Caulks:
 - 1. "STI SpecSeal Sealant
 - 2. "Dow", Firestop Sealant No. 2000
 - 3. "3M", CP25WB+ Caulk

- C. Firestop Putty:
 - 1. "STI", SpecSeal Firestop Putty Bars and Pads
 - 2. "3M", MPS-2 Moldable putty Stix and Putty Pads
- D. Firestop Collars:
 - 1. "STI", SpecSeal Firestop Collars
 - 2. "3M", PPD Collars
- E. Wrap Strips:
 - 1. "STI", SpecSeal Wrap Strip
 - 2. "3M", FS-195 Wrap Strip
- F. Accessories:
 - 1. Forming/Damming Materials: Mineral fiberboard or other type recommended by Manufacturer.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Examine the areas and conditions where firestopping is to be installed and notify the Architect of conditions determined to the proper and timely completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected by the contractor in a manner acceptable to the Architect.
- B. Verify that environmental conditions are safe and suitable for installation of firestopping products.

3.02 CONDITIONS REQUIRING FIRESTOPPING

A. General:

- 1. All through-penetrations, construction gaps, joints and through openings occurring in fire-rated wall assemblies.
- 2. Insulation types specified in other Sections shall not be installed in lieu of firestopping material specified herein.
- 3. All combustible penetrants (I.E. non-metallic pipes or insulated metallic pipes) shall be firestopped using products and systems tested in a configuration representative of the field condition.

3.03 INSTALLATION

A. General:

- 1. Installation of firestopping shall be preformed by a applicator/installer qualified and trained by the manufacturer. Installation shall be preformed in strict accordance with manufacturer's detailed installation procedures.
- 2. Apply firestopping in accordance with fire test reports, fire resistance requirements, acceptable sample installations, and manufacturer's recommendations.
- 3. Coordinate with plumbing, mechanical, electrical and other trades to assure that all pipe, conduit, cable and other items which penetrate fire-rated construction have been permanently installed prior to installation of firestopping. Schedule and sequence the work to assure that partitions and other construction which would conceal penetrations are not erected prior to the installation of firestopping.
- 4. Unless specified and approved, all insulations used in conjunction with through-penetrants shall remain intact and undamaged and may not be removed.

B. Dam Construction:

 When required to properly contain firestopping materials within openings, damming or packing materials may be utilized. Combustible damming material must be removed after appropriate curing. Noncombustible damming materials may be left as permanent component of the firestopping system.

C. Field Quality Control:

- 1. Prepare and install firestopping systems in accordance with manufacturer's printed instructions and recommendations.
- 2. Follow safety procedures recommended in the Material Safety Data Sheets.
- 3. Finish surfaces of firestopping which are to remain exposed in the completed work to a uniform and level condition.
- 4. All areas of work must be accessible until inspection by the applicable Code Authorities.
- 5. Correct unacceptable firestops and provide additional inspection to verify compliance with this specification at no additional cost.

3.04 CLEANING

- 1. Removing spilled and excess materials adjacent to firestopping without damaging adjacent surfaces.
- 2. Leave finished work in neat, clean condition with no evidence of spillovers or damage to adjacent surfaces.

SUBMITTAL CHECKLIST

- 1. Manufacturer's Data Sheets.
- 2 Shop Drawings.
- 3. UL Test Data.

END OF SECTION 07 8400

SECTION 07 9200 - JOINT SEALERS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. The extent of each form and type of joint sealer as indicated on the Drawings and specified herein.
- B. Types of joint sealants specified herein include:
 - 1. Elastomeric Sealants.
 - 2. Non-Elastomeric Sealants and Caulking Compounds.
- C. In general, all joints are to have joint sealers, including but not limited to the following:
 - 1. Sidewalk Joints.
 - 2. Expansion and control joints.
 - 3. Flashing and coping joints.
 - 4. Interior wall/ceiling/door/window frame joints.
 - 5. Joints between dissimilar materials.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Refer to Division 3 concrete surfaces.
- B. Refer to Division 8 sections for glazing requirements.
- C. Refer to sections of Division 22, 23 and 26 for joint sealers in mechanical and electrical work.

1.03 QUALITY ASSURANCE

A. Except as otherwise indicated, joint sealers are required to establish and maintain airtight and waterproof continuous seals on a permanent basis, within recognized limitations of wear and aging as indicated for each application. Failures of installed sealers to comply with this requirement will be recognized as failures of materials and workmanship.

1.04 SUBMITTALS

A. Product Data:

1. Submit manufacturer's product specifications, handling/installation/curing instructions and performance tested data sheets for each elastomeric product required.

2. Submit certified test reports for elastomeric sealants on aged performances as specified, including hardness, stain resistance, adhesion, cohesion or tensile strength, elongation, low-temperature flexibility, compression set, modulus of elasticity, water absorption, and resistance (aging, weight loss, deterioration) to heat and exposures to ozone and ultraviolet light.

B. Samples:

- 1. Submit color charts for selection.
- 2. Colors to be selected by Architect from manufacturer's entire selection.
- 3. Multiple colors may be selected for differing substrates and/or conditions throughout the project.

1.05 JOB CONDITIONS

A. Do not proceed with installation of liquid sealants under unfavorable weather conditions. Install elastomeric sealants when temperature is in lower third of temperature range recommended by manufacturer for installation.

1.06 WARRANTY

A. The Contractor shall provide a warranty against failure of sealant materials and workmanship including replacement of other materials damaged as a result of sealant failure for five (5) years from the date of Substantial Completion. Typical for all sealants at all locations and conditions, unless otherwise indicated.

PART 2 - PRODUCTS

2.01 GENERAL

A. General Sealer Requirements:

- 1. Select materials for compatibility with joint surfaces and other indicated exposures, and except as otherwise indicated, select modulus of elasticity and hardness or grade recommended by manufacturer for each application indicated.
- 2. Where exposed to foot traffic, select non-tracking materials of sufficient strength and hardness to withstand "stiletto" heel traffic without damage or deterioration of sealer system.
- 3. Provide colors as selected by Architect from the manufacturer's entire available color selection. Colors are to be selected for each differing material and condition. Various colors of each product are to be expected.

2.02 ACCEPTABLE MANUFACTURERS

- A. Provide products, as approved by the Architect, by one of the following approved manufacturers:
 - 1. Manufacturers of Elastomeric Sealants (Liquid):
 - a. "Sonneborn / BASF Building Systems"
 - b. "Tremco, Inc."

- c. "Capital Services"
- d. "DOW Corning"
- 2. Manufacturers of Non-Elastomeric Sealants (Liquid/Tape):
 - a. "Sonneborn / BASF Building Systems"
 - b. "Tremco, Inc."
 - c. "Capital Services"
 - d. "DOW Corning"
- 3. Manufacturers of Joint Fillers/Sealant Backers:
 - a. "Sonneborn / BASF Building Systems"
 - b. "Backer Rod Mfr. & Supply Co."
 - c. "Williams Products, Inc."

2.03 ELASTOMERIC SEALANTS

- A. For use at interior/exterior joints subject to movement: control joints, expansion joints, etc.
- B. Multi-Component Polyurethane Sealant: Except as otherwise indicated, provide manufacturer's standard, non-modified, 2-or-more-part, polyurethane-base, elastomeric sealant; complying with ASTM C920 Type M Class 25, non-sag grade/type.
- C. Modulus and Hardness: Where self-leveling grade/type is required, provide sealant with cured modulus of elasticity at 100% elongation of not more than 150 psi (ASTM D 412 test procedure), and Shore A hardness of not less than 55 (ASTM D 2240). Where non-sag grade/type is required, provide sealant with cured modulus of elasticity at 100% elongation of not more than 75 psi and Shore A hardness of 20 to 30.
- D. Tear Resistance: Not less than 50 lb. per inch (ASTM D 624).
- E. Acceptable Products:
 - 1. "Sonneborn". Sonolastic NP 1.
 - 2. "Sonneborn", Sonolastic NP 2.
 - 3. "Sonneborn", Sonolastic SL I.
 - 4. "Tremco", Dymeric.

2.04 NON-ELASTOMERIC SEALANTS AND CAULKING COMPOUNDS

- A. For general use as an exposed building construction sealant provide acrylic terpolymer, solvent-based, one-part, thermo-plastic sealant compound; solids not less than 95% acrylic.
- B. Performance Standard: Comply with either ASTM C 920 Type S Class 12-1/2 Grade NS or Class B Type Non-Sag.
- C. Bond and Cohesion: Comply with ASTM C 910, with less than 0.50 square inches of combined cohesion and bond failure for three (3) samples.

D. Acceptable Products:

- 1. "Sonneborn", Sonolac.
- 2. "Tremco", Mono.

2.05 MISCELLANEOUS MATERIALS

A. Joint Primer/Sealer:

Provide type of joint primer/sealer recommended by sealant manufacturer for joint surfaces to be primed or sealed.

B. Bond Breaker Tape:

Provide Polyethylene tape or other plastic tape as recommended by sealant manufacturer; to be applied to sealant-contact surfaces where bond to substrate or joint filler must be avoided for proper performance of sealant. Provide self-adhesive tape where applicable.

C. Sealant Backer Rod:

Provide compressible rod stock of polyethylene foam, polyurethane foam, polyethylene jacketed polyurethane foam, butyl rubber foam, neoprene foam or other flexible, permanent, durable non-absorptive material as recommended by sealant manufacturer for back-up of, and compatibility with sealant.

PART 3 - EXECUTION

3.01 PREPARATION

A. Examine substrates, (joint surfaces) and conditions under which joint sealer work is to be performed. Do not proceed with joint sealer work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Clean joint surfaces immediately before installation of sealants. Remove dirt, insecure coating, moisture and other substrates which could interfere with bond of sealant. Etch concrete and masonry joint surfaces as recommended by sealant manufacturer. Roughen vitreous and glazed joint surfaces as recommended by sealant manufacturer.
- B. Set joint filler units at depth or position in joint as indicated to coordinate with other work, including installation of bond breakers, backer rods and sealants. Do not leave voids or gaps between ends of joint filler units.
- C. Install sealant backer rod for liquid-applied sealants, except where shown to be omitted or recommended to be omitted by sealant manufacturer for application indicated. Install backer rod at all areas required for proper installation of sealant.

- D. Install backer rods at any location necessary for proper installation of all sealants, whether shown on drawings or not.
- E. Install bond breaker tape where indicated and where required by manufacturer's recommendations to insure that liquid-applied sealants will perform as intended.
- F. Employ only proven installation techniques, which will insure that sealants are deposited in uniform, continuous ribbons without gaps or air pockets, with complete "wetting" of joint bond surfaces equally on opposite sides. Except as otherwise indicated, fill joints with sealant to a slightly concave surface slightly below adjoining surfaces. Where horizontal joints are between a horizontal surface and vertical surfaces, fill joint to form a slight cove, so that joint will not trap moisture and dirt.
- G. Install liquid applied sealant to depths as shown or, if not shown, as recommended by sealant manufacturer but within the following general limitations:
 - 1. For normal moving joints sealed with elastomeric sealants but not subject to traffic, fill joints to a depth equal to 50% of joint width, but neither more than 1/2 inch deep nor less than 1/4 inch deep.
 - 2. For joints sealed with non-elastomeric sealants and caulking compounds, fill joints to a depth in range of 75% to 125% of joint width.
- H. Do not allow sealants or compounds to overflow from confines of joints, or to spill onto adjoining work, or to migrate into voids of exposed finishes. Clean adjoining surfaces by whatever means may be necessary to eliminate evidence of spillage.
- I. Do not overheat or reheat hot-applied sealants.

3.03 PROTECTION

- A. Cure sealant compounds in compliance with manufacturer's instructions and recommendations, to obtain high early bond strength, internal cohesive strength and surface durability.
- B. Protect joint sealers during construction period, so that they will be without deterioration or damage (other than normal wear and weathering) at time of substantial completion. Replace or restore sealants which are damaged or deteriorated during construction period.

SUBMITTAL CHECK LIST

- 1. Product Data.
- 2. Warranty.

END OF SECTION 07 9200

SECTION 08 1113 - STEEL DOORS AND FRAMES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Hollow metal doors and frames as shown on the Drawings and specified herein, including:
 - 1. Hollow steel doors and frames.
 - 2. Hollow steel frames for wood doors.
 - 3. Hollow steel frames for FRP flush doors.
 - 4. Hollow metal frames for glass.
 - 5. Modifying existing hollow metal doors and frames.
 - 6. Rough bucks, frame reinforcing, door reinforcing, door insulation, closer reinforcements, clip angles and anchorage.
 - 7. Factory prime paint finish.
 - 8. Grouting of hollow metal frames with masonry mortar where not covered under other Sections.

1.02 REFERENCES

- A. The following standards, tests and publications may be referred to herein and are applicable to this Section:
 - ANSI A250.8-1998/SDI-100 Recommended Specifications Standard Steel Doors and, Steel Door Institute, unless herein specified.
 - 2. UL 10C-98 and UBC 7-2 Positive Pressure Fire Tests of Door Assemblies.
 - 3. NFPA-80-1999 Standard for Fire Doors and Windows.
 - 4. NFPA-101-1997 Life Safety Code.
 - 5. NFPA-105 Standard for Smoke and Draft Control Assemblies.
 - 6. ASTM-A 366-95A Specification for Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality.
 - 7. ASTM-A 568-95 Specification for Steel, Sheet, Carbon, and High Strength, Low-Alloy, Hot-Rolled, and Cold-Rolled.
 - 8. ASTM-A 569-91a Specification for Steel, Carbon, (0.15 maximum percent), Hot-Rolled Sheet and Strip Commercial Quality.
 - 9. ASTM-A 924-95 General Requirements for Steel Sheet, Metallic Coated by the Hot-Dip Process.
 - 10. SDI-105-92 Recommended Erection Instructions for Steel Frames.
 - 11. ANSI A115.1-.18 Specification for Door and Frame Preparation for Hardware.
 - 12. ANSI A156.7 Standard Template Hinge Dimensions.

1.03 SUBMITTALS

A. Product Data:

- 1. Manufacturer's specifications for fabrication and installation, including data substantiating products comply with requirements.
- 2. Manufacturer's published product data sheets.

B. Shop Drawings:

- 1. Show type of door and frame for each opening, sections of all typical members, dimensioned elevations, anchors, reinforcements and other required components.
- 2. Preparation for installing hardware and glazing.

1.04 QUALITY ASSURANCE

- A. Provide doors and frames complying with Steel Door Institute "Recommended Specifications: Standard Steel Doors and Frames" (SDI-100) and as herein specified.
- B. Wind Load Performance Requirements: Comply with wind load requirements of the applicable State Building Code. Deflection shall not exceed 1/175 of span.
- C. Supplier Qualification: Qualified direct distributor of products to be furnished. The distributor shall have in their regular employment an A.H.C./C.D.C. or person of equivalent experience who will be available at reasonable times to consult with the Architect, Contractor and/or Owner regarding any matters affecting the total door and frame openings.
- D. Installer Qualification: Experience with installation of similar materials.
- E. Fire-Rated Door Assemblies: Where fire-rated door assemblies are indicated or required, provide fire-rated door and frame assemblies that comply with NFPA 80 "Standard for Fire Doors and Windows", and have been tested, listed, and labeled in accordance with ASTM E152 "Standard Methods of Fire Tests of Door Assemblies" by nationally recognized independent testing and inspection agency acceptable to authorities having jurisdiction.
 - Oversize Fire-Rated Door Assemblies: For door assemblies required to be fire-rated and exceeding sizes of tested assemblies, provide certificate or label from approved independent testing and inspection agency, indicating that door and frame assembly conforms to requirements of design, materials and construction as established by individual listings for tested assemblies.
 - 2. Temperature Rise Rating: At stairwell enclosures, provide doors which have Temperature Rise Rating of 450 degrees F maximum in 30 minutes of fire exposure.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver, handle and store doors and frames at the job site in such a manner as to prevent damage.
- B. Remove all damaged or otherwise unsuitable doors and frames.
- C. Deliver hollow metal doors in manufacturer's protective covering. Handle hollow metal with care to prevent damage.
- D. Door Storage: Store doors in upright position, under cover. Place doors on at least 4 inch high wood sills or on floors in manner that will prevent rust and damage. Do not use non-vented plastic or canvas shelters which create humidity chamber and promote rusting. If corrugated wrapper on door becomes wet, or moisture appears, remove wrapping immediately. Provide 1/4-inch space between doors to promote air circulation.

- E. Frame Storage: Store frames under cover on 4 inch wood sills on floors in manner that will prevent rust and damage. Do not use non-vented plastic or canvas shelters which create humidity chamber and promote rusting. Store assembled frames in vertical position, 5 units maximum in stack. Provide 1/4-inch space between frames to promote air circulation.
- F. Deliver doors and frames to the jobsite in stages or shipments as required for phasing, and in a timely manner so as not to delay progress of other trades.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

- A. Provide products, as approved by the Architect, by one of the following acceptable manufacturers:
 - 1. Atlas Companies.
 - 2. CECO Door Products.
 - Curries.
 - 4. Deansteel Manufacturing Company, Inc.
 - 5. Fenestra.
 - 6. Kewanee Corporation.
 - 7. Mesker.
 - Metal Products.
 - 9. Pioneer Industries, Inc.
 - 10. Republic Builders Products.
 - 11. Steelcraft Manufacturing Company.

2.02 MATERIALS

A. Cold-Rolled Steel Sheets:

- Commercial quality, stretcher leveled flatness, cold-rolled steel, free from scale, pitting or other surface defects.
- 2. Complying with ASTM A 366 and ASTM A568.

B. Galvanealed Steel Sheets:

- 1. ASTM A924, A60 zinc coating.
- 2. Use galvanealed steel sheets at the following locations, whether indicated or not:
 - a. All exterior doors and door frames.
 - b. All doors and frames in kitchens, locker rooms and restrooms.
 - c. All doors and frames in or directly exposed to swimming pool areas.
 - d. All doors and frames in any other area that is exposed to moisture for long periods of time.
 - e. All door louvers and other components within doors that require galvanealed steel sheets.
- 3. Internal reinforcing may be manufactured of hot rolled pickled and oiled steel per ASTM-A569.

C. Supports and Anchors:

- 1. Fabricate of not less than 16-gauge galvanized sheet steel.
- 2. Provide all blocking, backings and supports in all horizontal and vertical members as required for reinforcing of all door hardware as specified in Section 08 7100.

D. Inserts, Bolts and Fasteners:

1. Manufacturer's standard units, except hot-dip galvanize items to be built into exterior walls.

E. Drip Cap:

- 1. On all exterior door bottoms.
- 2. On all exterior door frame heads.

F. Primer:

1. For steel surfaces, use rust-inhibitive zinc oxide primer suitable as a base for specified finish paints.

2.03 FABRICATION

A. General:

- 1. Fabricate hollow metal work to be rigid, neat in appearance and free from defects, warp, or buckle.
- 2. Accurately form metal to required sizes and profiles.
- 3. Weld exposed joints continuously; grind and dress smooth.
- 4. Provide doors and frames bearing UL labels as scheduled. Construction similar to specified hollow metal work, modified to meet Underwrites Laboratories, Inc. requirements.

B. Galvanealed Steel Sheets:

- 1. ASTM A924, A60 zinc coating.
- 2. Internal reinforcing may be manufactured of hot rolled pickled and oiled steel per ASTM-A569.

C. Minimum Gauges of Hollow Metal:

1. Frames:

- a. 16 gauge: Interior door frames.
- b. 16 gauge: Typical labeled interior frames.
- c. 16 gauge: Interior glazed window and opening frames.
- d. 14 gauge: Exterior door frames.
- e. 14 gauge: Typical labeled exterior frames.
- f. 14 gauge: Exterior glazed window and opening frames.

2. Doors:

- a. 18 gauge: Interior doors.
- b. 18 gauge: Typical labeled interior doors.
- c. 16 gauge: Exterior doors.
- d. 16 gauge: Typical labeled exterior doors.

PROJECT NO. 24-179.000 Harrison REMC - Addition and Renovation Harrison REMC

STEEL DOORS AND FRAMES 08 1113 - 5 04/24/2025

- 3. Accessories:
 - a. 20 gauge: Trim members.
- 4. Provide heavier gauges at doors, frames and accessories as required by fire rating label, details or specific condition.
- 5. Entire frame, sidelight and transom unit shall be of the same gauge.

D. Doors:

- 1. Form face sheets in smooth seamless unbroken surface. Construct doors with smooth flush surfaces, without visible joints or seams on exposed faces or stile edges. Interior and exterior door edge seams shall be full height wire welded and ground smooth.
- 2. Reinforce, stiffen and sound deaden.
- 3. Stiffen face sheet with 20-gauge steel stiffener reinforced vertically, full height and width, spot welded to both face sheets. Stiffeners welded together top and bottom.
- 4. Close top and bottom edges of interior and exterior doors with continuous recessed flush steel channel minimum 16 gauge, extending full width of door, and spot welded to both faces. Provide drain holes in bottom closure of exterior doors.
- 5. Frame openings for glazing and provide cut-outs for glass and louvers with stops as shown. Form beads of 20-gauge steel; locate on inside of opening.
- 6. Insulate core of all exterior doors, whether indicated or not, and interior doors where indicated:
 - a. Insulate with 1 lb minimum density insulation.
 - b. Minimum insulation value R-2 minimum.
- 7. Labeled Doors: Insulate as required by Underwriters Laboratories. Build in special hardware and provide astragals as indicated. At one hour and at 1-1/2 hour doors at enclosures, maximum transmitted temperature end point shall not exceed 450 degrees F above ambient at end of 30 minutes of fire exposure per U.L.
- 8. Exterior Hollow Metal Door Louvers: Fabricate louver units of 16-gauge galvanized steel sheets with stationary, weatherproof Z-shaped blades and U-shaped frames, not less than 1-3/8 inch thick. Space louver blades not more than 1-1/2 inch o.c. Assemble units by welding. Provide insect screen on interior side of frame, consisting of 14 by 18 wire mesh in rigid, formed metal frame.
- 9. Interior Hollow Metal Door Louvers: Fabricate of 20-gauge cold-rolled steel sheets with stationary sight proof inverted V-shaped blades and U-shaped frames. Space louver blades not more than 3 inches o.c. Assemble units by welding.
- 10. Typical Reinforcement: Provide as required for hardware items. For lock reinforcement, provide manufacturer's standard reinforcement. Provide 12-gauge reinforcement for escutcheons or roses. centering clips to hold lock case in alignment. For door checks, provide 14-gauge channel type reinforcements, 3-1/2 inch deep by 14 inches long, or as required. Hinge reinforcement to be one piece 14-gauge continuous channel welded to the door. Reinforce doors for surface items such as surface and semi-concealed closers, brackets, surface holders and door stops. Drilling and tapping installation of these surface items shall be done in field by hardware installer.
- 11. Provide to design indicated including: Flush panel doors, flush panel with cut-out as indicated, stile and rail type, stile and rail with door louver.
- 12. Finish: Provide prime coat finish on doors. Thoroughly clean off rust, grease and other impurities. Grind welds smooth, no marks shall show. Apply metallic filler as required to fill cracks and joints and to level any weld areas or similar imperfections. Sand filler coat smooth.
- 13. All exterior metal doors to be Galvanealed Steel Sheets.

STEEL DOORS AND FRAMES 08 1113 - 6 04/24/2025

E. Frames:

- 1. Welded Frames. Knockdown frames not permitted, except where specifically indicated by Architect.
- 2. Close corner joints tight with trim faces mitered and continuously welded, ground smooth.
- 3. Provide dust cover boxes for hinge and strike plate cutouts and at all other hardware mortises.
- 4. Weld temporary steel spreader to feet of both jambs, or strap pairs with heads inverted, as bracing during shipping and handling.
- 5. Rated frames where indicated on drawings and at all rated door openings.
- 6. At masonry, provide wire or masonry "T" anchors approximately 24 inches on center.
- 7. Provide and secure galvanized steel drip cap at all exterior doors, field painted to match frame.
- 8. Silencers: Provide specified silencers, except where stop does not occur and at smoke gasketed openings, 3 per jamb at single door and one for each door at double doors.
- 9. Extensions: Reinforce transom bars or mullions as necessary to provide rigid installation. Where required (as at multiple openings) to stabilize large frames, provide frame or mullion extensions to anchor to structure above, proper size to fit within overhead construction. Provide angle clips to fasten to structure.
- 10. Mullions: Provide mullions, straight and without twist, of tubular design. No visible seams will be accepted. For removable mullions provide reinforcing at frame head.
- 11. Clearances: Provide and be responsible for proper clearances at metal frames, including for weatherstripping, soundstripping and smoke gasketing. Glass clearance shall be thickness of glass plus clearance each side (1/8 inch minimum exterior 1/16-inch minimum interior), adjust for installation, glass thickness to allow for glazing and sealant. Where sealed double glazing is indicated, provide rebates minimum of 3/4 inch and provide 1/4-inch clearance at glass edges. Where units fit around concrete blocks (blocks built into frames) obtain actual dimensions of blocks being used to establish minimum clearances.
- 12. Stops: Set with countersunk or Jackson head screws.
- 13. Labeled Frames: Construct in accordance with requirements for labeled work. Attach proper U.L. label, Warnok Hersey. "B" labeled frames shall be 1-1/2 hour construction.
- 14. Joinings: Furnish frames mitered, or coped, and continuously face welded. Grind smooth, and conceal joints for a seamless appearance. Touch up welded surfaces with manufacturer's standard prime paint.
- 15. Workmanship: Fabricate so no grind marks, hollow or other out-of-plane areas are visible. At joints of intermediate members (such as mullions and transom bars), provide tight joining, neatly accomplished without holes, burned out spots, weld build up or other defacing work. Fill to close cracks and to preserve shapes. Tightly fit loose stops, to hairline joints.
- 16. Finish: Clean frames by degreasing process and apply thorough coating of baked-on primer, covering inside as well as outside surfaces. At galvanealed frames, coat welds and other disrupted surface with zinc-rich paint containing not less than 90 percent zinc dust by weight.
- 17. All exterior metal frames to be Galvanealed Steel Sheets.

F. Hardware Preparation:

- 1. Mortise, reinforce, drill and tap doors and frames for mortised hardware.
- 2. Prepare strike iamb for 3 silencers on door side.
- 3. Typical Reinforcing: Provide minimum hinge reinforcement 3/16 inch by 1-1/2 inch by 10 inch. Provide similar reinforcement for hardware items as required to adequately withstand stresses, minimum 12 gauge, including channel reinforcement for door closers and closer arms, door holders and similar items. Provide reinforcement and clearances for concealed in-head door closers and for mortise locks, where applicable.
- 4. Anchorage: Provide standard and special anchorage items as required.

5. Cover Plates: For hinge and strike plate cutouts, provide fully enclosed pressed steel cover boxes spot welded to frames behind mortises.

G. Finish:

- 1. Chemically treat and apply manufacturer's standard rust inhibitive primer coat conforming to ANSI A224.1-1990.
- 2. Coat interior of frame with bituminous paint, minimum 1.5 mils.
- 3. Prep surfaces to receive finish painting in the field.

H. Fastenings:

- 1. Provide fastenings, anchors and clips as required to secure hollow metal work in place.
- 2. Provide Jackson head screws, or flatter.
- 3. Dimple metal work to receive screw heads.
- 4. Set stops and other non-structural fastenings with #6 Jackson head self-tapping screws.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Examine supporting structure and conditions under which hollow metal is to be installed.
- B. Verify that frame opening corresponds to dimensions of frames furnished.
- C. Check that surfaces to contact frames are free of debris.
- D. Do not proceed with installation until unsatisfactory conditions are corrected.

3.02 INSTALLATION

A. General:

- 1. Install in accordance with reviewed shop drawings and manufacturer's printed instructions.
- 2. Set hollow metal plumb, level, square to proper elevations, true to line and eye.
- 3. Units and trim shall be fastened tightly together, with neat, uniform and tight joints.

B. Anchorage:

- 1. Attach anchors to opening.
- 2. Minimum number of anchors: 3 per jamb.
- 3. Securely fasten and anchor work in place without twists, warps, bulges or other unsatisfactory or defacing workmanship.
- 4. Set clips and other anchors with Ramset "shot" anchors or drill in anchors as approved.

C. Frames:

- 1. Attach frames true to line with adjacent construction.
- 2. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set.
- 3. After wall construction is complete, remove temporary braces and spreaders leaving surfaces smooth and undamaged.
- 4. At cast-in-place concrete or masonry construction, set frames and secure in place using countersunk bolts and expansion shields, with bolt heads neatly filled with metallic putty, ground smooth and primed.

D. Doors:

- 1. Hang doors square to opening.
- 2. Minimum Clearances:
 - a. At head and jambs: 1/8".
 - b. Between meetings edges of pairs of doors: 1/8".
 - c. With Floor: 3/4", except 3/8" undercut at handicap accessible doors.
 - d. At Threshold: 1/4".
 - e. At Handicap Threshold: As required to coordinate with threshold height.
- 3. Fit hollow metal doors accurately in their respective frames, within following clearances:
 - a. Jambs and head 3/32 inch.
 - b. Meeting edges pair of doors 1/8 inch.
 - c. Sill where no threshold or carpet 1/4 inch above finished floor.
 - d. Sill at threshold 3/4 inch maximum above finished floor.
 - e. Sill at carpet 1/4 inch above carpet.

E. Labeled Doors and Frames:

- 1. Install in conformance with NFPA Standard 80.
- 2. Provide clearances in conformance with NFPA Standard 80.

3.03 ADJUST AND CLEAN

- A. Remove dirt and excess sealants from metal surfaces.
- B. Touch up marred or abraded surfaces.
- C. Lubricate hardware and adjust moving parts to operate smoothly.
- D. Remove debris from work area.
- E. Prime Coat Touch-Up: Modify existing doors and frames to receive new door hardware. Cut, patch, weld, bondo, and sand smooth, modified areas.

 Modifications will be seamless and not noticeable. Use compatible air-drying primer.
- F. Protection Removal: Immediately before final inspection, remove protective wrappings from doors and frames.

PROJECT NO. 24-179.000 Harrison REMC - Addition and Renovation Harrison REMC

STEEL DOORS AND FRAMES 08 1113 - 9 04/24/2025

SUBMITTAL CHECKLIST

- 1. Product Data.
- 2. Shop Drawings.

END OF SECTION 08 1113

SECTION 08 1416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Interior flush pre-fit, pre-machined standard and fire rated type wood doors as shown on the Drawings and specified herein.
- B. Modifications to existing doors receiving new door hardware, where applicable.

1.02 REFERENCES

- A. WDMA Window and Door Manufacturers Association: IS 1-A 1997 Industry Standard for Architectural Flush Wood Doors.
- B. NFPA-80: Standards for Fire Doors 1999 Edition.
- C. Uniform Building Code: UBC 7-2 1997 or UL10C, Positive Pressure Fire Door Assemblies.
 - Category "B" for single swing doors and Category "A" for pairs of swinging doors.
- D. NFPA-105: Recommended Practice for Installation of Smoke-Control Door Assemblies, 1999 Edition.
- E. NFPA-252: Standard Method of Fire Tests for Door Assemblies.
- F. UL: Building Materials Directory.
- G. WHI: Directory of Listed Products.
- H. ICC/ANSI-A117.1-2003: Accessible and Usable Buildings and Facilities.
- I. State and Local Building Codes including the Authority Having Jurisdiction.

1.03 QUALITY ASSURANCE

- A. Except as otherwise specified herein, wood doors shall conform with Architectural Woodwork Institute (AWI) Quality Standards and National Woodwork Manufacturer's Association (NWMA) I.S. 1 and I.S. 2.
- B. Fire-Rated Wood Doors: Provide wood doors which are identical in materials and construction to units tested in door and frame assemblies in accordance with UBC 7-2 1997 or UL10c, Positive Pressure Fire Door Test Method, and which are labeled and listed for ratings indicated by ITS Warnock Hersey, UL or other testing and inspection agency acceptable to authorities having jurisdiction.
 - 1. Doors: Comply with UBC 7-2 1997 or UL10C where required.
 - 2. Provide smoke gaskets or fire seals as required by manufacturers' individual authorities in compliance with UBC 7-2 1997 or UL-10C-1998.

- 3. Maintain one copy of each compliance document on the project site.
- 4. Fabrication of doors shall permit installation in accordance with NFPA Standard No. 80.
- 5. Fire doors to be rated UL10C Positive Pressure Category A.
- C. WDMA I.S. 1-A 2004 Quality Standard: Window and Door Manufacturers Association Quality Standards for grade of door, core, construction, finish, and other requirements.
- D. Temperature Rise Rating: At stairway enclosures, provide doors which have Temperature Rise Rating of 250 degrees F maximum in 30 minutes of fire exposure.
- E. Manufacturer must have qualifications specializing in the manufacturing of the products specified in this Section for a period of not less than 10 years.

1.04 SUBMITTALS

A. Manufacturer's Literature:

- 1. Manufacturer's published catalog data, product data sheets and cutsheets.
- 2. Certificate of compliance with NWMA I.S. 1.
- Indicate general construction, jointing methods, hardware and louver locations, locations of cut-outs for glass, thickness of veneers, materials, door swings, special blocking, stile and rail dimensions, undercuts, and storage and installation details. Do not proceed with any fabrication until all details are approved.

B. Shop Drawings:

1. Show elevations, dimensions, construction details, glazing, cut-outs and label.

C. Samples:

- 1. Actual samples of wood veneer and finish.
- 2. Stain colors and finishes to be selected from manufacturer's entire standard selection.
- 3. If stains are required to be custom matched, submit samples of actual finished product, along with sample of item door was to be matched to.

D. Warranty:

- 1. Manufacturer's standard warranty for materials.
- 2. Special Warranty as specified herein.

E. Certification:

- 1. Submit any information necessary to indicate compliance to all of these specifications.
- 2. All labeled fire door assemblies to be of a type which have been classified and listed in accordance with the latest edition of NFPA 80 and tested in compliance with NFPA-252, and UL-10B, and UBC-7-2.
- 3. A metal label is to be permanently affixed to the fire door at an authorized facility. Furthermore, all, 45, 60, and 90 minute labeled fire doors, are to have manufacturer's standard laminated stiles for improved screw holding and split resistance capabilities.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Do not deliver doors to the site until building has been closed in and is thoroughly dry.
- B. Deliver pre-finished wood doors to jobsite after all door frames have been painted, and all "wet" construction has been completed.
- C. Plastic wrap and protect wood doors during transit, storage and handling, to prevent damage, soiling or deterioration. Follow the Care and Installation guidelines as described in WDMA I.S. 1-A 2004.
- D. Store doors flat and protect from damage.
- E. Do not walk or stack any materials on top of any wood doors delivered to the jobsite, and do not drag any wood doors across each other during delivery or installation.
- F. Remove damaged or otherwise unsuitable doors from the job site.

1.06 SPECIAL WARRANTY

- A. The Contractor shall warrant the wood doors to be free of faults and defects for the life of the installation.
- B. Faults and Defects:
 - 1. Delamination in any degree.
 - 2. Warp or twist of 1/4" or more, in any 7'-0" plane, in any direction.
 - 3. Telegraphing of stile, rail, or core, through the face of the door to cause surface variation in excess of 1/100" in any 3" span.
 - 4. Any other defect that shall affect the operation of the door, shall be considered a defect under the provision of the warranty.
- C. Warranty to include refinishing and reinstallation that may be required due to repair or replacement of any defective doors.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Provide products, as approved by the Architect, by one of the following acceptable manufacturers:
 - 1. Algoma Hardwoods.
 - 2. Chappell.
 - 3. Eggers Industries.
 - 4. Graham Manufacturing.
 - 5. Ideal Wood Products.
 - 6. Marshfield Door Systems.
 - 7. Mohawk Flush Doors.
 - 8. Ohio Valley.

- Oshkosh.
- 10. VT Industries.

2.02 FABRICATION

- A. Typical Doors, Non-Fire Rated:
 - 1. Thickness: 1-3/4 inches.
 - 2. Interior flush, bonded, solid core, hardwood veneered.
 - 3. Door construction shall conform to WDMA I.S. 1-A 2004 Premium Grade and AWI Quality Standards Premium Grade.
 - 4. Core: bonded particle core (PC).
 - a. Solid particleboard bonded to the stiles and rails.
 - b. Comply with ANSI-A208-1 Grade 1-LD-2.
 - 5. Vertical Stiles: Hardwood to match face veneer, 1-3/8" minimum before trimming, over structural composite lumber (SCL), glued to core.
 - 6. Rails: Mill option hardwood or SCL. Top and bottom: 2 inches before trimming.
 - 7. Facing: Wood veneer cut and species as specified shall conform to WDMA I.S. 1-A 2004 "A" grade for Premium Grade Door Construction requirements.
 - 8. Crossbands: Hardwood, 1/16 inches thick, extending full width of door.
 - 9. Edge Bands: Same species as face veneer, matched for color.
- B. Provide all blocking, backings and supports in all horizontal and vertical members as required for reinforcing of all door hardware as specified in Section 08 7100.

2.03 WOOD VENEER

- A. Face Veneer:
 - 1. Shall meet quality standards conforming to WDMA I.S. 1-A 2004 "A" grade for transparent finish.
 - 2. Minimum face veneer thickness shall be 1/50" after finish sanding.
 - 3. Wood Species: Select White Oak to match existing doors.
 - 4. Face Cut: Plain Sliced.
 - 5. Face Assembly: Book Match.
 - 6. Face Symmetry: Running Match.

2.04 VISION FRAMES

- A. Non-Rated Doors:
 - 1. Flush bead wood frames, 1/2" thickness.
 - 2. Hardwood of same species as face veneer, matched for color.
- B. Glass:

- 1. Refer to drawings for type and thickness.
- 2. See Section 08 8100 Glass and Glazing.

2.05 FITTING AND FINISHING

A. Fitting:

1. Doors may be fitted for hardware at job site or pre-fitted and pre-machined at factory.

B. Field Stained Finish:

- 1. All doors shall be field stained to match existing doors. Supplier shall field verify all requirements so as to match existing door type, wood species, face cut, graining, and stain color, including custom stain matching as required.
- 2. Field stained doors on site shall be per requirements of Section 09 9000 Painting.
- 3. Where matching to existing doors is required,

C. Coordination:

- 1. Finish or stain doors before hanging.
- 2. Variations in finish due to body oils on doors, planer marks or other irregularities not attributable to natural wood grain variations will be cause for rejection.

2.06 ADHESIVES

A. Adhesives:

- 1. Face to core adhesives shall be Type I or Type II as appropriate for location in building.
- 2. All adhesives must be classified Type I or Type II per WDMA TM-6 "Adhesive Bond Test Method."
- 3. Use Type I adhesives for doors in exterior applications.
- 4. Use Type II adhesives for doors in interior applications.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Examine door frames and verify that frames are correct type and have been installed as required for proper hanging of corresponding doors. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with plumb, square, and level jambs and heads.
- C. Modify existing wood doors to receive new door hardware, where applicable. Drill, Cut, patch, and sand smooth, modified areas. Modifications shall be seamless and not noticeable. Use touch up stain provided by custom stain manufacturer. Clear coat with Polyurethane after custom stain has dried.

3.02 INSTALLATION

- A. Condition doors to average prevailing humidity in installation area prior to hanging. Install doors after building humidity is at an acceptable level.
- B. Handle doors in accordance with recommendations of WDMA I.S. 1-A, "Care and Installation at Job Site".
- C. Install wood doors in strict accordance with manufacturer's published instructions and as shown.
- D. Install accurately in frame. Install within the clearances specified in the manufacturer's written instructions. Install plumb, level, square and true.
- E. Install to operate freely, but not loosely, free from hinge and strike binding conditions. All doors shall be free from rattling when in the latched position.
- F. Pilot holes to be drilled for screws attaching hinges, locksets, and all other hardware to be installed on the doors. Pilot holes shall not exceed 90% of the diameter of the screw.
- G. Remove and replace all doors found to be warped, twisted, bowed, or otherwise damaged. Do not install doors which cannot be properly fitted to frames.
- H. Adjust pre-finished doors and hardware and other moving or operating parts to function smoothly and correctly.
- I. Ensure that smoke gaskets are in-place before pre-finished door installation.
- J. Bevel non-fire rated doors 1/8 inch in 2 inches lock and hinge edges.
- K. Fit to frames and machine for hardware to whatever extent not previously worked at factory as required for proper fit and uniform clearance at each edge.
- L. For non-rated doors provide the following clearances:
 - 1. 1/8 inch at jambs and heads.
 - 2. 1/2 inch at floor finish or covering.
- M. For installation of hardware, See Division 08710 Finish Hardware.

3.03 ADJUST AND CLEAN

- A. Rehang or replace doors which do not swing or operate freely.
- B. Refinish or replace doors damaged during installation.
- C. Protect installed wood doors from damage or deterioration until Substantial Completion.
- D. Adjust doors for a smooth, balanced, fully functional opening.
- E. Clean pre-finished doors and hardware.

PROJECT NO. 24-179.000 Harrison REMC - Addition and Renovation Harrison REMC

FLUSH WOOD DOORS 08 1416 - 7 04/24/2025

SUBMITTAL CHECKLIST

- 1. Manufacturer's Literature.
- 2. Shop Drawings.
- 3. Samples.
- 4. Warranty.
- 5. Certification.

END OF SECTION 08 1416

SECTION 08 1600 - FRP FLUSH DOORS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Fiberglass reinforced polyester (FRP) flush doors and hardware as shown on the Drawings and specified herein.

1.2 REFERENCES

- A. AAMA 920 Specification for Operating Cycle Performance of Side-Hinged Exterior Door Systems.
- B. AAMA 1304 Voluntary Specification for Forced Entry Resistance of Side-Hinged Door Systems.
- C. ASTM-C203 Standard Test Methods for Breaking Load and Flexural Properties of Block-Type Thermal Insulation.
- D. ASTM-C272 Standard Test Method for Water Absorption of Core Materials for Sandwich Constructions.
- E. ASTM-C273 Standard Test Method for Shear Properties of Sandwich Core Materials.
- F. ASTM-C518 Standard Test Method for Steady-State Thermal Transmission Properties by Means of Heat Flow Meter Apparatus.
- G. ASTM-C1363 Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus.
- H. ASTM-D1621 Standard Test Method for Compressive Properties of Rigid Cellular Plastics.
- I. ASTM-D1622 Standard Test Method for Apparent Density of Rigid Cellular Plastics.
- J. ASTM-D1623 Standard Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics.
- K. ASTM-D1761 Standard Test Methods for Mechanical Fasteners in Wood.
- L. ASTM-D-4226 Standard Test Methods for Impact Resistance of Rigid Poly(Vinyl Chloride) (PVC) Building Products
- M. ASTM-D5116 Standard Guide for Small-Scale Environmental Chamber Determinations of Organic Emissions from Indoor Materials/ Products.
- N. ASTM-D6670 Standard Practice for Full-Scale Chamber Determination of Volatile Organic Emissions from Indoor Materials/ Products.
- O. ASTM-E84 Standard Test Method for Surface Burning Characteristics of Building Materials.

- P. ASTM-E90 Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.
- Q. ASTM-E283 Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
- R. ASTM-E330 Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
- S. ASTM-E1886 Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors and Storm Shutters Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials.
- T. ASTM-E1996 Standard Specification for Performance of Exterior Windows, Glazed Curtain Walls, Doors and Storm Shutters Impacted by Wind Borne Debris in Hurricanes.
- U. ASTM-F1642-04 Standard Test Method for Glazing Systems Subject to Air Blast Loading
- V. ASTM-G-53_- Standard Practice for Operating Light-and Water-Exposure Apparatus (Fluorescent UV-Condensation Type) for Exposure of Nonmetallic Materials
- W. NFRC 100 Procedure for Determining Fenestration Products U-Factors.
- X. NFRC 400 Procedure for Determining Fenestration Products Air Leakage.
- Y. BB. ICC/ANSI-A117.1-2003: Accessible and Usable Buildings and Facilities.
- Z. CC. State and Local Building Codes including the Authority Having Jurisdiction.

1.3 PERFORMANCE REQUIREMENTS

- A. General: Provide door assemblies that have been designed and fabricated to comply with specified performance requirements, as demonstrated by testing manufacturer's corresponding standard systems.
- B. Pultruded Fiberglass Skin.
 - 1. Surface Burning, ASTM-E84: Flame Spread ≤ 25, Smoke Developed ≤ 450.
 - 2. Tensile Strength, ASTM-D638: 12,300 psi.
 - 3. Percent Fiberglass: Minimum 50%.
- C. Pultruded Structural Shapes.
 - 1. Tensile Strength, ASTM-D638: Minimum 30,000 psi.
 - 2. Compressive Strength, ASTM-D695: Minimum 30,000 psi.
 - 3. Flexural Strength, ASTM-D790: Minimum 30,000 psi.
 - 4. Tensile Strength, ASTM-D638: Minimum psi.
 - 5. Flexural Modulus, ASTM-D790: Minimum 1.6 x 106 psi.
 - 6. Short Beam Shear, ASTM-D2344: Minimum 4,500 psi.
 - 7. Impact, Notched, ASTM-D256: Minimum 25 ft-lb/in.
 - 8. Thermal Expansion, ASTM-D696: Maximum 8.0 x 10-6 psi.

9. Surface Burning, ASTM-E84: Flame Spread ≤ 25, Smoke Developed ≤ 450.

D. Door Core.

- 1. Surface Burning, ASTM-E84: Flame Spread ≤ 25, Smoke Developed ≤ 450.
- 2. Density, ASTM-D1622: 6.0 pcf.
- 3. Compressive Strength, ASTM-D1621: 139 psi.
- 4. Compressive Modulus = 4,527 psi.
- 5. Shear Strength, ASTM-C273: 84 psi.
- 6. Shear Modulus, ASTM-C273: 788 psi.
- 7. Tensile Modulus, ASTM-D1623: 136 psi.
- 8. Flexural Strength, ASTM-C203: 204 psi.
- 9. Flexural Modulus, ASTM-C203: 4,767 psi.
- 10. K-Factor, ASTM-C518: 0.16 Btu·in/hr·ft².°F.
- 11. R-Factor, ASTM-C518: 6.25 hr ft².°F/Btu.
- 12. Water Absorption, ASTM-C272: < 0.7% by volume.

E. Door Panel.

1. Thermal Transmittance, ASTM-C1363-11: U-Factor = 0.13 Btu/hr·ft²·°F, R-Value = 7.42 hr·ft²·°F/Btu.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications:

- 1. Continuously engaged in manufacturing of doors of similar type to that specified, with a minimum of 25 years successful experience.
- 2. Door and frame components from same manufacturer.
- 3. Evidence of a compliant documented quality management system.

1.5 SUBMITTALS

A. Manufacturer's Literature:

- 1. Manufacturer's published catalog data, product data sheets and cutsheets, description of materials, components, fabrication, finishes, and installation.
- 2. Indicate general construction, jointing methods, hardware and louver locations, locations of cut-outs for glass, materials, door swings, special blocking, stile and rail dimensions, undercuts, and storage and installation details. Do not proceed with any fabrication until all details are approved.
- 3. Manufacturer's maintenance and cleaning instructions for doors, including maintenance and operating instructions for hardware

B. Shop Drawings:

1. Show elevations, sections, dimensions, tolerances, materials, fabrication, doors, panels, framing, construction details, glazing, cut-outs and label.

C. Samples:

- 1. Door: Submit manufacturer's sample of door showing face sheets, core, framing, and finish.
- 2. Color: Submit manufacturer's samples of standard colors of doors and frames.
- 3. Color and finish to be selected by Architect from manufacturer's entire standard selection.

D. Warranty:

- 1. Manufacturer's standard warranty for materials.
- 2. Special Warranty as specified herein.

E. Certification:

1. Certified test reports from qualified independent testing agency indicating doors comply with specified performance requirements.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying opening door mark and manufacturer.
- B. Store materials in clean, dry area indoors in accordance with manufacturer's instructions.
- C. Plastic wrap and protect doors during transit, storage and handling, to prevent damage, soiling or deterioration.
- D. Store doors flat and protect from damage.
- E. Do not walk or stack any materials on top of any doors delivered to the jobsite, and do not drag any doors across each other during delivery or installation.
- F. Remove damaged or otherwise unsuitable doors from the job site.

1.7 SPECIAL WARRANTY

- A. The Contractor shall warrant the doors and factory hardware against failure in materials and workmanship, including excessive deflection, faulty operation, defects in hardware installation, and deterioration of finish or construction in excess of normal weathering.
- B. Warranty period to be ten years starting on date of Substantial Completion.
- C. In addition, provide a limited lifetime (while the door is in its specified application in its original installation) warranty covering: failure of corner joinery, core deterioration, delamination or bubbling of door skin.

PART 2 - PRODUCTS

1.8 BASIS OF SPECIFICATION

- A. Provide one of the following products or an approved equal:
 - 1. "Special-Lite", AF-100 Smooth Pultruded Fiberglass Door

1.9 DESCRIPTION

- A. Door Construction:
 - 1. Door Thickness: 1-3/4".
 - 2. Pultruded as one monolithic panel with integral stiles.
 - 3. Stiles: Seamless 9/16" thick solid FRP.
 - 4. Top Rail: 6" pultruded tube profile designed to fit flush and be chemically welded inside of door cavity.
 - Bottom Rail.
 - a. Standard pultruded inverted U channel designed to fit flush and be chemically welded inside the door which allows doors to be field trimmed.
 - b. Optional closed bottom rail.
 - 6. Core.
 - a. Polyurethane foam.
 - b. Minimum 6 pcf density.
 - 7. Face Sheet.
 - a. Smooth, pultruded FRP integral to construction of door.
 - b. Attachment of face sheet.
 - 8. Door to be pultruded as one monolithic panel.
 - 9. Cutouts.
 - a. Manufacture doors with cutouts for required vision lites, louvers, and panels.
 - 10. Hardware.
 - a. Pre-machine doors in accordance with templates from specified hardware manufacturers.
 - b. Surface mounted closures will be reinforced for but not prepped or installed at factory.
 - 11. Reinforcements.
 - 12. No metallic reinforcements will be allowed.

1.10 MATERIALS

- A. Fiberglass.
 - 1. Face Sheet: See 2.2, A.7.
 - 2. Stiles & Rails See 2.2, A.3 & A.4.

B. Fasteners.

- 1. All exposed fasteners will have a finish to match material being fastened.
- 2. 410 stainless steel or other non-corrosive metal.
- 3. Must be compatible with items being fastened.

1.11 FABRICATION

A. Factory Assembly.

- 1. Door and frame components from the same manufacturer.
- 2. Required size for door and frame units, shall be as indicated on the drawings.
- 3. Complete cutting, fitting, forming, drilling, and grinding of metal before assembly.
- 4. All cut edges to be free of burs.
- 5. Electrical arc welding of doors or frames is not acceptable.
- 6. Maintain continuity of line and accurate relation of planes and angles.
- 7. Secure attachments and support at mechanical joints with hairline fit at contact surfaces.

B. Shop Fabrication

- 1. All shop fabrication to be completed in accordance with manufactures process work instructions.
- 2. Quality control to be performed before leaving each department.

1.12 HARDWARE

- A. Pre-machine doors in accordance with templates from specified hardware manufacturers and hardware schedule.
- B. Factory install hardware.

1.13 VISION LITES

- A. Factory Glazing: 1/4" or 1" as noted on the drawings.
- B. Lites in Exterior Doors: Allow for thermal expansion.
- C. Rectangular Lites:
 - 1. Size: As indicated on the Drawings.
 - 2. Factory glazed with screw-applied aluminum stops anodized to match perimeter door rails.

1.14 FINISHES

A. Door.

1. Two-component flexible acrylic urethane Satin topcoat.

- a. Color to be selected from manufacturer's entire color options available.
- b. Excellent exterior durability.
- c. Unique, high-solids, high-build, multifunctional coating.
- d. Low VOC, Satin coating.
- e. Impact Resistance, ASTM D-4226 Minimum 1.2 in/lb/mil
- f. Color retention: ≤1∆ (CIE L.a.b.), Montreal 45° South: 12 months
- g. Very good chemical resistance.

PART 2 - EXECUTION

2.1 INSPECTION

- A. Examine areas to receive doors and frames and verify that items have been installed as required for proper hanging of corresponding doors. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Verify that doors and frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with plumb, square, and level jambs and heads.
- C. Ensure openings to receive frames are plumb, level, square, and in tolerance.

2.2 INSTALLATION

- A. Install doors in accordance with manufacturer's instructions.
- B. Install doors plumb, level, square, true to line, and without warp or rack.
- C. Anchor frames securely in place.
- D. Separate aluminum from other metal surfaces with bituminous coatings or other means approved by Architect.
- E. Set thresholds in bed of mastic and backseal.
- F. Install exterior doors to be weathertight in closed position.
- G. Repair minor damages to finish in accordance with manufacturer's instructions and as approved by Architect.
- H. Remove and replace damaged components that cannot be successfully repaired as determined by Architect.

2.3 ADJUST AND CLEAN

A. Adjust doors, hinges, and locksets for smooth operation without binding.

- B. Rehang or replace doors which do not swing or operate freely.
- C. Replace doors damaged during installation.
- D. Protect installed doors from damage until Substantial Completion.
- E. Adjust doors for a smooth, balanced, fully functional opening.
- F. Clean doors and hardware promptly after installation in accordance with manufacturer's instructions.
- G. Do not use harsh cleaning materials or methods that would damage finish

2.4 PROTECTION

A. Protect installed doors to ensure that, except for normal weathering, doors will be without damage or deterioration at time of substantial completion.

SUBMITTAL CHECKLIST

- 1. Manufacturer's Literature.
- 2. Shop Drawings.
- 3. Samples.
- 4. Warranty.
- 5. Certification.

END OF SECTION 08 1600

SECTION 08 3113.01 - ACCESS DOORS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Metal access doors as shown on the Drawings and specified herein, including:
 - 1. Access doors in walls.
 - 2. Access doors in ceilings.

1.02 QUALITY ASSURANCE

- A. Fire Resistive Ratings:
 - 1. Where access doors are shown in rated assemblies, provide panel door, frame, hinge and latch from manufacturer listed by Underwriters Laboratories for ratings indicated.
- B. Use manufacturer's standard size units for nominal sizes indicated. Field coordinate actual unit sizes with rough openings and built-in anchors and inserts.

1.03 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to job in manufacturer's unopened packages with labels intact.
- B. Store and handle products so as to prevent damage. Remove all damaged items from the job site.

1.04 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's published catalog information, product data sheets and cutsheets.
 - 2. UL fire rated test data stating achieved rating.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Provide products, as approved by the Architect, from one of the following acceptable manufacturers:
 - Babcock-Davis.
 - 2. Bilco.
 - 3. Dayton.
 - 4. J.L. Industries.

- 5. Karp Associates, Inc.
- 6. Milcor Incorporated.
- 7. Vestal Manufacturing Co.

2.02 MATERIALS

A. Access Doors:

- 1. Door: 14 gage steel.
- 2. Frame: 16 gage steel with 1 inch flange.
- 3. Hinge: Concealed spring type, 175 degree opening.
- 4. Lock: Screwdriver activated cam lock.
- 5. Finish: Gray baked enamel prime coat. Prepped for finish field coats.
- 6. Sizes: 20 inches x 40 inches minimum at attic access, unless otherwise indicated on Drawings.

24 inches x 24 inches all other locations, unless otherwise indicated on Drawings.

B. Fire-Rated Access Doors:

- 1. Door: 20 gage steel, insulated sandwich panel construction.
- 2. Frame: 15 gage steel with 1 inch flange.
- 3. Hinge: Concealed pin type.
- 4. Lock: Recessed turn ring with interior latch release.
- 5. Closer: Spring type closer, adjust to assure positive latching.
- 6. Finish: Gray baked enamel prime coat. Prepped for finish field coats.
- 7. Sizes: 20 inches x 40 inches minimum at attic access, unless otherwise indicated on Drawings.
 - 24 inches x 24 inches all other locations, unless otherwise indicated on Drawings.
- 8. Label: 1-1/2 hour "B" label, unless otherwise indicated on Drawings.

2.03 FABRICATION

- A. Fabricate units of continuous welded construction.
- B. Neatly fit all joints, and grind welds smooth and flush with adjacent surfaces.
- C. Furnish each access door as a complete unit with all parts ready for installation.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Field verify all rough opening dimensions.
- B. Assure that sufficient inserts, blocking and built-in anchors are provided for secure installation of doors.

PROJECT NO. 24-179.000 Harrison REMC - Addition and Renovation Harrison REMC

ACCESS DOORS 08 3113.01 - 3 04/24/2025

3.02 INSTALLATION

- A. Install per manufacturer's recommendations.
- B. Painting of doors is specified in Section 09 9000.

3.03 ADJUSTING AND CLEANING

- A. Adjust hardware so that all doors operate smoothly and freely.
- B. Remove and replace panels or frames which are bowed, warped or damaged.

3.04 PROTECTION

A. Protect doors from damage until Substantial Completion.

SUBMITTAL CHECKLIST

1. Product Data.

END OF SECTION 08 3113.01

SECTION 08 3613.01 - SECTIONAL OVERHEAD DOORS

PART 1 – GENERAL

1.01 WORK INCLUDED

- A. Motor operated upward acting sectional type doors. Work includes, but is not limited to, the following type doors:
 - 1. Steel Doors Insulated.
 - 2. Operators for electric motor operation of sectional doors.
- B. Work includes all labor, materials, accessories and hardware to furnish and install complete and operating door systems as indicated on the Drawings and specified herein.

1.02 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's published catalog information, product data sheets and cutsheets.
 - 2. Manufacturer's instructions on installation, operation and maintenance.
 - 3. Certification that springs have been tested and approved for specified higher cycles of use.
- B. Shop Drawings:
 - 1. Show locations, elevations, details and methods of anchorage.
 - 2. Show all components for operators and utility connections and requirements.
 - 3. Indicate clearances required for all components and proper operation.

1.03 DELIVERY, STORAGE AND HANDLING

A. Store and handle so as to prevent damage.

PART 2 - PRODUCTS

2.01 STEEL DOORS - INSULATED

- A. Provide one of the following approved products:
 - 1. "Overhead Door Corporation", 422 Series.
 - 2. "Clopay Building Products Company, Inc.", Model 520S.
 - 3. "Haas Door Company", Model 220-S.

B. Description:

- 1. Panel Sections: Rolled 20 gauge galvanized steel, woodgrain textured raised panel, rabetted meeting rails, full width interlocking, 2 inch nominal door thickness.
- 2. Center and End Stiles: Formed and welded so as to be integral with panels. 16 gauge center stile, 16 gauge channel shaped end stiles.
- 3. Tracks: Galvanized steel, 2 inches or 3 inches deep. High Lift track, unless otherwise indicated.
- 4. Track Supports: Intermediate vertical supports for horizontal track as required to properly secure track to be without excessive motion interfering with proper operation of the door or posing a detrimental effect on any other item or trade.
- 5. Hinges and Brackets: 14 gauge galvanized steel. Full floating ball-bearing rollers in case hardened steel races. Mounted to fit the taper of the track.
- 6. Weatherstripping: One piece, full length, at perimeter of opening jambs and header. EPDM, extruded PVC, vinyl or neoprene.
- 7. Bottom Section: Full length extruded aluminum astragal retainer, galvanized steel step plate and U-shaped flexible astragal.
- 8. Finish: White, baked enamel, both sides. Prep to accept field paint, where applicable.
- Lock: Pin tumbler keyed mechanism.
 Install universal cylinder and key to building master key system per Owner.
- 10. Glazing: Manufacturers standard window units, ¼ inch tempered clear glass.
- 11. Operation: Electric motor operation.
- 12. Springs: Higher cycle rated for 100K cycles.
- 13. Provide bottom sensing edge on electric motor operated units.
- 14. Back Cover: 27 gauge galvanized steel.
- 15. Insulation: Expanded polystyrene sandwiched between door panel faces (min. R=6.5).

2.02 HOIST OPERATOR

A. Description:

- 1. Hand Pull Rope:
 - a. Length to be within reach when door is open.
- Electric Operator:
 - a. Manufacturers standard electric operator, sized for each specific door.
 - b. Trolley, side or center mounted, per head room and clearance requirements.
- 3. Push Button Control Station:
 - a. Permanently mounted at inside of each door where indicated.
 - b. Three button position Open, Close, Stop.

PROJECT NO. 24-179.000 Harrison REMC - Addition and Renovation Harrison REMC

SECTIONAL OVERHEAD DOORS 08 3613.01 - 3 04/24/2025

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install plumb, square, level and true.
- B. Provide treated wood blocking, steel angles, shims, brackets and all other accessories necessary for a complete and finished installation.
- C. Paint all exposed wood blocking and shims. Do not paint weatherstripping.
- D. Paint steel doors under Division 9.
- E. Install door, track and all accessories per manufacturers requirements, unless less stringent than Drawings and Specifications.
- F. Install wiring for automatic operators under Division 26.

3.02 CLEANING AND ADJUSTING

- A. Upon completion, remove all materials, equipment and debris from the premises.
- B. Just prior to substantial completion, clean and touch up all surfaces, and check doors for proper operation.

 Adjust as necessary for tight fit and proper operation.

SUBMITTAL CHECKLIST

- 1. Product Data.
- 2. Shop Drawings.

END OF SECTION 08 3613.01

SECTION 08 4113 - ALUMINUM ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Furnish labor, materials, equipment, special tools, supervision and services required to complete the aluminum thermal-type and non-thermal type Entrances and Storefronts as shown on the Drawings and specified herein.

1.02 QUALITY ASSURANCE

- A. Comply with all Federal, State and Local building codes and regulations.
- B. Thermal Performance:
 - 1. AAMA Test Procedure 1502.7.
 - 2. Condensation Resistance Factor (CRF) of 43 (min.) at equivalent of 15 MPH wind velocity.
- C. Air Infiltration:
 - 1. ASTM E283.
 - 2. Maximum infiltration .06 CFM/ft. crack length under static pressure of 6.24 PSF (equivalent of 50 MPH wind velocity).
- D. Water Infiltration:
 - 1. ASTM E331.
 - 2. No water penetration for 15 minutes with 5 gal./hr./s.f. at 10.0 PSF pressure.
- E. Uniform Loading:
 - ASTM E-330.
 - 2. Max. 1/175 deflection, no permanent deformation under a load of 25 PSF.

1.03 SUBMITTALS

- A. Shop Drawings:
 - 1. Submit complete shop drawings prior to fabrication.
 - 2. Indicate metal thickness, construction, installation and anchorage details.
- B. Samples:
 - 1. Section of window wall assembly with glass.
 - 2. If finish is selected, submit sample of finish indicated.

ALUMINUM ENTRANCES AND STOREFRONTS 08 4113 - 2 04/24/2025

If not indicated, submit color and finish samples for selection by the Architect, from manufacturer's entire standard selection.

C. Test Reports:

- 1. Submit test reports certified by the mullion manufacturer's testing laboratory.
- 2. Show compliance with performance requirements.

D. Warranty:

1. Submit warranty as specified herein.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Deliver, handle and store doors and frames at the job site in such a manner as to prevent damage.
- B. Remove all damaged or otherwise unsuitable doors and frames from the job site.

1.05 WARRANTY

A. Provide written manufacturer's guarantee against defective workmanship and materials for a period of two (2) years.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Provide thermal barrier type mullion window and door system, to be approved by the Architect, as manufactured by one of the following approved manufacturers:
 - 1. "EFCO"
 - 2. "Kawneer"
 - 3. "Tubelite"
 - 4. "Vistawall"
 - "United States Aluminum"
 - 6. "Traco"
 - 7. "Wausau Window and Wall Systems"
 - 8. "Arch Aluminum and Glass"
 - 9. "YKK AP"
 - 10. "Manko Window Systems"
 - 11. "Graham Architectural Products"
- B. Clarification that any/all aluminum window, curtain walls and entrances and storefronts in the scope of work are to all be provided by a single source manufacturer for the entire project.

PROJECT NO. 24-179.000 Harrison REMC - Addition and Renovation Harrison REMC

ALUMINUM ENTRANCES AND STOREFRONTS 08 4113 - 3 04/24/2025

C. Basis of Specification:

- 1. Window Wall Systems:
 - a. "EFCO", Series 403 (T), Thermal Storefront Framing.
 Provide at all locations exposed directly to the exterior.
 - b. "EFCO", Series 402 (NT), Non-Thermal Storefront Framing.
 Provide at all locations interior to the building, including interior unit of vestibules, unless otherwise indicated.

2. Door Systems:

- c. Wide Stile: "EFCO", Series D500 Wide Stile Doors, 1-3/4" Standard Doors.
- d. Custom modified to provide for widths and depths of stiles and rails as indicated on the Drawings, Door Elevations, and as specified herein.

2.02 MATERIALS

A. Aluminum Extrusions:

- 1. ASTM B 221.
- 2. Alloy 6063-T5.
- 3. Finish: Class 1 Anodic Coating with integral color, AA-M12-C22. Dark Bronze anodized to match existing building.

B. Aluminum Sheets:

- 1. ASTM B209.
- 2. Alloy 5005 where exposed, 3003 where concealed.
- Finish: Match extrusions.

C. Fasteners and Anchors:

1. Stainless steel or aluminum, finish to match extrusions at exposed fasteners.

D. Glass:

- 1. 1 inch insulating glass for all exterior glass applications.
- 2. 1/4 inch glass for all interior applications and all door units.
- 3. See Section 08 8100 for glass specifications.
- 4. See drawings for window, door and frame elevations.

E. Thermal Break:

- 1. Poured polyurethane or PVC, standard with manufacturer.
- 2. 3/8 inch minimum thickness.

F. Setting Blocks:

1. As specified in Section 08 8100.

ALUMINUM ENTRANCES AND STOREFRONTS 08 4113 - 4 04/24/2025

- G. Glazing Gaskets:
 - 1. Elastomeric gaskets of type recommended by window manufacturer.
- H. Glazing Tape:
 - 1. Shimmed polymer type recommended by window manufacturer.
- I. Perimeter Joint Sealer:
 - 1. As specified in Section 07 9200.
- J. Backup Joint Filler:
 - 1. Closed-cell expanded polyethylene, as specified in Section 07 9200.
- K. Joint Cleaner:
 - 1. Cleaner recommended by sealant manufacturer for the specified joint surface condition.
- L. Joint Primer and Sealer:
 - 1. Compounds recommended by sealant manufacturer for the specific joint surface conditions.
- M. Bond Breaker:
 - 1. Polyethylene tape.
- N. Weatherstripping:
 - 1. Neoprene, hypalon, vinyl, PVC, as standard with manufacturer, double row, continuous with vulcanized corners.
- O. Subsill:
 - High Performance extruded aluminum with thermal break, and integral weep hole system.
- P. Provide all blocking, backings and supports in all horizontal and vertical members as required for reinforcing of all door hardware as specified herein or in Section 08 7100.
- Q. Hardware:
 - 1. See Section 08 7100 Finish Hardware for all other items not listed herein.
 - 2. Cylinder Collars: Anodized aluminum. Cylinder specified in Section 08 7100.
 - 3. Weatherstripping (Provide on all exterior doors):
 - a. Vinyl, Neoprene, EPDM, TPE (thermoplastic elastomer), or silicone.
 - b. Full length and width of opening at each condition.
 - c. Provide weatherstripping seal sets at entire perimeter jambs and head of all exterior doors, whether scheduled or not.

ALUMINUM ENTRANCES AND STOREFRONTS 08 4113 - 5 04/24/2025

- d. All weatherstripping sets shall be determined by the door hardware supplier as appropriate to the application and able to provide a weather-tight and weather-proof seal, while allowing proper operation of the door and all other hardware.
- e. Jambs and Head:
 - Manufacturer's standard type per requirements of this specification herein.
- f. Door Bottom Sweep:
 - Vinyl, Neoprene, EPDM, TPE (thermoplastic elastomer), or silicone weathersweep, screw applied to door with concealed fasteners. Finish to match door.

2.03 FABRICATION

A. Window Wall Members:

- 1. Main extruded members: Minimum thickness .075 inches minimum.
- 2. Vertical and horizontal framing members: 2 inches nominal face dimension.
- 3. Perimeter members: 2 inches nominal face dimension.
- 4. Overall depth: 4-1/2 inches nominal.

B. Door Members:

- 1. Minimum Thickness: .075" minimum.
- 2. Overall Depth: 1-3/4 inches nominal.
- 3. Vertical Stiles: Provide as indicated on Drawings or Door Elevations (modified wide stile). If not indicated, provide 5 inches nominal width (wide stile).
 - Reinforce for continuous hinges specified herein or in Section 08 7100.
- 4. Top Rail: Provide as indicated on Drawings or Door Elevations (modified wide stile).
 - If not indicated, provide 5 inches nominal width (wide stile).
 - Reinforce for closers or holders specified herein or in Section 08 7100.
- 5. Intermediate Panic Rail: Provide as indicated on Drawings or Door Elevations (modified wide stile). If not indicated, provide 6 inches nominal width.
 - Location to be centered on panic device with dimension as required by Code and ADA. Reinforce for panic devices specified herein or in Section 08 7100.
- 6. Bottom Rail: 10 inches nominal width (modified). Accessory line as required for extra tall rail.

C. Thermal Break:

- 1. Provide thermal break on all window members.
- 2. Poured in place, self-adhering elastomer.
- 3. Do not violate or bridge the thermal break with hardware or fasteners.
- D. Preassemble all units to the greatest extent possible to minimize field jointing and assembly at the site. Disassemble units only to the extent necessary to comply with shipping limitations.
- E. Fabricate all units to produce uniform sight lines and to be level, plumb, and in same plane as adjacent panels.
- F. Accurately fabricate all joints for proper fit and weld all corners.
- G. Provide slotted holes or other acceptable means for erection adjustment.

- H. Protect exposed surfaces against damage from scratches and discoloration.
- I. Provide fully resilient settings for glass panels by use of neoprene gaskets on both sides of glass.

PART 3 - EXECUTION

3.01 PREPARATION

A. Examine all surfaces of opening and verify dimensions. Installation of frames constitutes acceptance of the existing conditions.

3.02 INSTALLATION

- A. Install window walls, doors and hardware in accordance with manufacturer's instructions.
- B. Assemble and anchor the various components to allow for expansion and contraction, maintaining a watertight condition.
- C. In general, for field assembly, conform to welding and joining requirements specified for shop fabrication.
- D. Install items plumb, straight, square, level and in their proper elevation, plane and location, and in proper alignment with other work. Employ only skilled workmen and erection.
- E. Install doors plumb and in alignment with frames. Apply hardware in accordance with hardware manufacturer's instructions. Drill and tap for machine screws. Adjust door installation for free and easy movement with uniform clearances and contact at stops.
- F. Use shims as required.
- G. Caulk perimeter after all lime, mortar, plaster and other corrosive materials have been removed from aluminum surface with solvents not harmful to finish. Provide backer rods as required.
- H. Install glass in window walls in accordance with recommendations of the mullion system manufacturer and requirements specified in Section 08 8100.

SUBMITTAL CHECKLIST

- 1. Shop Drawings.
- 2. Samples.
- 3. Test Reports.
- 4. Warranty.

END OF SECTION 08 4113

SECTION 08 5653

TSS BR TRANSACTION WINDOW - ARCHED BACKER

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Prefabricated bullet resistant aluminum frame windows with cash transaction tray.

1.2 REFERENCES

- A. Underwriters Laboratory UL 752-Standard for Bullet Resisting Equipment.
- B. ASTM E119-98- Standard Test Methods for Fire Tests of Building Construction and Materials.
- C. ASTM B 209/B 209M- Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate.
- D. ASTM A 666-Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar.

1.3 ACTION SUBMITTALS

- A. Refer to Section 01 3100 SUBMITTAL PROCEDURES.
- B. Product Data: For each type of framing [and glass] including manufacturer recommended installation instructions.
- C. Shop Drawings: Include plans, elevations, sections, details, attachment to other work [and glazing details].
- D. Samples: For each exposed finish.

1.4 INFORMATION SUBMITTALS

- A. Manufacturer's Instructions: for installation and cleaning of TSS Bullet Transaction Window Assemblies. All required submittals shall be approved prior to installation.
- B. Product Test Reports: Indicating compliance with requirements
- C. Warranty: Sample of finish warranty

1.5 CLOSEOUT SUBMITTALS

- A. Refer to Section 01 7800 CLOSEOUT SUBMITTALS.
- B. Maintenance data.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Refer to Section 01 6500 PRODUCT DELIVERY AND HANDLING
- B. Protect windows and accessories in accordance with AAMA CW-10 "Care and Handling of Architectural Aluminum from Shop to Site" until Substantial Completion.
- C. Deliver materials to the project site with the manufacturer's UL Listed Labels intact and legible. Handle the materials with care to prevent damage. Store materials inside and under cover, stack flat and off floor. Project conditions (temperature, humidity, and ventilation) shall be within the maximum limit recommendations provided by manufacturer. Do not install products stored in conditions outside manufacturer's recommended limits.

1.7 WARRANTY

- A. Workmanship Warranty: All materials shall be warranted against defects for a period of 1 year for the date of receipt at the project site. Provide certificates of manufacturer's standard limited warranty with closeout documents.
- B. Finish Warranty: Manufacturer's warranty against deterioration of factory finishes for the period of 5 years from the date of Substantial Completion.

PART 2 – PRODUCTS

2.1 MANUFACTURED UNITS

- A. Basis of Design:
 - 1. Subject to compliance with requirements, provide products by the following:
 - a. Total Security Solutions, Inc., 935 Garden Lane, Fowlerville, MI 48836, 866 734-6277. Attn: Sales Department, sales@tssbulletproof.com. Web: www.tssbulletproof.com.
 - 2. Subject to compliance with requirements and approval by Architect, manufacturers of products of equivalent design may be acceptable if approved in accordance with 01 6200 PRODUCT OPTIONS AND SUBSTITUTIONS.
- B. Design Performance:

- 1. Through the design, manufacturing techniques and material application, the TSS Arched Backer Transaction Window shall be of the "non-ricochet" type. This design is intended to permit the capture and retention of an attacking projectile lessening the potential of a random injury or lateral penetration.
- 2. This assembly shall provide single transaction positions utilizing the "Acrylic" backer configuration. This design shall employ an acrylic voice ports in transaction glazing to complete the "Hole and Backer" design. Each transaction position may have a stainless steel dip tray as shown on the drawings.
- 3. Components must be manufactured in strict accordance with the specifications, design and details. All vision panels shall be cut to size with all exposed edges polished. Necessary holes shall be pre drilled and tapped where required.
- 4. Stainless Steel assembly screws and acrylic spacers shall be provided. Clear anodized angles and channels shall be provided. Anchor screws shall be provided by the installer.
- 5. No field alterations to the construction of the units fabricated under the acceptable standards shall be allowed unless approved by the manufacturer and the Architect.
- 6. Standard manufacturing tolerances +/- 1/16" shall be maintained.

2.2 PERFORMANCE CRITERIA

A. Ballistic Resistant:

1. Level 3 in accordance with UL 752 – Testing for Ballistic Resistance for the complete assembly including framing, glazing and panels.

2.3 FABRICATION

- A. Aluminum sections to be manufactured in accordance with ASTM B209, Extruded aluminum alloy 6063 T5 Anodized to match the existing décor and be free of sharp edges or burrs when in place.
- B. Glazing Channel: U-Channel specifically designed for securing transparencies tightly in place. Angles and stops are only acceptable for top attachment.
- C. Tolerances: All joints and connections shall be tight, providing hairline joints and true alignment of adjacent members

2.4 FRAME FINISH

A. Factory-applied finish:

- 1. Architectural Class I, clear coating AA-M10C22A41 Mechanical Finish Chemical Finish: etched, medium matte; 0.70 mils minimum complying with AAMA 611 "Voluntary Specification for Anodized Architectural Aluminum"
- B. Cap the bottom of glazing with the corresponding finish material selected for frame.

2.5 GLAZING

- A. Glazing shall be as shown on the drawings or as specified separately in 08 8853-1 SECURITY GLAZING
 - 1. <u>Bullet Resistant Level 3</u>

1 1/4" LP 1250 Laminated

1 1/4" TSS-003 L/S Glass Clad

- B. Acrylic: All acrylic pieces shall meet or exceed UL 752 testing for ballistic integrity. All edges of acrylic shall be filed, sanded after cutting to remove rough edges and then polished until "water clear" transparent. All through holes for fasteners shall be 3/8" in diameter and be drilled clean. Chipped edges at through-hole exit points are not acceptable. All acrylic pieces shall be supported in the proper glazing channel designed for this purpose (see aluminum, Section D).
- C. Glazing gaskets:

1. Interior: Closed cell neoprene.

2. Exterior: Solid neoprene.

2.6 ACCESSORIES

- A. Anchors: Fully concealed manufacturer recommended.
- B. Mounting plates and connecting clips shall be fabricated from 1/8" thick clear polycarbonate.
- C. Cash Tray:

1. Location: Recessed.

2. Finish: Brushed Stainless Steel #4 finish.

3. Material: 18 gauge stainless steel.

- 4. Dimensions: 16" x 10" from the outside edge of flanges with a clear opening.
- 5. Provide a counter 1 1/2" thick by full width of window to accommodate recessed cash tray. The countertop shall be as shown in drawings and as specified in Division 06.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prior to beginning installation, verify that all supports have been installed as required by the Contract Documents and architectural drawings, and Shop Drawings have been approved.
- B. Notify Architect of any unsatisfactory preparation that is responsibility of others.
- C. Clean and prepare all surfaces per manufacturers recommendations as required for achieving the best results for the substrate under the project conditions.
- D. Verify field dimensions of openings prior to fabrication of framing.
- E. Coordinate structural requirements to ensure proper attachment and support.
- F. Do not begin installation of material until all unsatisfactory conditions have been resolved and approved by Architect.

3.2 INSTALLATION

- A. Do not begin installation until openings have been verified and surfaces properly prepared in accordance with Drawings.
- B. Install in accordance with manufacturer's instructions and UL 752. Set all equipment plumb.
- C. All products shall be installed per installation instructions provided by manufacturer.
- D. Security window units shall arrive on site completely pre-fabricated to field dimensions approved by Shop Drawings.
- E. Install framing and secure to structure in accordance with manufacturer's recommendations and approved shop drawings.
- F. Provide required support and securely fasten and set windows plumb, square, and level without twist or bow.
- G. Apply sealant in accordance with window and sealant manufacturer's recommendations as indicated in installation instructions.
- H. Remove excess sealant and leave exposed surfaces clean and smooth

3.3 PROTECTION

A. Clean and protect windows from damage during ongoing construction operations. If damage occurs, remove and replace as required to provide windows in their original, undamaged

SECURITY TRANSACTION WINDOW 08 5653 - 6 04/24/2025

condition.

- B. Inspection and Cleaning: Verify installation is complete and complies with manufacturer's requirements.
- C. Provide final cleaning of product and accessories, removing excess sealant, labels and protective covers.
- D. Touch-up, repair or replace damaged products prior to Substantial Completion.

END OF SECTION

SECTION 08 5653

TSS BULLET RESISTANT FRAMING SYSTEM – BL 1.75

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Bullet resistant aluminum BL 1.75 framing system.

1.2 REFERENCES

- A. Underwriters Laboratory UL 752-Standard for Bullet Resisting Equipment.
- B. ASTM E119-98- Standard Test Methods for Fire Tests of Building Construction and Materials
- C. ASTM C 1172 Standard Specification for Laminated Architectural Flat Glass.
- D. ASTM B 209 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- E. ASTM B 221 Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

1.3 ACTION SUBMITTALS

- A. Refer to Section 01 3300 Submittal Procedures
- B. Product Data: For each type of framing and glass including manufacturer recommended installation instructions.
- C. Shop Drawings: Include plans, elevations, sections, details, attachment to other work.
- D. Samples: For each exposed finish.

1.4 INFORMATION SUBMITTALS

- A. Product Test Reports: Indicating compliance with requirements
- B. Warranty: Sample of finish warranty

1.5 CLOSEOUT SUBMITTALS

A. Refer to Section 01 7800 Closeout Submittals

B. Maintenance data.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Refer to Section 01 6500 PRODUCT DELIVERY AND HANDLING
- B. Deliver materials to the project site with the manufacturer's UL Listed Labels intact and legible. Handle the materials with care to prevent damage. Store materials inside and under cover, stack flat and off floor. Project conditions (temperature, humidity, and ventilation) shall be within the maximum limit recommendations provided by manufacturer. Do not install products stored in conditions outside manufacturer's recommended limits.

1.7 WARRANTY

- A. Workmanship Warranty: All materials shall be warranted against defects for a period of [1] year for the date of receipt at the project site. Provide certificates of manufacturer's standard limited warranty with closeout documents.
- B. Finish Warranty: Manufacturer's warranty against deterioration of factory finishes for the period of 5 years from the date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

- A. Basis of Design:
 - 1. Subject to compliance with requirements, provide products by the following:
 - a. Total Security Solutions, Inc., 935 Garden Lane, Fowlerville, MI 48836, 866 734-6277. Attn: Sales Department, sales@tssbulletproof.com. Web: www.tssbulletproof.com.
 - 2. Subject to compliance with requirements, manufacturers of products of equivalent design may be acceptable if approved in accordance with 01 6200 PRODUCT OPTIONS AND SUBSTITUTIONS

B. Design Performance:

- 1. Through the design, manufacturing techniques and material application the <u>TSS Bullet Resistant Aluminum BL 1.75 Framing System</u> shall be constructed of extruded aluminum in 6061-T6 alloy/tempered.
- 2. Protection rating shall be UL Standard 752 Level 3.
- 3. Door and frame shall have no exposed fasteners.

- 4. Corner joints shall consist of extruded and keyed aluminum spline with continuous 3/8" diameter steel tie rod at door top and bottom rails.
- 5. All joints and connections shall be tight, providing hairline points and true alignment of adjacent members.
- 6. Panels shall not be removable from threat side.
- 7. Door system to be available in right hand, left hand and reverse swings.
- 8. Door to defeat ballistic assaults from a .44 magnum superpower small arms handgun as tested with UL Standard 752.
- C. Field alterations to the construction of the assembly fabricated under the acceptable standards are not allowed unless approved in writing by the manufacturer and the Architect.
- D. Standard manufacturing tolerances +/- 1/16" shall be maintained.
- E. Materials shall meet or exceed UL 752 requirements.

2.2 PERFORMANCE CRITERIA

A. Ballistic Resistant:

1. Level 3 in accordance with UL 752 – Testing for Ballistic Resistance for the complete assembly including framing, glazing and panels.

2.3 FABRICATION

- A. Bullet Resistant Fixed Framing System:
 - 1. Head and sill shall be one piece extrusions with no integral weep system at the sill.
 - 2. Jambs shall be two piece extrusions with removable faces to allow for re-glazing.
 - 3. Mullions shall be three piece extrusions with removable faces to allow for glazing and individual lite replacement.
 - 4. All joints and connections shall be tight, providing hairline joints and true alignment of adjacent members.
 - 5. Glazing must not be removable from the threat side of the sash.
 - 6. Provide to dimension heights and widths indicated on the Drawings.
- B. System shall be designed to defeat ballistic assaults from a .44 magnum handgun in accordance with UL 752, Level 3.

- C. Aluminum Frames: Head, Sill and Jamb Size: 1-3/4" x 4", Mullion 3-1/2" x 4".
- D. Glazing shall conform to UL 752 for protection Level 3.
- E. Glazing Channel: U-Channel specifically designed for securing transparencies tightly in place. Angles and stops shall only be used for top attachment. All exposed aluminum edges shall be clean cut and have no burrs. Exposed corners shall be rounded and sanded.
- F. Tolerances: All joints and connections shall be tight, providing hairline joints and true alignment of adjacent members

2.4 FRAME FINISH

A. Factory-applied finish:

Architectural Class I, clear coating AA-M10C22A41 Mechanical Finish Chemical Finish: etched, medium matte; 0.70 mils minimum complying with AAMA 611 "Voluntary Specification for Anodized Architectural Aluminum"

B. Cap the bottom of glazing with the corresponding finish material selected for frame.

2.5 GLAZING

A. Glazing shall be as shown on the drawings or as specified separately in 08 8853-1 SECURITY GLAZING

Bullet Resistant Level 3
1 1/4" LP 1250 Laminated
1 1/4" All Poly 1250
1 1/4" TSS-003 L/S Glass Clad

- B. Acrylic: All acrylic pieces shall meet or exceed UL 752 testing for ballistic integrity. All edges of acrylic shall be filed, sanded after cutting to remove rough edges and then polished until "water clear" transparent. All through holes for fasteners shall be 3/8" in diameter and be drilled clean. Chipped edges at through-hole exit points are not acceptable. All acrylic pieces shall be supported in the proper glazing channel designed for this purpose (see aluminum, Section D).
- C. Glazing gaskets:

1. Interior: Closed cell neoprene.

2. Exterior: Solid neoprene.

2.6 ACCESSORIES

A. Anchors: Fully concealed manufacturer recommended.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prior to beginning installation, verify that all supports have been installed as required by the Contract Documents and architectural drawings, and Shop Drawings have been approved.
- B. Notify Architect of any unsatisfactory preparation that is responsibility of others.
- C. Clean and prepare all surfaces per manufacturers recommendations as required for achieving the best results for the substrate under the project conditions.
- D. Verify field dimensions of openings prior to fabrication of framing.
- E. Coordinate structural requirements to ensure proper attachment and support.
- F. Do not begin installation of material until all unsatisfactory conditions have been resolved and approved by Architect.

3.2 INSTALLATION

- A. Do not begin installation until openings have been verified and surfaces properly prepared in accordance with Drawings.
- B. Install in accordance with manufacturer's instructions and UL 752. Set all equipment plumb.
- C. All products shall be installed per installation instructions provided by manufacturer.
- D. Security window units shall arrive on site completely pre-fabricated to field dimensions approved by Shop Drawings.
- E. Install framing and secure to structure in accordance with manufacturer's recommendations and approved shop drawings.
- F. Provide required support and securely fasten and set windows plumb, square, and level without twist or bow.
- G. Apply sealant in accordance with window and sealant manufacturer's recommendations as indicated in installation instructions.
- H. Remove excess sealant and leave exposed surfaces clean and smooth.

3.3 PROTECTION

- A. Clean and protect windows from damage during ongoing construction operations. If damage occurs, remove and replace as required to provide windows in their original, undamaged condition.
- B. Inspection and Cleaning: Verify installation is complete and complies with manufacturer's requirements.
- C. Provide final cleaning of product and accessories, removing excess sealant, labels and protective covers.
- D. Touch-up, repair or replace damaged products prior to Substantial Completion.

END OF SECTION

SECTION 08 5659 - DRIVE-THRU WINDOWS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. All drive-thru windows, as shown on the Drawings and specified herein.

1.02 SUBMITTALS

Submit the following:

- A. Manufacturer's Literature:
 - 1. Manufacturer's published catalog pages and materials description.
 - 2. Detailed information of unit construction and installation.
 - 3. Manufacturer's data on glass.
- B. Shop Drawings:
 - 1. Details on installation with building construction, specific to the project conditions.
 - 2. Indicate anchorage locations and details.
 - 3. Indicate details of installation through wall.

1.03 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store and handle material at the job site in such a manner as to prevent damage.
- B. Deliver, store and handle material in strict accordance with the manufacturer's recommendations.

PART 2 - PRODUCTS

2.01 MANUFACTURER AND PRODUCT

- A. Provide one of the following approved products:
 - 1. "Ready Access", 603 Flushmount Window with Transaction Drawer.

2.02 PRODUCT DESCRIPTION

A. Overall Frame Size: 47-1/2" wide x 58-1/2" high (43-1/2" H fixed window). Complete unit depth of 17".

- B. Cash Drawer: 9-1/2" wide x 14-1/4" deep x 2-1/4" without deal tray.
- C. Materials:
 - 1. All extruded aluminum components of frame and service window.
 - 2. Dark bronze anodized aluminum finish.
 - 3. Glass to be 3/4" Solarban 70 XL Insulated Low E.
- D. Electrical:
 - 1. Speaker supplied with cord & plug for 120 volt / 60 / 1 phase connection .

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Examine all surfaces to receive parts of the Work specified herein. Verify all dimensions of in-place and subsequent construction. Installation of materials constitutes acceptance of the existing conditions.
- B. Install unit plumb and level within wall opening.
- C. Anchor unit within wall opening per manufacturer's requirements.
- D. Caulk and sealant at entire perimeter of unit, interior and exterior.

3.02 ADJUSTMENT AND PROTECTION

- A. Adjust unit as required for proper operation.
- B. Protect all surfaces from damage until Final Acceptance.

SUBMITTAL CHECK LIST

- 1. Manufacturer's Literature.
- 2. Shop Drawings.

END OF SECTION 08 5659

SECTION 08 7100 - FINISH HARDWARE

PART 1 – GENERAL

1.01 WORK INCLUDED

Furnish labor, materials, equipment, special tools, supervision and services required to complete all Finish Hardware work as indicated, noted, detailed, and scheduled on the Drawings and specified herein.

1.02 OWNER VERIFICATION AND REVIEW MEETING

Contractor and hardware supplier are required to meet with the Owner to review and verify the hardware schedule and sets per door. Contractor and supplier shall be responsible for verifying door and hardware handings, lockset operations, and keying required. All information, except for keying, shall be included in the submittals prior to being forwarded to the Architect.

1.03 KEYING MEETING

Contractor and hardware supplier are required to meet with the Owner to review and verify all requirements for keys and keying per door. Incorporate and coordinate all locking hardware in the Project to provide for a complete and unified system of keying. A complete keying schedule shall be submitted to the Architect and Owner, for approval, within seven days after the meeting. Determine cylinders and cores required to match or be compatible with any existing building master keying systems in place as per the Owner's requirements.

1.04 QUALITY ASSURANCE

A. Hardware Supplier:

- 1. An established firm dealing in architectural commercial door hardware, with an office, sample room, warehousing facilities and an adequate inventory.
- 2. Has demonstrated a record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project.
- 3. Supplier must have, as an employee, an experienced and certified Architectural Hardware Consultant (AHC), who is available to Owner, Architect, and Contractor, for consultation throughout the course of the Work.
- 4. Provide a competent technician to service the hardware on the job as may be required.
- 5. A regular franchised distributor for all materials required for this project.
- 6. Shall replace damaged or defective materials prior to shipment to the site. Repairs not acceptable.
- 7. Shall meet with the Owner to review and verify all requirements and keying required.
- 8. Shall conduct a comprehensive training class for the Owner's maintenance personnel prior to date of acceptance on all special application mechanical hardware provided under this Section.
- B. All work to comply with the latest requirements of ADA, ICC/ANSI A117.1, and the accessibility chapter of the Building Code.
- C. All work to comply with the latest requirements of NFPA 80, NFPA 101 and NFPA 252 in providing hardware for all fire rated openings.

1.05 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. ANSI A117.1, Providing Accessibility and Usability for Physically Handicapped People.
 - 2. ANSI/BHMA A156.1, Butts and Hinges.
 - 3. ANSI/BHMA A156.3, Exit Devices.
 - 4. ANSI/BHMA A156.4, Door Controls-Closers.
 - 5. ANSI/BHMA A156.6, Architectural Door Trim.
 - 6. ANSI/BHMA A156.7, Template Hinge Dimensions.
 - 7. ANSI/BHMA A156.13, Locks & Latches, Mortise.
 - 8. ANSI/BHMA A156.16, Auxiliary Hardware.
 - 9. ANSI/BHMA A156.18, Materials and Finishes.
- B. American Society for Testing and Materials (ASTM):
 - 1. ASTM-E2074-2001 Standard Test Method for Fire Tests of Door Assemblies, Including Positive Pressure Testing of Side-Hinged and Pivoted Swinging Door Assemblies.
- C. Code of Federal Regulations (CFR) Americans with Disabilities Act (ADA):
 - 1. Latest version as adopted, approved and accepted by the State.
- D. Door and Hardware Institute (DHI):
 - 1. Keying Systems and Nomenclature.
 - 2. Hardware for Labeled Fire Doors.
 - 3. Sequence and Format for the Hardware Schedule.
 - 4. Abbreviations and Symbols.
- E. National Fire Protection Association (NFPA):
 - 1. NFPA 80 Standard for Fire Doors and Windows.
 - 2. NFPA 101 Life Safety Code.
 - 3. NFPA 105 Recommended Practice for the Installation of Smoke-Control Door Assemblies.
 - 4. NFPA 252 Standard Methods of Fire Tests of Door Assemblies.
- F. Steel Door Institute (SDI):
 - 1. SDI 100 Recommended Specifications for Standard Steel Doors and Frames.
- G. Underwriter's Laboratories, Inc. (UL) UL Standards for Safety:
 - 1. UL 10C-97 Positive Pressure Fire Tests of Door Assemblies.
 - 2. UL 228 Door Closer-Holders, With or Without Integral Smoke Detectors.
 - UL 305 Panic Hardware.

1.06 SUBMITTALS

A. Hardware Schedule:

- 1. Submit a completely detailed schedule of finish hardware in "Vertical Format" per the Door and Hardware Institute's Sequence and Format. Include a complete typewritten schedule indicating every item required for each door or opening. Schedules include, but are not limited to; the manufacturers, model numbers, materials, types, styles, sizes, handings, finishes, etc.
- 2. Numbering of hardware sets is to match those as indicated in the Specifications and as noted on Schedule on the Drawings. Cross reference plans and schedules.
- 3. Include all prep of doors and frames required for hardware, including mounting heights, locations and dimensions.
- 4. Clearly indicate door sets altered from that specified.

B. Owner Verification and Review Meeting:

- 1. Submit with submittals, confirmation that the meeting was conducted with the Owner.
- 2. Include list of those present at the meeting.
- 3. Itemize all items resulting from discussions of the meeting in a "meeting minutes" format.
- 4. Review of set functions shall be done on a "per door" basis, and not merely by sets. Sets included herein is for the convenience of review by grouping like conditions and not intended to necessarily be representative of same function for all doors in the set. Verify with Owner.

C. Manufacturer's Product Information:

- 1. Furnish catalog cutsheets, drawings, and other descriptive data on all hardware items.
- 2. After final approval of the hardware by the Architect, furnish copies of submittals to door and frame suppliers and any other subcontractors and suppliers necessary for coordination and installation of door hardware complete.

D. Samples:

- 1. If requested by the Architect, submit one (1) sample of each different item of hardware for approval, accompanied by an itemized list showing where the different items are to be used, the manufacturer's number, the finish, sizes applicable, and the number required.
- 2. Submit a full sample ring of hardware finishes for all manufacturers included.
- 3. After review, the samples will be returned to the supplier.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Deliver hardware or templates, or both to factory or to building as required by those furnishing items to which hardware is to be applied.
- B. Plainly mark packages or hardware so locations of use may be ascertained without breaking the packages.
- C. Deliver work so all work will progress without delay or interruption.
- D. The Contractor is responsible for providing adequate locked storage space for the scheduled quantities of hardware when delivered to the job.

1.08 PROJECT CONDITIONS

- A. The hardware supplier is responsible to examine the door and frame drawings and elevations to determine the suitability of hardware specified.
- B. It will be this supplier's responsibility to furnish the correct hardware to fit the door and frame conditions as indicated for correct and proper operation.

1.09 Warranty

A. Furnish manufacturer's limited warranty covering defects in materials and workmanship for periods indicated as follows:

Door Closers: Minimum Ten (10) years.
 Locksets: Minimum Ten (10) years.
 Exit Devices: Minimum Five (5) years.

4. Hinges: Lifetime.

5. All Other Hardware: Minimum One (1) year.

PART 2 - PRODUCTS

2.01 KEYING AND KEYS

- A. Key system must match Owner's existing building system.
- B. Key, master key and grandmaster key to Owner's requirements. The key schedule will be developed by hardware supplier in cooperation with Owner's representative.
- C. Provide six (6) grandmaster keys, six (6) master keys per group, and two (2) keys per lock.
- D. Engrave all keys with the words **UNLAWFUL TO DUPLICATE THIS KEY**.

2.02 LOCKS, LATCHES AND CYLINDERS

- A. Cylinders may be keyed by local locksmith of Owner's choice.
- B. All cylinders to have removable cores.
- C. Provide construction cores on all doors as required.
- D. Hardware supplier must be an authorized stocking distributor of the lock they propose to furnish.
- E. Provide a cylinder for every lock requiring one, whether specifically specified or not.

FINISH HARDWARE 08 7100 - 5 04/24/2025

F. Unless specifically indicated otherwise, all cylinders supplied throughout the entire project are to be capable of being keyed from the same master keying system. Key cylinders in dogged panic devices, keyed removable mullions, coiling doors, overhead doors, etc. to match building master keying system.

2.03 FINISHES

A. All finishes, typical, are to be:

Satin Chrome US26D (652 Plated Steel, 626 Plated Brass) unless otherwise indicated.

Materials unable to have this finish applied are to have a finish to closely match and compliment (aluminum, dulled chrome, clear satin anodized, satin stainless steel, mil. painted, etc.).

- B. All finishes at dark bronze anodized doors to be:
 - Dark Bronze USL2 (695 Powder Steel, 695 Powder Brass) unless otherwise indicated.

Materials unable to have this finish applied are to have a finish to closely match and compliment

(Satin Bronze, Oil-Pubbed US10B(613, Duranodic Dark Bronze, 313, dark brown nating, weathered/a

(Satin Bronze, Oil-Rubbed US10B/613, Duranodic Dark Bronze 313, dark brown patina, weathered/aged oiled bronze, weathered/aged antique bronze, painted, etc.).

- C. All hardware for painted or other aluminum storefront doors to have finish to match doors and frames. Contact Architect during bidding for any clarifications or concerns in providing finishes to match.
- D. Contact Architect during bidding for any clarifications or concerns for finishes to be provided.

2.04 HARDWARE SETS

A. Verification:

- The following schedule is intended to describe, in general, the types and quantities of hardware required for the various types of doors and for the other parts of the building which will require hardware. Do not consider this schedule as entirely inclusive.
- 2. Hardware supplier is responsible for visiting the jobsite and reviewing the requirements for each installation. The supplier shall be responsible for providing all hardware as required to serve the door's intended purpose and intent and include all costs for such in their bid.
- 3. Hardware supplier is responsible for coordination of all hardware items used together in conjunction with one another, mounting as required to coordinate with all doors and frames as designed, and include all costs for such in their bid.
- 4. Hardware supplier is responsible for conducting the Owner Verification and Review Meeting, incorporating all items into submittals, and include all costs for such in their bid.
- 5. Hardware supplier is responsible for conducting the Owner Keying Meeting, determining cylinders and cores required to match any existing building master keying system, provide and install compatible items and key per Owner's requirements.

B. General Requirements:

- 1. Provide all fire and smoke seals and gaskets as required per Code for all rated door assemblies and for all smoke partition assemblies; full perimeter at head, jambs and bottom.
- 2. Provide glass and materials as required to meet and maintain fire ratings for all assemblies.
- 3. All items as listed in hardware sets are "per door", unless otherwise indicated.
- 4. All hardware to be mounted per ADA and ICC/ANSI A117.1.

2.05 HARDWARE PRODUCTS

A. Acceptable Manufacturers:

Hardware Item Manufacturer

Hinges: Ives, Hager, McKinney, Stanley, Bommer

Locksets (Cylindrical): Schlage, Falcon, Best, Sargent, Hager, Dorma, Yale Deadbolts: Schlage, Falcon, Best, Sargent, Hager, Dorma, Yale Cylinders: Schlage, Falcon, Best, Sargent, Hager, Dorma

Keyway Cores: Match Owner's existing building system

Panic Devices: Von Duprin, Precision (PHI), Hager, Falcon, Sargent, Dorma, Yale

Push/Pulls: Ives, Glynn-Johnson, Hager, Rockwood, Trimco

Surface Closers: LCN, Sargent, Hager, Falcon, Norton, Stanley, Dorma, Yale

Wall/Floor Stops: Ives, Glynn-Johnson, Hager, Rockwood, Trimco Wall/Floor Holders: Ives, Glynn-Johnson, Hager, Rockwood, Trimco

Removable Mullions: Von Duprin, Falcon, Detex, Sargent, Dorma, Stanley, Yale, Precision (PHI)

Thresholds: Hager, NGP, Pemko, Reese, Zero

Seals/Gaskets/Sweeps/Bottoms: Hager, NGP, Pemko, Reese, Zero

Overhead Drip Guards: Hager, NGP, Pemko, Reese, Zero Flushbolts/Dustproof Strikes: Ives, Hager, Rockwood, Trimco

Plates: Ives, Hager, Rockwood, Trimco Silencers: Ives, Hager, Rockwood, Trimco Automatic Door Bottoms: Hager, NGP, Pemko, Reese

Position Switches: Schlage, Securitron

Electric Strikes: Von Duprin

B. Hinges:

- 1. All interior standard hinges shall be one of the following:
 - a. Ives, 5BB1WT, steel hinge and pin.
 - b. Hager, BB1168, steel hinge and pin.
- 2. All exterior standard hinges shall be one of the following:
 - a. Ives, 5BB1HW, brass hinge and stainless steel pin.
 - b. Hager, BB1199, brass hinge and stainless steel pin.
- 3. All continuous hinges shall be one of the following:
 - a. Ives, 700, stainless steel.
 - b. Hager Roton, 790-900, stainless steel.
- 4. All continuous hinges shall be one of the following

(where finish other than clear is desired or to match painted or anodized aluminum storefronts):

- a. Ives, 112HD, aluminum geared.
- b. Hager Roton, 780-112, aluminum geared.
- 5. All interior spring hinges shall be one of the following:
 - a. Ives, 3CB1HW, steel.
 - b. Hager, 1250, steel.

- 6. All exterior spring hinges shall be one of the following:
 - a. Ives, 3CB1HW, brass hinge and pin.
 - b. Hager, 1150, brass hinge and pin.
- 7. Interior and exterior standard hinges shall be 5 knuckle, ball bearing, heavy weight, full mortise, wide throw template type hinges with flush barrel and non-removable pins.
- 8. All exterior hinges shall be of non-corrosive metals, stainless steel, brass, or aluminum as specified, and appropriate for finishes required. Painted or galvanized steel is not permitted. Hinges on all exterior entry doors and all doors receiving panic hardware shall be continuous hinge type and configuration, full height of door.
- 9. All interior standard hinges shall be capable of 180 degree throw.
 - Use wide throw hinges where necessary to clear jamb trim. Provide same material and finish as standard hinges such that all hinges match for like use and applications.
- 10. All continuous hinges at access control doors are to be provided with electric power transfer prep, located and sized as required to coordinate with devices, equipment, and wiring needs.
- 11. Except where label provisions require larger or heavier hinges or where specified otherwise:
 - a. Provide 1-1/2 pairs of hinges for each door up to 7'-6".
 - b. Provide 2 pairs of hinges for doors over 7'-6".
 - c. Use 4-1/2" hinges on doors up to 3'-4" wide.
 - d. Use 5" hinges on doors over 3'-4" wide.
- C. Locksets (Cylindrical):
 - 1. All standard-duty Grade 2 cylindrical locksets shall be one of the following:
 - a. Schlage, AL Series, "Saturn" lever and escutcheon.
 - b. Falcon, B Series, "Dane" lever and escutcheon.
 - c. Best, 7KC Series, "15" lever and "D" escutcheon.
 - d. Sargent, 7 Line Series, "L" lever and escutcheon.
 - e. Hager, 3500 Series, "Withnell" lever and escutcheon.
 - f. Dorma, CL700 Series, "LR" lever and escutcheon.
 - g. Yale, 4600(LN) Series, "Augusta AU" lever and escutcheon.
 - 2. All locksets shall have 2-3/4" backset with appropriate standard strike package.
 - 3. All classrooms shall be equipped with latch having a dead latching pin. Function shall provide for anti-intruder capabilities which enable the doors to be closed and locked from the inside of the room, allow egress from the inside without the use of a key, and remain locked upon re-closing without relocking by key. No deadbolt is permitted.

Function equal to:

- a. "Schlage" L9071, Classroom Security Lock.
- a. "Sargent" 38, Classroom Security Lock.
- 4. All other conditions, function and operation as selected by Owner from all manufacturer's available.
- D. Deadbolts (Cylindrical, when no mortise set is present):
 - 1. All heavy-duty Grade 1 deadbolts shall be one of the following:
 - a. Schlage, B560 Series.
 - b. Falcon, D100 Series.
 - c. Best, T Series.
 - d. Sargent, 34 Series.

- e. Sargent, 480 Series.
- f. Hager, 3100 Series.
- g. Dorma, D800 Series.
- h. Yale, 3500 Series.
- 2. Provide with standard backset and high security dead latching lockbolt.
- 3. Deadbolts from public rooms shall be equipped with anti-throw capabilities such that the latch cannot be thrown from the interior side of the room. Operation of the inside ADA compliant thumbturn shall allow the locked deadbolt to unlatch without the use of a key.
- 4. All other conditions, function and operation as selected by Owner from all manufacturer's available.

E. Panic Devices (Rim Type):

- 1. All panics shall be one of the following:
 - a. Von Duprin, 99 Series, "06" lever design.
 - b. Von Duprin, 35A Series, "06" lever design.
 - c. Stanley (PHI), Apex 2100 Series, "A" lever design.
 - d. Hager, 4500 Series, "Withnell" lever design.
 - e. Falcon, 25 Series, "Dane" lever design.
 - f. Sargent, 80 Series, "L" lever design.
 - g. Dorma, 9000 Series, "LR" lever design.
 - h. Yale, 7000 Series, "Augusta AU" lever design.
- 2. Provide Lever Trim with ANSI Function "08" on exterior of all devices, unless indicated otherwise. Only compression springs shall be used in devices, latches and outside trim and/or controls.
- 3. Where Door Pulls are scheduled, provide Ives 8190, 90 degree offset pull. 12" center-to-center x 1" diameter x 3-1/4" projection, concealed mounting, brass.
- 4. All exterior doors to receive locking cylinders with night latch function, unless indicated otherwise.
- 5. Provide Cylinder Dogging on all devices, unless specifically indicated otherwise.
- 6. Provide cylinders for all panic devices to be compatible for brand of locksets provided and/or for building's master keying system.
- 7. Provide fire rated devices for all rated door assemblies.
- 8. Exterior panic doors to have universal function, adjustable in the field for operation as desired.
- 9. All classrooms shall be equipped with anti-intruder capabilities which enable the doors to be closed and locked from the inside of the room, allow egress from the inside without the use of a key, and remain locked upon reclosing without relocking by key.
 - Provide Double Cylinder and Lever Trim. No dogging permitted.
- 10. All other conditions, function and operation as selected by Owner from all manufacturer's available.
- 11. Exit devices shall be tested to ANSI/BHMA A156.3 test requirements by a BHMA certified laboratory. A written certification showing successful completion of a minimum of 1,000,000 cycles shall be provided upon request.
- 12. Touch pad shall extend a minimum of one half of the door width. Maximum unlatching force shall not exceed 15 pounds. End cap will have three-point attachment to the door.
- 13. Provide roller strikes for all rim and surface-mounted vertical rod devices, ASA strikes for mortise devices, and manufacturer's standard strikes for concealed vertical rod devices.
- 14. All devices to incorporate a security dead-latching feature.
- 15. Provide removable mullion for any pair of doors where panic devices are used, whether scheduled or not, and whether frame is existing or new. Prep frames as required.
- 2. 16. In retrofit or renovation work, provide cover plate kit to cover cutouts required by existing exit device installations consisting of inside and outside plates for hinge stile cutouts, an inside plate for the lock stile, and all necessary hardware.

F. Push/Pulls:

- 1. All push plates shall be Hager, A40R, size: 6"x16", brass.
- 2. All pulls shall be Hager, 9G, brass.
- 3. All flush cup pulls shall be Hager, 17N, brass.

G. Surface Closers:

- 1. Push side condition (with parallel arm) shall be one of the following:
 - a. LCN, 4110 Series.
 - b. Sargent 351 Series.
 - c. Hager, 5200 Series.
 - d. Falcon, SC70 Series.
 - e. Norton 7570 Series.
 - f. Stanley D4550 Series.
 - g. Dorma 8916 Series.
 - h. Yale 4400 Series.
- 2. Pull side condition (with non-parallel arm) shall be one of the following:
 - a. LCN, 4010 Series.
 - b. Sargent 351 Series.
 - c. Hager, 5200 Series.
 - d. Falcon, SC70 Series.
 - e. Norton 7570 Series.
 - f. Stanley D4550 Series.
 - g. Dorma 8916 Series.
 - h. Yale 4400 Series.
- 3. Provide reduced force ADA cylinder.
- 4. Door closers shall be hydraulic, full rack and pinion action with a high strength cast iron or aluminum alloy cylinder. Cylinder body shall be 1-1/2" diameter, and double heat-treated pinion.
- 5. All closers shall have forged steel main arms and forearms.
- 6. Mounting shall be on the inside face of the door, interior to the room.
 - Closers shall not be seen on the corridor, hallway or public side of the door.
- 7. All covers shall be high impact plastic.
- 8. All finishes shall be powder coat aluminum.
- 9. Provide hold open functions where specified. All hold opens to be adjustable set up to 180 degrees.
- 10. Provide concealed closer in lieu of surface closer where a closer is used in conjunction with overhead stops/holders.
- 11. In all cases, the manufacturer's recommended table of sizes is to govern the size of closers to be furnished
- 12. Use through-bolts to fasten surface closers to mineral core wood and hollow metal doors.
- 13. Furnish special overhead closers where shown or specified.
- 14. Provide arms, corner brackets, mounting brackets, or drop plates as required.
- 15. Provide 180° door swing wherever possible.
- 16. Reduced force opening of less than 5 lbs. of force for interior hinged doors per ADA.
- 17. Closing speed of sweep period shall be adjusted so that from an open position of 70 degrees the door will take at least 3 seconds to move to a point 3 inches from the latch per ADA.

H. Wall/Floor Stops:

- 1. All wall stops shall be one of the following:
 - a. Ives, WS401CCV, brass.
 - b. Hager, 236W, brass.
- 2. All floor stops shall be one of the following:
 - a. Ives, FS436; FS438 if high stop condition is required, brass.
 - b. Hager, 241F; 243F if high stop condition is required, brass.
- 3. All heavy-duty floor stops shall be one of the following:
 - a. Ives, FS18S, steel stud grouted in concrete.
 - b. Hager, 269F, steel stud grouted in concrete.
- 4. Provide stops or bumpers wherever an opened door strikes any part of building construction, whether indicated or not. In general, provide wall mounted stops for all doors.
- 5. Furnish floor dome type where wall type cannot be used.
- 6. Furnish heavy-duty floor stops at all exterior entry and panic doors, whether indicated or not.

I. Wall/Floor Holders:

- 1. All wall holders shall be one of the following:
 - a. Ives, WS40.
 - b. Hager, 327W.
- 2. All floor holders shall be one of the following:
 - a. Ives, FS40.
 - b. Hager, 326F.

J. Removable Mullions:

- 1. All removable mullions shall be one of the following:
 - Von Duprin, 4954.
 - b. Falcon, 4023.
 - c. Detex, 90KR.
 - d. Sargent, L980.
 - e. Hager, 4900.
- 2. Rim cylinders compatible with those for locksets.
- 3. Strikes compatible with panic devices and locksets.
- 4. Finish painted to match frame.
- 5. Provide removable mullion for any pair of doors where panic devices are used, whether scheduled or not, and whether frame is existing or new.
- 6. Provide fire rated devices in all fire rated openings.

K. Thresholds:

- 1. Aluminum, saddle-type.
- 2. Fully ADA compliant.
- 3. Span entire width and depth of opening.
- 4. 1/2" maximum height.
- 5. 1:2 ratio bevel slope.

- 6. Finish to match all other hardware specified for opening, and storefront units where applicable.
- L. Seals/Gaskets/Sweeps/Bottoms (used for Weatherstripping):
 - 1. All bottoms for doors with recessed bottom channels shall be one of the following:
 - a. Hager, 750SN.
 - 2. All bottoms for doors without recessed bottom channels shall be one of the following:
 - a. Hager, 772S.
 - 3. All bottoms to be mil finish aluminum.
 - 4. Provide bottoms on all exterior doors, whether scheduled or not.
 - Weatherstripping to be Vinyl, Neoprene, EPDM, TPE (thermoplastic elastomer), or Silicone.
 - 6. Full length and width of opening at each condition.
 - 7. All weatherstripping sets shall be determined by the door hardware supplier as appropriate to the application and able to provide a weather-tight and weather-proof seal, while allowing proper operation of the door and all other hardware.
 - 8. Provide weatherstripping seal sets at entire perimeter jambs and head of all exterior doors, whether scheduled or not.
- M. Seals/Gaskets (used for Sound Seals):
 - 1. All sound seals shall be one of the following:
 - a. Pemko, S88 Series.
 - 2. Silicone, adhesive-backed, with compression bulb and stabilizer flange.
 - 3. Full length and width of opening at each condition.
 - 4. Provide sound seal sets at entire perimeter jambs and head.
- N. Seals/Gaskets (used for Fire and Smoke Seals):
 - 1. All fire and smoke seals shall be one of the following:
 - a. Pemko, HSS2000 Series.
 - 2. High temperature silicone, self-extinguishing and non-toxic.
 - 3. Full length and width of opening at each condition.
 - 4. Provide fire and smoke seal sets at entire perimeter jambs and head as required.
- O. Overhead Drip Guards:
 - 1. All drip strips shall be NGP, 16 Series.
 - 2-1/2" wide x 1-1/2" high x full width of the door frame.
 - Arching horizontal drip shield and vertical fastening leg.
 - 2. All drip strips to be aluminum.
 - 3. Provide clear anodized or bronze anodized finish as applicable to match aluminum door. If not an aluminum door, match all other hardware. Provide clear anodized, typical.
 - 4. Install drip strip along top edge of all exterior doors, whether scheduled or not. Caulk sealant along top edge.
- P. Flushbolts/Dustproof Strikes:

- 1. All flushbolts shall be one of the following:
 - a. Ives, 262.
 - b. Hager, 281D.
- 2. Provide at top and bottom of doors.
- 3. Provide dust proof strike for bottom flushbolts, provide as deep as possible.

Q. Plates:

- 1. All kick plates shall be height=8", length=2" less than door, unless otherwise indicated, and one of the following:
 - a. Ives, 8400.
 - b. Hager, 194S.
- 2. All armor plates shall be height=36", length=1" less than door, unless otherwise indicated, and one of the following:
 - a. Ives, 8400.
 - b. Hager, 194S.
- 3. All plates to be .050" thick minimum, brass, stainless steel, or aluminum.
- 4. All plates to have beveled edges on all 4 sides.
- 5. All plates to have countersunk screws.
- 6. Screw-fasten solid to door.
- 7. Provide kick plates on the interior side of all doors in a restroom, custodial or janitorial room, mechanical or electrical room, laundry room or other such utility space, whether scheduled or not.
- 8. Provide armor plates on both sides of all crash or impact doors, whether scheduled or not.

R. Automatic Door Bottoms:

- 1. All automatic door bottoms shall be one of the following:
 - a. Hager, 730S.
 - b. NGP, 422.
 - c. Pemko, 411ARL.
 - d. Reese 521C.
- 2. Non-handed, reversible, full mortise, flush mounting.
- Comprised of an aluminum case surrounding a movable drop-bar seal. The drop-bar seal is actuated by a
 plunger which contacts the jamb as the door closes, forcing the drop-bar seal down against the floor or
 threshold surface.
- 4. Mill aluminum finish with black sponge neoprene insert.
- 5. Provide appropriate type of unit applicable to each door material and thickness.

S. Silencers:

- 1. All door silencers in metal frames shall be one of the following:
 - a. Ives. SR64.
 - b. Hager, 307D.
- 2. All door silencers in wood frames shall be one of the following:

- a. Ives, SR65.
- b. Hager, 308D.
- 3. Furnish silencers for all interior single and pairs of doors, whether scheduled or not.
- 4. Omit silencers at doors where they may interfere with other types of seals already required, such as fire rated doors, smoke doors, sound proof doors, or light proof doors.

T. Position Switches:

- 1. All position switches for wood doors in wood frames shall be one of the following:
 - a. Schlage, 679-05.
 - b. Securitron, DPS-W.
- 2. All position switches for hollow metal doors in hollow metal frames shall be one of the following:
 - a. Schlage, 679-05 HM.
 - b. Securitron, DPS-M.
- 3. All position switches for wood doors in hollow metal frames shall be one of the following:
 - a. Schlage, 679-05 WD.
- 4. All position switches for aluminum doors in aluminum frames shall be one of the following:
 - a. Schlage, 7764.
- 5. Monitor the position status of door.
- 6. Concealed switches, flush-mounted in top of door and head of frame, directly opposite one another.
- 7. Magnetic switch and a permanent magnet, normally closed.
- 8. Finish as selected by Architect.

U. Electric Strikes:

- 1. All electric strikes for cylindrical or mortise locksets shall be one of the following:
 - a. Von Duprin, 6200 Series.
- 2. All electric strikes for panic devices and removable mullions shall be one of the following:
 - a. Von Duprin, 6100 Series.
- 3. Provide Von Duprin PS902 Power Supply.
- 4. 24 VDC or 12 VDC voltage as selected.
- 5. Field convertible between Fail-Safe and Fail-Secure.
 - Upon loss of power, the electric strike shall fail to Fail Secure condition so that the door remains in a locked position to maintain security to the building and spaces.
- 6. Adjustable keeper.
- 7. Internal solenoid.
- 8. Non-handed.
- 9. Continuous duty operation.
- 10. Tamper resistant faceplate.
- 11. Stainless steel material. Finish on stainless steel to match all other hardware at opening.
- 12. Hardware supplier is responsible to coordinate the model required with the condition of installation so as to assure proper fit. Verify condition and dimensions of door frames, mullions, removable mullions, and abutting walls where strikes are to be installed.

- V. Access Control Door Controllers and Credential Readers:
 - 1. Provide by Owner's separate vendor.

2.06 HARDWARE SCHEDULE

NOTE:

*Provide Fire/Smoke seals on all doors with a fire rating

For all existing doors receiving new hardware:

*Replace existing hardware items with new as scheduled

*Where new hardware items are scheduled, completely remove all existing items

*Return all removed hardware items to Owner

*All existing hardware items not being replaced are to remain

*Repair existing door and frame as required

*Repair existing wall and floor surfaces as required

*Provide covers, trims, and fillers at all existing preps

Hardware Set #1 (Exterior, Automatic, Access Control)

Continuous Hinge w/ electronic power transfer prep

Electrified Rim Panic Device

Surface Closer w/ Cush-n-stop arm

Threshold

Weatherstripping (08 41 13)

Automatic Door Bottom (08 41 13)

Components provided by Owner's separate vendor:

Access Control Credential Reader

Access Control Door Controllers

Access Control Remote Entry

Hardware Set #2 (Exterior, Automatic)

Continuous hinge

Rim Panic Device

Surface Closer w/ Cush-n-stop arm

Threshold

Weatherstripping (08 41 13)

Automatic Door Bottom (08 41 13)

Hardware Set #3 (Exterior, Access Control)

Continuous Hinge

Rim Panic Device

Surface Closer w/ Cush-n-stop arm

Threshold

Weatherstripping (08 41 13)

Door Bottom (08 41 13)

Components provided by Owner's separate vendor:

Access Control Credential Reader

Access Control Door Controllers

Access Control Remote Entry

Hardware Set #4 (Interior, Passage)

Hinges

Surface Closer

Lockset (Passage)

Wall Stop

Kick Plate

Hardware Set #5 (Interior, Access Control)

Hinges

Lockset (Storage Function)

Surface Closer

Electronic Strike

Wall Stop

Kick Plate

Components provided by Owner's separate vendor:

Access Control Credential Reader

Access Control Door Controllers

Hardware Set #6 (Interior, Office)

Hinges

Surface Closer

Lockset (Entry/Office)

Wall Stop

Sound Seals

Automatic Door Bottom (08 41 13)

Hardware Set #7 (Interior, Panic)

Hinges

Surface Closer

Lockset (Passage)

Rim Panic Hardware

Wall Stop

Kick Plate

Hardware Set #8 (Interior, Panic, Access Control)

Hinges

Surface Closer

Lockset (Passage)

Electronic Strike

Rim Panic Hardware

Wall Stop

Kick Plate

Components provided by Owner's separate vendor:

Access Control Credential Reader

Access Control Door Controllers

Hardware Set #9 (Exterior, Pair)

PROJECT NO. 24-179.000 Harrison REMC - Addition and Renovation Harrison REMC

FINISH HARDWARE 08 7100 - 16 04/24/2025

Continuous Hinge (each leaf)
Lockset (Storeroom) (active leaf)
Surface Closer w/ Cush-N-Stop Arm (active leaf)
Flush bolts w/ Dustproof Strike (inactive leaf)
Overhead Stop (inactive leaf)
Threshold
Weatherstripping (each leaf by 08 41 13)
Door Bottom (each leaf by 08 41 13)

Hardware Set #10 (Interior, Pair, Storage)

Hinges (each leaf)
Lockset (Storeroom) (active leaf)
Surface Closer w/ Cush-N-Stop Arm (active leaf)
Flush bolts w/ Dustproof Strike (inactive leaf)
Overhead Stop (inactive leaf)

Hardware Set #11 (Interior, Single Use Restroom)

Hinges
Surface Closer
Lockset (Privacy) w/ Vacant/Occupied Indicator
Wall Stop

Hardware Set #12 (Exterior, Pump room)

Continuous Hinge Lockset (Storeroom) Surface Closer w/ Cush-N-Stop Arm Threshold

Hardware Set #13 (Interior, Passage - locker room)

Hinges Surface Closer Push plate and door pull Wall Stop Kick Plate

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install finishing hardware as recommended by the National Builders Hardware Association.
- B. Only use fasteners supplied by the manufacturer. Provide fasteners of suitable size, quantity, type and finish to secure hardware in position for heavy use and long life.
- C. Hardware for application on metal surfaces:
 - 1. Made to standard templates.

- 2. Fastening harmonized with hardware as to material and finish.
- 3. Fastenings with approved type anchors according to the manufacturer.
- 4. In general, ends of through-bolts shall be countersunk.
- D. Mount hardware in accordance with current state and federal accessibility standards and guidelines.
- E. Install hardware per manufacturers instructions and in compliance with:
 - 1. NFPA-80.
 - 2. NFPA-101.
 - 3. NFPA-105.
 - NFPA-252.
 - 5. ANSI A117.1.
- F. Install each hardware item in compliance with the manufacturer's instructions and recommendations. Where cutting and fitting is required to install hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation or application of surface protection with finishing work specified in the Division 9 Sections. Do not install surface-mounted items until finishes have been completed on the substrates involved.
- G. Set units level, plumb, and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
- H. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.
- I. Set thresholds for exterior doors in full bed of butyl-rubber or polyisobutylene mastic sealant complying with requirements specified in Division 7 Section "Joint Sealers".
- J. Weatherstripping and Seals: Comply with manufacturer's instructions and recommendations to the extent installation requirements are not otherwise indicated.

3.02 FIELD QUALITY CONTROL

A. Material supplier to inspect hardware after installation and before final acceptance in order to ensure that hardware has been properly installed. If there are any discrepancies the material supplier is to provide the Architect, General Contractor and Installer with a written report detailing any and all discrepancies. All discrepancies are to be corrected prior to final acceptance unless otherwise directed by the Owner.

3.03 ADJUSTING AND CLEANING

- A. Adjust and check each operating item of hardware and each door to ensure proper operation or function of every unit.
- B. Immediately prior to Substantial Completion replace all construction cores.
- C. Tag all keys.

PROJECT NO. 24-179.000 Harrison REMC - Addition and Renovation Harrison REMC FINISH HARDWARE 08 7100 - 18 04/24/2025

- D. Check each key and each lockset to verify proper working order.
- E. Lubricate and adjust all hardware to provide smooth operation.
- F. Clean all hardware per manufacturer's instructions after installer makes final adjustments and prior to final acceptance, remove all mortar, drywall mud, paint overspray, foreign materials, labels, markings, soil, oils, etc. Polish all locksets, plates, and other hardware.
- G. Clean adjacent surfaces soiled by hardware installation
- H. Replace, at no cost to Owner, items that cannot be cleaned to manufacturer's level of new finish quality or that cannot be adjusted to operate freely and smoothly or as intended for the application made.
- I. Where door hardware is installed more than one month prior to acceptance or occupancy of a space or area, return to the installation during the week prior to acceptance or occupancy and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to function properly with final operation of heating and ventilating equipment.

SUBMITTAL CHECKLIST

- 1. Hardware Schedule.
- 2. Owner Verification and Review Meeting.
- 3. Manufacturer's Product Information.
- 4. Samples.

END OF SECTION 08 7100

SECTION 08 7113.01 - AUTOMATIC DOOR OPERATOR

PART 1 - GENERAL

1.01 DESCRIPTION

A. Furnish labor, materials, equipment, special tools, supervision and services required to install low energy power operator equipment as indicated on drawings and as specified herein, including but not limited to operator, push plate activator, keypad activator, relays, contacts, power supplies, controllers, timeclocks and all other accessories as necessary for a complete and fully operational installation.

1.02 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies.
 - 1. Underwriters Laboratory, Inc. (UL).
 - 2. Federal Regulation ANSI 117.1.
 - 3. All automatic equipment to comply with ANSI A156.19

1.03 SUBMITTALS

A. Shop drawings showing compete elevations, details and method of anchorage to location; installation of hardware; size, shape and thickness of materials; joints and connections; and details of joining with other construction.

1.04 WARRANTY

A. Warranty of power operators, controls and labor provided by automatic door equipment installer against defects in material and workmanship at no cost to owner, for a period of one year from date of substantial completion.

PART 2 - PRODUCTS

2.01 AUTOMATIC SWING DOOR SYSTEM

- A. Automatic door operator shall be one of the following or an approved equivalent:
 - a. Dorma ED900 Low Energy Operator
 - b. Stanley Magic Access Lower Energy Operator
- B. Mode of Operation: Wiring schematic on drawings indicates the following sequence of operation:
 - a. During regular business hours, electric strike is retracted disengaging latchbolt. Door is "unlocked" in this state. Automatic door operator is activated by push plate operation either

inside or outside. Activation operates both interior and exterior vestibule doors in synchronized time delay sequence.

- b. During times other than business hours electric strike is not retracted and latchbolt is engaged preventing free opening of door. Door is "locked" in this state. Staff will gain access via credential activation of operator. Credential reader shall simultaneously retract electric strike and activate automatic operator. Operation of exterior activation device during non-business hours shall be disabled when door is locked to prevent damage to operator. Interior push plates will remain operational at all times. Automatic door operator shall have programmed time delay so that operator does not activate prior to credential reader retracting electric strike in order to prevent damage to door operator. Activation operates both interior and exterior vestibule doors in synchronized time delay sequence.
- c. Power assist function to operate through entire opening cycle when door is manually opened.
- d. Door operator to activate by manually opening door approximately 4 degrees from closed position.
- e. On board power supply: 1.5 amps @ 24VDC.
- f. Field adjustable losing speed and latch force under power failure conditions.
- g. Positive mechanical stops to prevent door opening past 90 degrees or other pre-determined angle under power failure conditions.
- h. Obstacle detection to close door if an obstacle is detected during the opening cycle and reopen door is an obstacle is detected during the closing cycle.
- i. Synchronized Pair of Doors Integration so that opening of interior vestibule door is delayed when exterior vestibule door is opened.
- j. Power boost during latching cycle to overcome wind & door seal resistance.
- k. Door to remain in closed position when unlocked until operator is activated.

C. Operator Housing:

Aluminum extrusions with finished end caps and shall be prepared for mounting to new door frames.
 All structural sections shall have a minimum thickness of 0.146@ (3.7 mm) and shall be fabricated of 6063-T5 aluminum alloy.

D. Activating Devices:

- 1. Wall mount push plates:
 - a. Inside push plates: brushed aluminum with universal accessibility logo, flush mounted in locations as indicated on Drawings.
 - b. Outside push plates: brushed aluminum with universal accessibility logo, flush mounted in locations as indicated on Drawings. NEMA 3R enclosure.
 - c. Provide free standing pedestal for push plate if no adjacent wall area is available.
- 2. Credential reader provided by Owner's separate vendor. Coordinate installation as required.

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PROJECT NO. 24-179.000 Harrison REMC - Addition and Renovation Harrison REMC AUTOMATIC DOOR OPERATOR 08 7113.01 - 3 04/24/2025

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Automatic door equipment shall be installed in compliance with manufacturer's recommendations and approved shop drawings.
- B. Fully commission operators and instruct Owner's personnel in operation and maintenance procedures.

3.02 CLEANING AND PROTECTION

A. After installation, clean framing members as recommended by manufacturer. Aluminum surfaces in contact with masonry, concrete and steel shall be protected from contact by use of neoprene gaskets where indicated, or a coat of bituminous paint to prevent galvanic or corrosive action. Protect unit from damage during subsequent construction activities.

END OF SECTION 08 7113.01

SECTION 08 8100 - GLASS AND GLAZING

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Glass and glazing as shown on the Drawings and specified herein.

1.02 QUALITY ASSURANCE

- A. Comply with the following:
 - 1. Glazing Material:
 - a. ANSI Z97.1.
 - b. ASTM 1036, Standard Specifications for Flat Glass.
 - 2. Safety Glazing:
 - a. Federal Standard CPSC 16 CFR 1201.
 - b. ANSI Z97.1.
 - c. ANSI Z97.1q.
 - d. U.S. Consumer Product Safely Commission Standard 16 CFR 1201 CI and CII.
 - e. ASTM C1172, Standard Specification for Laminated Architectural Flat Glass.
 - 3. Insulating Glass:
 - a. Manufacturing: ASTM E 6 P03, Class CBA.
 - b. Installation: SIGMA A-3000.
- B. Unless otherwise shown or governed by other reference standards specified, conform with details and procedures of FGMA Glazing Manual.
- C. The level of acceptability for glass and glazing products may be more strict than the basic standards referenced herein. The Owner and/or Architect reserve the right to determine whether a product is acceptable for its intended use, in its intended application, for its intended clarity of visibility, and as required for its intended aesthetic effect.

1.03 SUBMITTALS

- A. Manufacturer's Literature:
 - 1. Materials description and installation instructions for glazing compounds.
- B. Samples:
 - 1. Submit 6" x 6" actual sample of each glass type, color, tint, etc.
 - 2. Submit 12" x 12" actual sample of insulated units or spandrel units.

- C. Warranty:
 - 1. Submit specified warranty for review.

1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver glazing materials to project site in manufacturer's unopened containers, fully identified with trade name, color, size, hardness, type, class and grade. Store each item in accordance with manufacturer's instructions. Remove all damaged, or otherwise unsuitable material immediately from the job site.

1.05 JOB CONDITIONS

A. Do not perform work under adverse weather or job conditions. Install liquid sealants when temperatures are within lower or middle third of temperature range recommended by manufacturer.

1.06 WARRANTY

A. Provide manufacturer's warranty for insulated glass units against material obstruction of vision resulting from moisture infiltration or dust collection between interior glass surfaces for ten (10) years.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Provide products, as approved by the Architect, from one of the following, or as otherwise specifically listed:
 - 1. "AGC Glass Company North America".
 - 2. "Guardian Industries".
 - 3. "Oldcastle Building Envelope".
 - 4. "Pilkington North America, Inc.".
 - 5. "Vitro/PPG Industries, Inc.".

2.02 GLASS TYPES

A. Clear Float Glass:

- 1. Glass sheet made by floating molten glass on a bed of molten tin.
- 2. Thickness as shown on Drawings or specified herein.
- 3. Safety glass in all doors, windows, transoms and sidelights, where required by code and where shown on the Drawings and specified herein, whether required by Code or not.
- 4. Safety glass to be laminated or tempered at all exterior units and tempered at all interior units, unless otherwise indicated.

Glass to be clear.

B. Tinted Float Glass:

- 1. Thickness as shown on Drawings or specified herein.
- 2. All requirements of clear float glass apply as specified above, except glass lites to be tinted.
- 3. Body tinted by adding colorants to normal batch of clear molten glass.
- 4. Tint color to be selected by Architect from manufacturer's entire selection to match existing bulding.

C. Low-E Glass:

- 1. Coated to reduce transmission of radiation, infrared, and ultraviolet rays.
- 2. Smooth, sputter coating. Pyrolytic coatings are not permitted.
- 3. Thickness as shown on Drawings or specified herein.
- 4. All requirements of clear float glass or tinted float glass apply as specified above, except glass lites to be Low-E coated and applied to surface 2 (from outside face).
- 5. See Tinted Float Glass for tint color, where tinted glass is required.
- 6. Provide one of the following approved products, or an approved equal:
 - a. "AGC"; Energy Select 36.
 - b. "Guardian", SunGuard SuperNeutral 68.
 - c. "PPG", Solarban 60.

D. Tempered Safety Glass:

- 1. Thickness as shown on Drawings or specified herein.
- 2. Single thickness of clear or tinted float glass.
- 3. Reheated to just below melting point and suddenly cooled for tempering.
- 4. Upon major impact, the glass surface shall shatter into small pieces free of sharp points or slivers.
- 5. See Tinted Float Glass for tint color, where tinted glass is required.

E. 1" Insulating Glass:

- 1. Manufacturer's standard units comprised of (1) 1/4" outdoor lite and (1) 1/4" indoor lite with an overall nominal thickness of 1".
- 2. Complete units tested and approved in accordance with requirements of the Sealed Insulating Glass Manufacturer's Association (SIGMA).
- 3. Outdoor Lite:
 - a. 1/4" Low-E glass, tinted
 - b. Tempered safety glass.
 - c. All requirements of Low-E glass apply as specified above.
 - d. See Tinted Float Glass for tint color.
- 4. Indoor Lite:
 - a. 1/4" clear float glass,
 - b. Tempered safety glass.
 - c. All requirements of laminated or tempered safety glass apply as specified above.
- 5. Separate outdoor and indoor lites by 1/2" desiccant spacer bar.

2.03 MISCELLANEOUS MATERIALS

- A. Glazing Sealant for Exterior Glazing:
 - 1. One Part Silicone, FS TT-S-00230C, Type II, Class A.
 - 2. Provide one of the following approved products:
 - a. "General Electric Company", 1200 Series.
 - b. "Dow Corning Corporation", Dow Corning Silicone Rubber Sealant.
 - c. "Tremco", Proglaze Silicone Construction Sealant.
 - d. "Pecora Chemical Corporation", 863.
 - e. "DAP, Inc.", Dap Flexiglaze 1231 Glazing Compound.

B. Glazing Tape:

- 1. Polyisobutylene / butyl.
- 2. Provide one of the following approved products:
 - a. "Tremco", Tremco 440 Tape.
 - b. "Pecora Chemical Corporation", G-66.
 - c. "Pecora Chemical Corporation", BB-50.
 - d. "DAP, Inc.", Butyl Rubber Tape.

C. Setting Blocks:

1. Neoprene blocks, 80 to 90 Type A durometer hardness.

D. Spacers:

1. Neoprene blocks, 40 to 50 Type A durometer hardness, 3" long, self-adhesive on one face only.

2.04 FABRICATION

- A. Sealed Edge Construction for Insulated Units:
 - 1. Fabricate units with a permanent, hermetically sealed, dry air or gas filled space of the width indicated, between sheets of glass as indicated.
 - 2. Except as otherwise indicated, fabricate units with 1/2" wide air spaces.
 - 3. Label each unit to show compliances with required standards and regulations.
 - 4. Indicate which face of unit is for exposure to exterior of weather.
 - 5. Provide removable label except where regulations require a permanent label.

PART 3 - EXECUTION

3.01 PREPARATION

A. Examine all surfaces to receive the parts of the Work specified herein.

- B. Verify all dimensions of in-place and subsequent construction.
- C. Application or installation of materials constitutes acceptance of the related construction.

3.02 INSTALLATION

- A. Employ only experienced glaziers who have had previous experience with the materials and systems being applied. Use tools and equipment recommended by the glass manufacturer.
- B. Maintain a minimum temperature of 40°F during glazing unless the manufacturer of the glazing materials specifically agrees to application of his materials at lower temperatures.
- C. Clean glazing stops and rabbets to receive glazing materials of all obstructions and deleterious substances which might impair the work. Remove protective coatings which might fail in adhesion of interfere with bond of sealants. Comply with manufacturer's instructions for final wiping of surfaces immediately before application of primer and glazing compounds or tapes.
- D. Inspect each piece of glass immediately before installation.

 Do not install pieces which are defective or damaged in any way.
- E. Set glass on setting blocks or shims. Use blocks of proper size and spacing to support the glass in accordance with manufacturer's recommendations.
- F. Provide spacers for all glass to separate glass from stops, except where continuous gaskets or tape are required.
- G. Set glass in a manner which produces greatest possible degree of uniformity in appearance.
- H. Install glass according to manufacturer's recommendations and in accordance with the Flat Glass Marketing Association Glazing Manual.
- I. Clean excess sealant or compound from glass and framing members immediately after application, using solvents or cleaners recommended by manufacturers.

3.03 CURING, PROTECTION AND CLEANING

- A. Cure sealants in accordance with the manufacturer's instructions to attain maximum durability and adhesion to glass and framing as soon as possible.
- B. Remove and replace any glass which has become broken, cracked, chipped, or damaged, in any way and from any source, including weather, vandalism, construction, handling, accidents during the construction period, etc.
- C. Maintain glass in a reasonably clean condition during construction so that it will not become stained and will not contribute to the deterioration of glazing materials.

D. Remove labels, clean and polish glass on both faces prior to final inspection. Comply with instructions and recommendations of the glass manufacturer and glazing materials manufacturer for cleaning in each case.

3.04 TESTING OF EXTERIOR GLAZING SYSTEMS

A. After completion of exterior glazing and nominal curing of sealants, perpendicularly from a 3/4" hose at normal domestic water pressure, test each exterior glazing unit. Repair leaks and other defects, and retest as directed. Repair or replace other work damaged by such leaks.

SUBMITTAL CHECKLIST

- 1. Manufacturer's Literature.
- 2. Samples.
- 3. Warranty.

END OF SECTION 08 8100

SECTION 08 8853

TSS BR GLAZING - LAMINATED POLYCARBONATE - ALL POLY

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Bullet resistant laminated polycarbonate all poly security glass.

1.2 REFERENCES

- A. Underwriters Laboratory UL 752-Standard for Bullet Resisting Equipment.
- B. ASTM C 1172 Standard Specification for Laminated Architectural Flat Glass.

1.3 ACTION SUBMITTALS

- A. Refer to Section [01 3300 Submittal Procedures] [Insert section number and title].
- B. Product Data: Including manufacturer recommended installation instructions.
- C. Shop Drawings: Include plans, elevations, sections, details, attachment to other work.
- D. Samples: For each exposed glazing type.

1.4 INFORMATION SUBMITTALS

- A. Product Test Reports: Indicating compliance with requirements
- B. Warranty: Sample of warranty

1.5 CLOSEOUT SUBMITTALS

- A. Refer to Section 01 7800 CLOSEOUT SUBMITTALS
- B. Maintenance data.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Refer to Section 01 6500 PRODUCT DELIVERY AND HANDLING
- B. Deliver materials to the project site with the manufacturer's UL Listed Labels intact and legible.

Handle the materials with care to prevent damage. Store materials inside and under cover, stack flat and off floor. Project conditions (temperature, humidity, and ventilation) shall be within the maximum limit recommendations provided by manufacturer. Do not install products stored in conditions outside manufacturer's recommended limits.

1.7 WARRANTY

- A. Workmanship Warranty: All materials shall be warranted against defects for a period of [1] year for the date of receipt at the project site. Provide certificates of manufacturer's standard limited warranty with closeout documents.
- B. Finish Warranty: Manufacturer's warranty against deterioration of factory finishes for the period of [1] year from the date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

- A. Basis of Design:
 - 1. Subject to compliance with requirements, provide products by the following:
 - a. Total Security Solutions, Inc., 935 Garden Lane, Fowlerville, MI 48836, 8866 734-6277. Attn: Sales Department, sales@tssbulletproof.com. Web: www.tssbulletproof.com.
 - Subject to compliance with requirements, manufacturers of products of equivalent design may be acceptable if approved in accordance with 01 6200 PRODUCT OPTIONS AND SUBSTITUTIONS.

2.2 BULLET RESISTANT ALL GLASS GLAZING

- A. Through the design, manufacturing techniques and material application the TSS Bullet Resistant Polycarbonate Laminated All Poly glazing shall be constructed of polycarbonate core with additional 1/8" polycarbonate layers on each side of glazing.
- B. UL Standard 752 rating shall be Level 3.
- C. Thickness of glass shall range from 3/4" to 1-1/4" thick.

2.3 FABRICATION

A. Tolerances: All joints and connections shall be tight, providing hairline joints and true alignment of adjacent members

2.4 GLAZING

- A. Glazing shall be as shown on the drawings or as specified separately in 08 8853 SECURITY GLAZING
- B. Product shall meet UL Standard 752 rating level 3.

TSS Polycarbonate LP shall be All Poly 1250 – Level 3, light transmission of 77% with thickness of 1-1/4".

- C. Glazing gaskets:
 - 1. Interior: Closed cell neoprene.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prior to beginning installation, verify that areas have been prepared as required by the Contract Documents and architectural drawings, and Shop Drawings have been approved.
- B. Notify Architect of any unsatisfactory preparation that is responsibility of others.
- C. Clean and prepare all surfaces per manufacturers recommendations as required for achieving the best results for the substrate under the project conditions.
- D. Do not begin installation of material until all unsatisfactory conditions have been resolved and approved by Architect.

3.2 INSTALLATION

- A. Do not begin installation until areas have been verified and surfaces properly prepared in accordance with Drawings.
- B. Install in accordance with manufacturer's instructions and UL 752. Set all equipment plumb.
- C. Apply sealant in accordance with manufacturer's recommendations as indicated in installation instructions.
- D. Remove excess sealant and leave exposed surfaces clean and smooth

3.3 PROTECTION

A. Clean and protect material from damage during ongoing construction operations. If damage occurs, remove and replace as required to provide voice ports in their original.

undamaged condition.

- B. Inspection and Cleaning: Verify installation is complete and complies with manufacturer's requirements.
- C. Provide final cleaning of product and accessories, removing excess sealant, labels and protective covers.
- D. Touch-up, repair or replace damaged products prior to Substantial Completion.

END OF SECTION

SECTION 08 9000 - LOUVERS AND VENTS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Furnish labor materials, equipment, special tools, supervision and services necessary to provide architectural air intake and exhaust louvers as indicated on the Drawings and specified herein.

1.02 REFERENCES

- A. ADC 1062 Certification, Rating and Test Manual.
- B. AMCA 500 Test Method for Louvers, Dampers and Shutters.
- C. ARI 650 Air Outlets and Inlets.
- D. ASHRAE 70 Method of Testing for Rating the Air Flow Performance of Outlets and Inlets.

1.03 QUALITY ASSURANCE

A. Test and rate performance of louvers in accordance with AMCA 500.

1.04 SUBMITTALS

A. Product Data:

1. Manufacturer's product data sheets, cutsheets, specifications, materials description, installation and maintenance instructions.

B. Shop Drawings:

1. Show proposed method of installation, anchoring and interface between the work of this Section and the work of adjacent trades.

C. Samples:

- 1. Actual samples of all items needed for colors and finishes.
- 2. Colors and finishes to be selected by Architect from manufacturer's entire selection.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Provide products, as approved by the Architect, from one of the following approved manufacturers:
 - 1. "Greenheck"
 - 2. "Ruskin Company"
 - 3. "Air Louvers, Inc."
 - 4. "Dowco, Inc."

2.02 LOUVERS

- A. Basis of Specification: "Greenheck", ESD-635.
- B. Frame:
 - 1. Extruded Aluminum, 6063-T5, .081 inch min. thickness.
 - 2. 6 inch frame nominal depth.
 - 3. Size, profile and configuration as indicated on the Drawings.
 - 4. Finish: Baked enamel coating, color as selected from manufacturer's entire standard selection.

C. Blades:

- 1. Extruded Aluminum, 6063-T5, .081 inch min. thickness.
- 2. Stationary drainable style.
- 3. 37.5° angle blades, 4 inch nominal spacing.
- 4. Finish: Color and finish to match frame.
- D. Extended Sill Sub-Frame:
 - 1. Extruded aluminum, 6063-T5, .080 inch min. thickness.
 - 2. Extended front counterflashing leg and raised rear flashing leg in "Z" profile.
 - 3. Finish: Color and finish to match frame.

E. Screens:

- 1. 1/2 inch frame x 19 gauge galvanized steel bird screen.
- 2. Rear mounted.
- 3. Finish: Aluminum frame color and finish to match frame.

2.03 FABRICATION

- A. Fabricate with hidden mullions.
- B. Louvers too large for shipping may be assembled on site from factory fabricated sections to provide the required overall size.

PROJECT NO. 24-179.000 Harrison REMC - Addition and Renovation Harrison REMC

LOUVERS AND VENTS 08 9000 - 3 04/24/2025

C. Provide integral structural supports to withstand 20 psf wind load.

PART 3 - EXECUTION

3.01 PREPARATION

A. Field verify all dimensions prior to fabricating louvers.

3.02 INSTALLATION

- A. Install per manufacturer's details and recommendations.
- B. Paint portions of aluminum subframe in contact with concrete on mortar with bituminous paint.
- C. Install sealant along entire perimeter of louver.

3.03 PROTECTION

A. Protect louvers from damage.

SUBMITTAL CHECK LIST

- 1. Product Data.
- 2. Shop Drawings.
- 3. Samples.

END OF SECTION 08 9000

SECTION 09 2900.01 - GYPSUM DRYWALL - STEEL STUD CONSTRUCTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Gypsum wallboard and gypsum drywall finish as shown on Drawings and specified herein.
- B. Non-load bearing interior partition steel stud construction as shown on Drawings and specified herein.
- C. Exterior sheathing products where not specifically specified elsewhere.

1.2 QUALITY ASSURANCE

- A. Gypsum wallboard construction shall comply with all laws, ordinances, rules, regulations and orders of
- B. public authorities having jurisdiction.
- C. All material shall be from a single manufacturer.
- D. Installation of steel framing members to receive gypsum wallboard shall comply with ASTM C754.

1.3 REFERENCES

- A. Comply with applicable requirements of ANSI/ASTM C 840 for application and finishing of gypsum board, unless otherwise indicated.
- B. Gypsum board terminology standard: GA-505 by Gypsum Association.

1.4 DELIVERY, STORAGE AND HANDLING

A. All materials shall be delivered to the job in their original, unopened containers or bundles, stored in a place providing protection from damage and exposure to the elements. Remove damaged or otherwise unsuitable material from the job site.

1.5 SUBMITTALS

A. Product Data: Manufacturer's literature, materials description, cutsheets and recommended installation instructions for systems use.

PART 2 - PRODUCTS

2.1 GYPSUM BOARD

- A. Gypsum Board (Non-Fire Rated Assemblies):
 - 1. Provide one of the following approved products:
 - a. "Georgia-Pacific"; Gypsum Sheathing.
 - b. "USG"; Sheetrock Gypsum Panels.
 - c. "Certainteed"; M2Tech Gypsum Board.
 - 2. Manufacture to meet specifications for FS SS-L-30, ASTM C 36 and ASTM C 1396.
 - 3. Provide in maximum lengths available to minimize end-to-end butt joints.
 - 4. Standard type, regular gypsum core gypsum board for all areas, except as otherwise indicated. If needed for specified thickness, provide product in Type X gypsum core.
 - 5. Thickness: 5/8 inch or 1/2", as indicated on the Drawings.
 - 6. Width: 4 feet.
 - 7. Length: 8 feet minimum.
 - 8. Edges: Tapered.
- B. Gypsum Board (Fire Rated Assemblies-Type X):
 - 1. Provide one of the following approved products:
 - a. "Georgia-Pacific"; Gypsum Sheathing, Type X.
 - b. "USG"; Sheetrock Gypsum Panels, Type X.
 - c. "Certainteed"; M2Tech Gypsum Board, Type X.
 - 2. Manufacture to meet specifications for FS SS-L-30, ASTM C 36 and ASTM C 1396.
 - 3. Provide in maximum lengths available to minimize end-to-end butt joints.
 - 4. Type X gypsum core gypsum board.
 - 5. Thickness: 5/8 inch.
 - 6. Width: 4 feet.
 - 7. Length: 8 feet minimum.
 - 8. Edges: Tapered.
- C. Gypsum Board (Tile Backer Board):
 - 1. Provide one of the following approved products:
 - a. "Georgia-Pacific"; Dens-Shield Tile Backer.
 - b. "National Gypsum Company / Gold Bond"; eXP Tile Backer.
 - 2. Manufacture to meet specifications for ASTM C 1178.
 - 3. Provide in maximum lengths available to minimize end-to-end butt joints.
 - 4. Thickness: 5/8 inch or 1/2", as indicated on the Drawings.
 - 5. Width: 4 feet.
 - 6. Length: 8 feet minimum.
 - 7. Edges: Square.
 - 8. Provide at all areas where wall tile is scheduled. See Drawings.

GYPSUM DRYWALL – STEEL STUD CONSTRUCTION 09 2900.01 - 3 04/24/2025

- D. Gypsum Board (Abuse-Resistant/Paperless):
 - 1. Provide one of the following approved products:
 - a. "Georgia-Pacific"; DensArmor Plus.
 - 2. Moisture-resistant gypsum core with inorganic glass mats embedded into face and back. Abuse-resistant and paperless facing interior gypsum wallboard.
 - 3. Manufacture to meet specifications for ASTM C 630 and ASTM C 1177.
 - 4. Resist the growth of mold and mildew in accordance with ASTM D 3273.
 - 5. Provide in maximum lengths available to minimize end-to-end butt joints.
 - 6. Thickness: 5/8 inch or 1/2", as indicated on the Drawings.
 - 7. Width: 4 feet.
 - 8. Length: 8 feet minimum.
 - 9. Edges: Tapered.
- E. Gypsum Board Sheathing Substrate (Non-Fire Rated Assemblies):
 - 1. Provide one of the following approved products:
 - a. "Georgia-Pacific"; Dens-Glass Sheathing.
 - b. "Certainteed"; GlasRoc Sheathing.
 - 2. Manufacture to meet specifications for ASTM D 3273.
 - 3. Provide in maximum lengths available to minimize end-to-end butt joints.
 - 4. Fiber glass mats over moisture-resistant gypsum core. Paperless facings.
 - Thickness:
 - a. Framing at 16 inches o.c.: 1/2 inch, or as otherwise indicated on the Drawings.
 - b. Framing at 24 inches o.c.: 5/8 inch, or as otherwise indicated on the Drawings.
 - 6. Width: 4 feet.
 - 7. Length: 8 feet minimum.
 - 8. Edges: Square.

2.2 STEEL STUDS

- A. Provide Steel Stud Systems, as approved by the Architect, by one of the following manufacturers:
 - 1. "U.S. Gypsum Company" (USG).
 - 2. "National Gypsum Company".
 - 3. "Georgia-Pacific".
 - 4. "Clark Dietrich Building Systems".
 - 5. "Phillips Manufacturing Co.".
 - 6. "Marino/Ware".
 - 7. "CEMCO Steel".
 - 8. "Flex-Ability Concepts".
 - 9. "MBA Metal Framing".
 - 10. "Dale/Incor".
 - 11. "Superior Steel Studs".

B. System Components:

With each type of metal stud and joist required, provide manufacturer's standard runners (tracks), shoes, clips, ties, stiffeners, fasteners, grommets to protect electrical wiring, door jamb reinforcers and accessories as recommended by the manufacturer for the applications indicated, and as needed to provide a complete metal stud system. Where special types, conditions, or products are indicated, provide as required to match gauge, depth and section of associated wall construction.

C. Non-Load Bearing Screw Type Steel Studs:

- 1. Manufacturer's standard formed light gauge steel studs of the height, size, and gauge indicated, with punched webs to facilitate erection of system and passage of mechanical/electrical service lines. Lateral loading shall have a minimum of 5 lbs. per sq. ft.
- 2. Steel stud framing at interior partitions:
 - a. Gauge: minimum 20 gauge and 30 mils thickness, ASTM C645.
 - b. Depth of Section: 3-5/8 inches, unless otherwise indicated on drawings.
 - c. Flange width: Not less than 1.25 inches.
 - d. Shape: Cee shape (returned flanges).
 - e. Steel and Finish: ASTM A591, commercial quality electrolytic zinc coated steel, class B.
 - f. Face of flanges: Knurled to facilitate use of self-tapping fasteners.
 - g. Use 1-1/2 inches cold rolled channel at 48 inches o.c. horizontally above interior ceiling.
 - h. Floor and Ceiling Tracks: Cold formed channel shape, galvanized, width as required to receive studs, and flange/leg size not less than 1.25 inches.
 - i. Double 20 gauge studs at all door and window jambs.

D. Deflection Stud Runners:

- 1. Equal to: "Clark Dietrich Building Systems", SLP-TRK.
- Positive attachment secured through sides of track, to allow up to 1" vertical movement.
- 3. Match gauge, depth and section of associated vertical metal stud wall members, minimum 20 gauge and 30 mils thickness.
- 4. Flange/leg size not less than 1.25 inches.
- 5. UL approved for use in fire rated assemblies, where applicable.

E. Flexible Steel Stud Runners and Tracks:

- 1. Equal to: "Flex-Ability Concepts", "FLEX-C TRAC".
- 2. Galvanized steel sheet track.
- Zinc-coated steel side bands.

F. Furring Channels or Strips:

- 1. 7/8" or 1-1/2", as indicated on Drawings. If not indicated, provide 1-1/2".
- 2. 20 gauge, minimum.
- 3. Cee shape or Hat Channel profile.
- 4.

2.3 MATERIALS AND COMPONENTS

A. Fasteners:

- 1. Type S and S-12 screws, bugle head or pan head.
- 2. Sized to provide 3/8 inch penetration beyond thickness of wallboard.

B. Accessories:

- 1. Corner reinforcements, casing beads and metal trim, fabricated from 26 gauge galvanized sheet steel with perforated flanges, designed to receive joint compound.
- C. Control Joints:
 - 1. "USG", "No. 093".
- D. Suspension System for Suspended Gypsum Board Ceiling:
 - 1. "USG/Donn", "Rigid X".
- E. Hangar Wires:
 - 1. ASTM A-641, 12 gauge, 0.475 lbs/ft.

PART 3 - EXECUTION

3.1 INSTALLATION OF WALLBOARD

- A. Single Layer Wallboard Metal Stud Partitions:
 - 1. Secure metal runners to concrete slabs with power driven anchors, space 24 inches o.c.
 - 2. Space metal studs 16 inches o.c. and locate studs at door and window frames, partition intersections and corners. Locate studs within 2 inches of all door-frame jambs and anchor to jamb and head anchor clips of frame by screw attachment. Over frames a cut-to-length stud extending from door frame header to ceiling runner shall be positioned over vertical joints over door frame. Anchor all frames at jamb anchor clips, after stud and before gypsum wallboard is installed.
 - 3. Sound attenuation blankets shall be pressure-fit between studs.
 - 4. Apply single layer wallboard face out with long dimension vertical. All abutting ends and edges shall occur over stud on different studs. Screws shall be spaced 12 inches o.c. in field of board and 8 inches o.c. staggered along vertical edges.
 - 5. Use wallboard of maximum practical lengths to minimize end joints.
 - 6. Use single panel to span entire length of width of surface where possible.
 - 7. Stagger end joints when they occur.
 - 8. Locate end joints as far as possible from center of wall or ceiling.
 - 9. Butt wallboards without forcing
 - 10. Support ends and edges of wallboard panels on framing or furring members.

B. Wall Board Ceilings - Suspended:

- 1. Install suspension system level and true, in accordance with manufacturer's instructions, to a tolerance of 1/8 inches in 12'-0".
- 2. Install suspension system to comply with ASTM C636. Secure only from building structural members. Locate hangers near each end and at 4'-0" along each carrying channel.
- 3. Install fastener type and spacing per manufacturer or corrosion resistant buglehead drywall screws at 12 inches o.c. in field and 8 inches o.c. along edges; whichever is the most restrictive requirement.

C. Accessories:

- 1. Corner beads shall be installed on all exterior corners attached with suitable fasteners spaced 9 inches o.c. on both sides, and shall be in single lengths unless corner exceeds standard stock lengths.
- 2. Metal trim shall be installed over face-layer wallboard, attached with suitable fasteners shaped 9 inches o.c. and shall be in single lengths unless application length exceed standard stock lengths.
- 3. Wallboard screws shall be applied with an electric driver.
- 4. Provide control joints at maximum 28'-0" o.c. If additional shrinkage cracks occur, install control joints and patch cracks.

D. Joint Treatment:

- 1. Finish all joints and interior corners with joint tape and joint compound.
 - Apply joint compound sufficiently thick to hide board surface at angles and joints. Cover nail/screw heads and depressions with compound.
 - b. Apply tape, squeeze out excess compound and cover tape with compound.
 - c. When first coat has thoroughly dried apply two coats of compound, extending each coat slightly beyond previous coat. Sand to smooth, flat surface, ready for specified finish.

E. Finish:

- 1. Level 5 finish at all exposed areas.
- 2. If specifically permitted by the Architect, provide Level 4 finish at all exposed areas and Level 5 finish at the following conditions:
 - a. All walls indicated to receive a skim coating.
 - b. All walls scheduled to receive a highly reflective wallcovering.
 - c. All wall areas scheduled to receive a dryerase or projectable wallcovering.
 - d. All wall areas scheduled to receive a dryerase paint or chalkboard paint.
 - e. All surfaces of all drywall which is paperless, fiberglass mats, or otherwise textured.
- 3. Level 2 finish at concealed areas (above ceilings, draftstopping).
- 4. No textured walls or ceilings.

3.2 CLEANING

A. Remove soil, stain caused by drywall installation.

PROJECT NO. 24-179.000 Harrison REMC - Addition and Renovation Harrison REMC

GYPSUM DRYWALL – STEEL STUD CONSTRUCTION 09 2900.01 - 7 04/24/2025

PART 4 - SUBMITTAL CHECKLIST

A. Product Data.

END OF SECTION 09 2900.01

SECTION 09 3000 - TILE

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: General and Supplementary Conditions of the Contract, Division 1 General Requirements, and Drawings are applicable to this Section.

B. Section Includes:

- 1. Porcelain floor tile and base where shown on Drawings.
- 2. Porcelain wall tile where shown on Drawings.
- 3. Glazed ceramic wall tile where shown on Drawings.

1.2 SUBMITTALS

A. Shop Drawings:

- 1. Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control joints, thresholds, and setting details.
- 2. Locate and detail expansion and control joints.

B. Product Data:

1. Manufacturer's product data sheets, cutsheets, specifications and instructions for using mortars, adhesives, and grouts.

C. Samples:

- 1. Tile: Submit color samples as specified on Drawings or manufacturer's entire color selection.
- 2. Grout: Submit color samples as specified on Drawings or manufacturer's entire color selection.

1.3 QUALITY ASSURANCE

A. Single Source Responsibility:

- 1. Obtain each type and color tile material required from single source.
- 2. Obtain setting and grouting materials from one manufacturer to ensure compatibility.
- 3. Furnish a 10 year guarantee from installation material manufacturer. The guarantee is inclusive of installation materials, finish product, and labor.

B. Manufacturer Qualifications:

1. Tile: Minimum 5 years experience in manufacture of tile products.

- 2. Setting Materials: Minimum 10 years experience in manufacture of setting and grout materials specified.
- 3. Membrane: Minimum 5 years experience in manufacture of membrane materials specified.

C. Installer Qualifications:

1. Specializing in tile work having minimum of 5 years successful documented experience with work comparable to that required for this Project.

D. Certifications:

- 1. Submit "Master Grade Certificate" for each type of ceramic, quarry, and paver tile in accordance with requirements of ANSI A137.1.
- 2. Submit manufacturer's certifications that mortars, adhesives, and grouts are suitable for intended and specified use.
- E. Conform to ANSI- Recommended Standard Specifications for Ceramic Tile A137.1
- F. Conform to TCA Ceramic Tile: The Installation Handbook.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of Section 01 6500.
- B. Labeling: Comply with ANSI A137.1.
- C. Deliver materials in manufacturer's unopened containers, fully identified with name, brand, type, and grade.
- D. Protect materials from contamination, dampness, freezing, or overheating in accordance with manufacturer's instructions.
- E. Broken, cracked, chipped, stained, or damaged tile will be rejected, whether built-in or not.
- F. Protect mortar and grout materials against moisture, soiling, or staining.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Comply with requirements of referenced standards and recommendations of material manufacturers for environmental conditions before, during, and after installation.
- B. Do not begin installation until building is completely enclosed and HVAC system is operating and maintaining temperature and humidity conditions consistent with "after occupancy" conditions for a minimum of 2 weeks.
- C. Maintain continuous and uniform building temperatures of not less than 50 degrees F during installation nor more than 100 degrees F.
- D. Ventilate spaces receiving tile in accordance with material manufacturers' instructions.

1.6 MAINTENANCE MATERIALS AND DATA

- A. See Specification Section 01 7846 Closeout Maintenance Materials.
- B. Submit maintenance data under provisions of Section 01 7800 Closeout Submittals.
- C. Include cleaning and maintenance methods, cleaning solutions recommended, stain removal methods, and polishes and waxes recommended.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Dal-Tile Corp."
- B. "Atlas Concorde"

2.2 GENERAL

A. ANSI Standards:

- 1. Comply with ANSI A137.1 "American National Standard Specifications for Ceramic Tile" for types, compositions, and grades of tile indicated.
- 2. Furnish tile complying with "Standard Grade" requirements unless otherwise indicated.
- B. ANSI Standard for Tile Installation Materials:
 - 1. Comply with ANSI standard referenced with products and materials indicated for setting and grouting.

C. Factory Blending:

1. For tile exhibiting color variations within the ranges selected during sample submittals, blend tile in factory and package accordingly so that tile units taken from one package show the same range in colors as those taken from other packages and match approved samples.

D. Mounting:

- 1. Where factory-mounted tile is required, provide back-face or edge-mounted tile assemblies as standard with manufacturer unless another mounting method is indicated.
- 2. Where tile is indicated for installation in swimming pools, on exteriors or in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies that this type of mounting is suitable for these kinds of uses and has been successfully used on other projects.

2.3 PORCELAIN TILE

A. Porcelain Floor Tile:

- 1. Type: As shown on Drawings.
- 2. Size: As shown on Drawings.
- 3. Pattern: As shown on Drawings.
- 4. Color: As shown on Drawings.

B. Porcelain Wall Tile:

- 1. Type: As shown on Drawings.
- 2. Size: As shown on Drawings.
- 3. Pattern: As shown on Drawings.
- 4. Color: As shown on Drawings.

2.4 CERAMIC TILE

A. Glazed Ceramic Wall Tile:

- 1. Type: As shown on Drawings.
- 2. Size: As shown on Drawings.
- 3. Pattern: As shown on Drawings.
- 4. Color: As shown on Drawings.

2.5 THRESHOLDS

A. Metal Edge Strip:

- 1. General:
 - a. Provide metal edge strip at the transition between the tile flooring to the adjacent flooring.
 - b. Equal to: "Schluter Systems" transition and edge strips.
- 2. Size and Profile:
 - a. Bent angle profile with smooth finished edges.
 - b. Configuration as required to provide proper transition between finished surface of tile and that of the adjacent finished flooring.
 - c. Height to match the thickness of the tile, with top surface smooth and flush with the tile.
- 3. Finish:
 - a. White zinc, aluminum or stainless steel.
 - b. Finish as selected from all manufacturer's standard selection.

2.6 TRIMMERS

A. Provide necessary caps, stops, returns, trimmers and other shapes to complete installation.

2.7 MORTAR MATERIALS - THIN SET BEDS

- A. Portland Cement With Latex Additive; Thin-Set (for use with ceramic wall tile):
 - 1. Provide one of the following acceptable products:
 - a. "Custom Building Products", CustomCrete Latex Mortar Admix with site mixed Mortar or CreteMix.
 - b. "Laticrete, 4237 Latex Thin Set Mortar Additive.
 - c. "Mapei, Keracrete System, consisting of KER 303 Latex mixed with 1:1 sand/cement blend.
 - 2. Description:
 - a. Latex additive and site mixed portland cement mortar. Complying with ANSI A118.4.
 - 3. Quantity:
 - a. As recommended by latex additive manufacturer.
- B. Lightweight Portland Cement; Thin-Set (for use with large format 18" x 18" or larger floor tile):
 - 1. Provide one of the following acceptable products:
 - a. "Custom Building Products", ProLite Tile & Stone Mortar or approved equal.
 - 2. Description:
 - a. Lightweight formula for use with large format tile and stone.
 - b. Complying with ANSI A118.4TE, A118.15TE and A118.11.

2.8 MEMBRANES, PRIMERS AND SEALERS

- A. Crack Isolation and Waterproofing Membrane:
 - 1. Provide one of the following acceptable products:
 - a. "Mapei", Mapelastic 315.
 - b. "Custom Building Products", Red Gard.
 - 2. Description:
 - a. Trowel applied elastomeric compound.
 - 3. Accessories:
 - a. Preformed fiberglass mesh coving, inside and outside corners, and drain fittings.
 - b. Preformed expansion joint flashing.
- B. Concrete Slab Primers and Sealers:
 - Where existing substrate is unacceptable for adhesion or bonding of new materials: Provide primers and sealers as required by flooring manufacturer to achieve the proper substrate conditions for installation of flooring.

2. Scarify, shot-blast, or sand-blast floor as required at no change in bid price.

2.9 GROUT

A. Epoxy Grout:

- 1. Provide one of the following acceptable products:
 - a. "Custom Building Products", CEG2000 100% Solids Epoxy Grout.
 - b. "Laticrete", Spectralock 2000 IG Chemical Resistant Industrial Grade Epoxy Grout.
 - c. "Mapei", Kerapoxy Chemical Resistant Grout.
- 2. Multi-component, factory prepared,100 percent epoxy resin and hardener with sand or mineral filler material.
- 3. Comply with ANSI A118.3.
- 4. Color: As indicated or to be selected by Architect from manufacturer's entire selection.
- 5. Location: Provide for all floor and wall surfaces, unless indicated otherwise.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that areas to receive tile installed by thin bed method have wood float finish and pitched to drains. Substrates are to be true within 1/8 inch in 10'-0" (for all tiles 18" and larger). Substrates are to be true within 1/4 inch in 10'-0" (for all tiles smaller than 18").
- B. Condition of Surfaces to Receive Tile:
 - 1. Firm, dry, clean and free of oily or waxy films, mortar and soil.
 - 2. Grounds, anchors, plugs, hangers, bucks, electrical and mechanical work in or behind tile installed.
- C. Air Temperature and Surfaces in Rooms to Receive Flooring:
 - 1. Between 60 degrees to 90 degrees F, unless otherwise recommended by manufacturers of materials being installed.

3.2 PREPARATION

- A. Clean substrates.
- B. Wet down or wash dry, dusty surfaces and remove excess water immediately prior to application of tiles.
- C. Prepare surfaces in strict accordance with instructions of manufacturer whose setting materials or additives are being used.

- D. Acid Based Cleaners: Use not permitted.
- E. Scarify concrete substrates with blast track equipment if necessary to completely remove curing compounds or other substances that would interfere with proper bond of setting materials. Clean and maintain substrate in condition required by setting material manufacturer.
- F. Do not seal substrate unless required by manufacturer.
- G. Prime substrate when required by manufacturer.
- H. H. Blending:
 - 1. For tile exhibiting color variations within the ranges selected during sample submittals, verify that tile has been blended in factory and packaged accordingly so that tile units taken from one package show the same range in colors as those taken from other packages and match approved samples.
 - 2. If not factory blended, either return to manufacturer or blend tiles at project site before installing.

3.3 INSTALLATION

- A. Concrete Slab Primers and Sealers:
 - 1. Install primers and sealers in accordance with manufacturers recommended installation guidelines and details.
 - 2. Apply all concrete slab primers and sealers as required to achieve an acceptable substrate for installation of flooring per flooring manufacturer's requirements. Apply when areas are ready or scheduled to receive flooring without delays to the project or schedule, and without any additional costs or change in time. If floor is required to be sandblasted, shot-blasted, scarified, or otherwise prepared, perform this work at no additional cost or change in time.
- B. Crack Isolation and Waterproofing Membrane:
 - 1. Install membrane in accordance with manufacturers recommended installation guidelines and details.
 - 2. Install membrane over cracks of up to 1/8 inch or greater in substrates.

 Apply a 12 inch wide strip centered on crack as crack isolation membrane.
 - 3. Install membrane with products or methods approved in writing by membrane manufacturer when joining, sealing, fastening, or adhering sheet membranes.
 - 4. Once all cracks have been addressed, install membrane to entire floor substrate as waterproofing membrane
 - 5. Flash waterproofing up adjacent walls and surfaces in accordance to manufacturer's details, full height of base.
 - 6. Use preformed cove, corners, and expansion joint flashing.
 - 7. Allow membrane to cure as prior to setting tile.
 - 8. Do not allow construction traffic on membrane.
 - 9. Flood test waterproof membranes after fully cured.
 - 10. Field Quality Control water test when required.
- C. Tile Installation, General:

- 1. Install tile materials in accordance with ANSI A137.1, other referenced ANSI and TCNA specifications, and TCNA "Handbook for Ceramic Tile Installation", except for more stringent requirements of manufacturer or these Specifications.
- 2. Cut and fit tile tight to protrusions and vertical interruptions and treat with a compatible sealants as required. Form corners and bases neatly.
- 3. Work tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make joint watertight, without voids, cracks, excess mortar, or grout.
- 4. Prepare surface, fit, set, bond, grout and clean in accordance with applicable requirements of ANSI standards and Tile Council of North America.

D. Layout:

- 1. Lay out work to pattern indicated so that full tile or joint is centered on each wall and no tile of less than half width need be used. Do not interrupt pattern through openings. Lay out tile to minimize cutting and to avoid tile less than half size.
- 2. For heights stated in feet and inches, use courses of full tile to produce nearest attainable heights without cutting tile.
- 3. No staggered joints will be permitted.
- 4. Align joints in tile in both directions.
- 5. Align joints between floor and base tile.
- 6. Make joints between sheets of tile exactly same width as joints within sheet.
- 7. File edges of cut tile smooth and even.
- 8. Cut and fit tile at penetrations through tile. Do not damage visible surfaces. Carefully grind edges of tile abutting built-in items. Fit tile at outlets, piping and other penetrations so that plates, collars, or covers overlap tile.
- 9. Extend tile work into recesses and under or behind equipment and fixtures, to form complete covering without interruptions, except as otherwise indicated. Terminate work neatly at obstructions, edges and corners without disrupting pattern or joint alignments.
- 10. Accurately form intersections and returns.
- E. Thin Set Method, Floors and Walls, ANSI-108.4, 108.5, 108.14, 108.15, 108.16:
 - 1. Apply mortar or adhesive with notched trowel using scraping motion to work material into good contact with surface to be covered. Maintain 90 percent coverage on back of tile and fully bed all corners.
 - 2. Apply only as much mortar or adhesive as can be covered within allowable windows as recommended by mortar or adhesive manufacturer or while surface is still tacky.
 - 3. When installing large tiles, ceramics or mosaics, trowel small quantity of mortar or adhesive onto back of each tile or sheet of tiles.
 - 4. Set tiles in place and rub or beat with small beating block.
 - 5. Beat or rap tile to ensure proper bond and also to level surface of tile.
 - 6. Align tile to show uniform joints and allow to set until firm.
 - 7. Clean excess mortar or adhesive from surface of tile with wet cheese cloth (not a sponge) while mortar is fresh.
 - 8. Allow face mounted tile to set until firm before removing paper and before grouting.
 - 9. Sound tile after setting. Replace hollow sounding tiles.

F. Grouting, ANSI A108.9- 108.10:

1. Allow tiles to set a minimum of 48 hours before grouting.

- 2. If bonding materials are rapid setting, follow manufacturer's recommendations.
- 3. Install in accordance with grout manufacturer's recommendations and ANSI A108.10.
- 4. Pack joints full and free before mortar takes initial set.
- 5. Clean excess grout from surface with wet cheesecloth as work progresses. Do not use hydrosponges.
- 6. Cure after grouting by covering with kraft or construction paper for 72 hours.
- 7. Install sealant in vertical wall joints at interior corners.

G. Control Joints and Other Sealant Usage, ANSI-A108.1:

- 1. Install control joints where tile abuts any/all retaining surfaces such as perimeter walls, curbs, columns, wall corners and directly over cold joints and control joints in structural surfaces conforming to architectural details.
- 2. Install control joint in floors at spacings as indicated in TCNA Installation Handbook, unless noted otherwise.
- 3. Rake or cut control joints through setting bed to supporting slab or structure. Keep joints free of mortar.
- 4. Install in full accordance with TCNA Installation Handbook.
- 5. Fill joints with self-leveling polyurethane sealant and backing material as required.
- 6. Fill joints around toilet fixtures with white silicone sanitary sealant.

H. Expansion Joints:

- 1. Keep expansion joints free of mortar and grout.
- 2. Use manufacturer's expansion joint flashing when covering expansion joints with waterproof or crack isolation membranes.
- 3. Provide expansion joints directly over changes in material, over control and expansion joints in substrate, at juncture of floors and walls, at other restraining surfaces such as curbs, columns, bases, and wall corners, and where recommended by TCNA EJ171 Expansion Joint requirements.
- 4. Install sealant in expansion joints.
- 5. Provide sealant material at items penetrating tile work, unless otherwise indicated.
- 6. Provide sealants and related materials in accordance with cited ANSI A108.1 and TCNA requirements.

3.4 ADJUSTING

A. Sound tile after setting. Replace hollow sounding units.

3.5 CLEANING

- A. Clean excess mortar from surface with water as work progresses. Perform cleaning while mortar is fresh and before it hardens on surfaces.
- B. Sponge and wash tile diagonally across joints. Polish with clean dry cloth
- C. Remove grout haze following recommendation of mortar additive manufacturer. Do not use acids for cleaning.

- D. Remove temporary protective coating by method recommended by coating manufacturer that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent it from clogging drains.
- E. Wipe all sealer from glazed surfaces or any other surface that will not accept sealer. Clean tile surfaces to remove any residue and do not allow to dry on surface.

3.6 PROTECTION

- A. Prohibit traffic from floor finish for 72 hours after installation.
- B. Where temporary use of new floors is unavoidable, supply large, flat boards or plywood panels for walkways over kraft paper.
- C. Protect work so that it will be without any evidence of damage or use at time of acceptance.

PART 4 - SUBMITTAL CHECKLIST

- A. Shop Drawings.
- B. Samples.
- C. Manufacturer's Product Data.

END OF SECTION 09 3000

SECTION 09 5113 - ACOUSTICAL CEILINGS

PART 1 - PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Extent of acoustical ceilings as shown and scheduled on the Drawings.
- B. Types of acoustical ceilings specified in this Section include the following:
 - 1. Acoustical panel ceilings, exposed grid suspension.

1.02 QUALITY ASSURANCE

- A. UL Fire Hazard Classification:
 - 1. Where acoustical ceilings are indicated to comply with fire hazard classification provide acoustical materials which have been tested, rated and labeled by UL for indicated ratings.
 - 2. Classification: Maximum of 25 for flame spread.
- B. Sound and Noise Classification:
 - 1. Provide systems with NRC ratings in accordance with ASTM C423 and STC ratings in accordance with AMA1-II, as tested by an independent agency.

1.03 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's product data sheets, cutsheets, specifications and installation instructions.
- B. Samples:
 - 1. Where colors are specified, submit one sample of each type of acoustical unit and suspension system member.
 - 2. Where colors are not specified, or are specified as "to be selected", submit samples showing manufacturer's full range of standard colors for each type acoustical unit and suspension system.
 - 3. Submit additional or larger samples of selected colors upon request.

1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the site in manufacturers original, unopened packages, with labels intact. Store and handle to avoid damage and exposure to elements. Remove damaged or otherwise unsuitable material from job site.

1.05 MAINTENANCE MATERIALS AND DATA

- A. See Specification Section 01 7846 Closeout Maintenance Materials.
- B. Submit maintenance data under provisions of Section 01 7800 Closeout Submittals.

1.06 PROJECT CONDITIONS

A. Do not install acoustical ceilings until space is enclosed and weatherproof, and until wet-work in space is completed, and until temperature and humidity will be continuously maintained at values near those indicated for final occupancy.

PART 2 - PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Provide ceiling panels, as approved by the Architect, by one of the following manufacturers:
 - 1. "Armstrong"
 - 2. "U.S. Gypsum" (USG)
 - 3. "Celotex"
 - 4. "National Gypsum Company" (NGC)
 - "Certainteed"
- B. Provide suspension systems from same manufacturer as the ceiling panel, as approved by the Architect, or by one of the following manufacturers:
 - 1. "Armstrong"
 - 2. "U.S. Gypsum/Donn Ceilings"
 - 3. "Chicago Metallic Corporation"

2.02 CEILING SYSTEMS

- A. Provide the following acoustical ceiling systems as indicated on the Drawings:
 - 1. Panel and Suspension System Type:

(Lay-in, 2'x2', Drop Edge)

a. Panel:

1. Model: "USG", Frost #414.

2. Size: 2' x 2' x 7/8".

3. Edge: Shadowline Beveled.

4. NRC: 0.70.

5. Light Reflect: 0.85.

6. Color: White.

b. Suspension System:

1. Model: "Armstrong", Prelude XL. "USG", Donn DX/DXL.

Profile: 2' x 2' grid, 15/16" flange.
 Material: Hot dipped galvanized

4. Color: White.

2. Panel and Suspension System Type:

(Lay-in, 2'x2', Square Edge, High NRC)

- a. Panel:
 - 1. Model: "Armstrong", Optima Open Plan Fine Fissured #3159. "USG", Halcyon Clima Plus #99221.
 - 2. Size: 2' x 2' x 1-1/2".
 - 3. Edge: Square.
 - 4. NRC: 1.00.
 - 5. Light Reflect: 0.88 minimum.
 - 6. Color: White.
- b. Suspension System:
 - Model: "Armstrong", Prelude XL. "USG", Donn DX/DXL.
 - 2. Profile: 2' x 2' grid, 15/16" flange.
 - 3. Material: Hot dipped galvanized.
 - 4. Color: White.

2.03 CEILING SUSPENSION MATERIALS

- A. Comply with ASTM C 635, as applicable to type of suspension system required for type of ceiling units indicated. Coordinate with other work supported by or penetrating through ceilings, including light fixtures, and HVAC equipment.
- B. Structural Class:
 - 1. Intermediate-duty system.
- C. Attachment Devices:
 - 1. Size for 5 times design load indicated in ASTM C 635, Table 1, Direct Hung.
- D. Hanger Wires:
 - 1. Galvanized carbon steel, ASTM A 641, soft temper, pre-stretched, yield-stress load of at least 3 times design load, but not less than 12 gauge (0.106 inch).
- E. Type of System:
 - 1. Either direct-hung or indirect hung suspension system, as required to meet performance requirements.
- F. Carrying Channels:
 - 1. 1-1/2 inch steel channels, hot-rolled or cold-rolled, not less than 0.475 lbs. per lineal ft.

G. Edge Moldings:

- 1. Manufacturer's standard channel molding for edges and penetrations of ceiling, with single flange of molding exposed.
- 2. 15/16 inch minimum exposed leg, finish to match grid finish.

H. Exposed Suspension System:

- 1. Manufacturer's standard exposed runners, cross-runners and accessories, of double web types and profiles indicated, with exposed cross runners coped to lay flush with main runners.
- 2. Provide uniform factory-applied finish on exposed surfaces of ceiling suspension systems, including moldings, trim and accessories.
- 3. Manufacturer's standard baked polyester finish, low gloss, color as selected.

PART 3 - PART 3 - EXECUTION

3.01 PREPARATION

- A. Furnish layouts for inserts, clips or other supports required to be installed by other trades for support of acoustical ceilings.
- B. Establish layout of acoustical units in compliance with reflected ceiling plan. Balance border widths at opposite edges of each ceiling. Avoid use of less-than-half width units at borders.

3.02 INSTALLATION

- A. Install materials in accordance with manufacturer's printed instructions, and to comply with governing regulations, fire resistance rating requirements as indicated, and industry standards applicable to work.
- B. Install all acoustical units with grain in one plane and direction.
- C. Install suspension systems to comply with ASTM C 636, with hangers supported only from building structural members. Locate hangers near each end and spaced 4'-0" along each carrying channel or direct-hung runner, unless otherwise indicated, leveling to tolerance of 1/8 inch in 12'-0".
- D. Install edge moldings of type indicated at perimeter of acoustical ceiling area and at locations where necessary to conceal edges of acoustical units.
 - 1. Sealant Bed: Apply continuous ribbon of acoustical sealant, concealed on back of vertical leg before installing moldings.
 - 2. Screw-attach moldings to substrate at intervals not over 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to tolerance of 1/8 inch in 12'-0". Miter corners accurately and connect securely.
- E. Install panels in coordination with suspension system, with edges concealed by support of suspension members. Scribe and cut panels to fit accurately at borders and at penetrations.

ACOUSTICAL CEILINGS 09 5113 - 5 04/24/2025

F. Install hold-down clips in areas indicated, and in areas where required by governing regulations or for fire resistance ratings; space as recommended by panel manufacturer, unless otherwise indicated or required.

3.03 ADJUST AND CLEAN

- A. Clean exposed surfaces of acoustical ceilings, including trim, edge moldings, and suspension members; comply with manufacturer's instructions for cleaning and touch-up of minor finish damage.
- B. Remove and replace work which cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

SUBMITTAL CHECKLIST

- 1. Product Data.
- 2. Samples.

END OF SECTION 09 5113

RESILIENT TILE FLOORING 09 6519 - 1 04/24/2025

SECTION 09 6519 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Section Includes:

- 1. Rubber Base.
- 2. Luxury Vinyl Tile.
- 3. Resilient flooring accessories.
- B. Furnish labor, materials, equipment, special tools, supervision and services required for floor preparation for tile installation.
- C. Furnish labor, materials, equipment, special tools, supervision and services required to install the products and systems complete as shown on the Drawings and/or specified herein.

1.2 SUBMITTALS

A. Manufacturer's Literature:

- 1. Manufacturer's product data and descriptive literature.
- 2. Manufacturer's installation instructions.
- 3. Manufacturer's maintenance instructions.
- 4. Material safety data sheets.

B. Samples:

- 1. Flooring:
 - a. 3"x3" actual tiles of colors as specified on drawings. Color charts alone are not acceptable.
 - b. If color is not specified, submit samples of manufacturer's entire selection.
- 2. Base:
 - a. Full size sections of colors as specified on drawings. Color charts alone are not acceptable.
 - b. If color is not specified, submit samples of manufacturer's entire selection.

1.3 DELIVERY, STORAGE AND HANDLING

- A. Receive all products and materials as packaged by the manufacturer with manufacturer's seals and labels intact. Store materials at the job site within the building and in a dry place at least 48 hours before installing flooring materials.
- B. Store in space with temperature maintained between 65 degrees F and 90 degrees F.

1.4 MAINTENANCE MATERIALS AND DATA

- A. See Specification Section 01 7846 Closeout Maintenance Materials.
- B. Submit maintenance data under provisions of Section 01 7800 Closeout Submittals.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Provide products, as approved by the Architect, from one of the following approved manufacturers:
 - 1. Rubber Base:
 - a. "Tarkett".
 - b. "Roppe"
 - c. "Flexco", Wallflowers.
 - 2. Luxury Vinyl Tile:
 - a. "The Mohawk Group"
 - b. "Patcraft"
 - c. "Shaw Contract Group"
 - d. "Interface"
 - e. "Mannington Commercial"
 - 3. Vinyl Composition Tile
 - 4. Resilient Accessories
 - a. "Tarkett"
 - b. "Mannington Commercial"
 - c. "Patcraft"

2.2 MATERIALS

- A. Rubber Base:
 - 1. FS SS-W-40A, Type I, TS rubber.
 - 2. Meets ASTM F-1860, Group 1.
 - 3. 1/8" thickness, 120' rolls, coved, set-on type.
 - 4. 4" high unless otherwise shown.
 - 5. Color: as shown on Drawings.
 - 6.
- B. Luxury Vinyl Tile:

- 1. Type: as shown on Drawings.
- 2. Size: as shown on Drawings.
- 3. Finish: as shown on Drawings.
- 4. Color: as shown on Drawings.
- 5. Wear Layer Thickness: 22 mil; Clear.
- 6. Overall Thickness: 4.5 mm (nominal).
- 7. Warranty: 20-year wear warranty.

C. Rubber Base Adhesive:

- 1. Comply with recommendations of rubber base manufacturer.
- D. Rubber or Vinyl Reducer Strips:
 - 1. 1-1/2" wide, trim to match tile thickness.
 - 2. Finish: as selected from manufacturer's entire selection.
- E. Concrete Slab Primers and Sealers:
 - 1. Where existing substrate is unacceptable for adhesion or bonding of new materials: Provide primers and sealers as required by flooring manufacturer to achieve the proper substrate conditions for installation of flooring.
 - 2. Scarify, shot-blast, or sand-blast floor as required at no change in bid price.
- F. Leveling Compound:
 - 1. Latex type as recommended by flooring manufacturer.
- G. Subfloor Leveler System:
 - 1. Equal to: "Tarkett", Subfloor Leveler System.
 - 2. Resilient PVC gradual sloping ramped wedged materials.
 - 3. Provide slope, profile, and lengths as required for specific condition.

PART 3 - EXECUTION

3.1 .PREPARATION

- A. Spaces shall be at a minimum temperature of 70 degrees F. Temperature shall be maintained during and 48 hours after installation.
- B. Surfaces shall meet the minimum requirements of the manufacturer of the flooring. Do not install directly over plywood. Provide luan underlayment over all plywood decks. Commencement of installation of materials constitutes acceptance of the substrates.
- C. Work shall not be started until all items penetrating the flooring have been installed.

- D. No flooring shall be installed until the installer has ascertained that the chemical treatment of substrates will not interfere with the successful application of the flooring materials.
- E. Spaces in which resilient flooring is being installed shall be closed to traffic or other work.
- F. When solvent-based adhesives are used, the space shall be ventilated; use spark proof fans if natural ventilation is inadequate. Prohibit all smoking.
- G. Before installing flooring, test concrete floor for excessive moisture by taping an 18" x 18" mat of rubber or vinyl sheet material to floor at edges with masking tape. If condensation is apparent on the underside of the sheet after 24 hours, do not install flooring.
- H. Before installing flooring, fill all cracks and holes and level depressions with underlayment compound. Surfaces shall not vary more than 1/8" in 10' in any dimension.
- I. Before installing flooring, test concrete floor for acceptable adhesion and bonding of new materials atop substrate. If proper adhesion and bonding are not apparent, do not install flooring until sealer and primer are applied. Scarify, shot-blast, or sandblast floor if required to install sealer/primer.
- J. Install floor tiles wall to wall, under all moveable casework and cabinets, under all open counter areas, and up to fixed equipment and casework.

3.2 INSTALLATION

- A. Install flooring and products in accordance with the manufacturer's recommendations.
- B. Apply all concrete slab primers and sealers as required to achieve an acceptable substrate for installation of flooring per flooring manufacturer's requirements. Apply when areas are ready or scheduled to receive flooring without delays to the project or schedule, and without any additional costs or change in time. If floor is required to be sandblasted, shot-blasted, scarified, or otherwise prepared, perform this work at no additional cost or change in time. This includes, but is not limited to, floor slabs which are not acceptable due to excessive moisture content.
- C. Install subfloor leveler at all doors and openings as required so as to maintain a smooth, flat, and true transition between these flooring materials and adjacent flooring materials.
- D. Mix and apply adhesive as recommended by the manufacturer. Lay flooring so that fields or patterns center on areas. Adjust pattern so that edge pieces shall not be less than 1/2 size. Lay flooring true to line, level, and with tight joints. Cut flooring to and around all permanent cabinets and bases. Roll flooring to assure contact and proper adhesion to substrate.
- E. Apply wall base to walls, columns, pilasters, casework, and other permanent fixtures in rooms or areas where base is required. Install base in lengths as long as practicable with continuous wrapping outside corners, and miter cut inside corners. Do not use preformed corner pieces.
- F. Remove excessive adhesive in accordance with flooring manufacturer's instructions.
- G. Install edge strips at termination of flooring where substrate is exposed and extends beyond.

- H. Install edge strips at doors, openings, and any and all other junctions of this flooring and adjacent flooring materials. Firmly anchor strips to subfloor with adhesive. Make transition in floor finish at centerline of door bottom or opening through wall.
- I. After installation, maintain a minimum space temperature of 55 degrees F.
- J. Installation of rubber base at bullnose block:
 - 1. Applies to all rubber base products designed for square corners, not bullnose type.
 - 2. Traditional wall base profiles should be able to wrap the radius of the wall surface with no issues, but if issues exist, adhesion is a problem, a short return exists, or profiles are non-standard, then the use of a heat gun and pipe shall be required.
 - 3. The material shall be draped over the pipe that matches the radius of the wall, then apply heat to the surface until the material softens.
 - 4. Next the base shall be placed into a container of cold water to change the memory and profile.
 - 5. Then the pieces shall be cut to the proper and full length of the area and return.
 - 6. Apply contact adhesive, type as per the manufacturer's recommendations, for short returns.

3.3 LUXURY VINYL TILE POST-INSTALLATION/INITIAL CLEANING

- A. Wait 48 hours after flooring installation before performing initial cleaning.
- B. Sweep, dust mop or vacuum the floor thoroughly to remove all loose dust, dirt, grit and debris.
- C. Remove any dried adhesive residue with a clean cloth dampened with mineral spirits.
- D. Wash thoroughly, with a cleaning solution using a pH neutral cleaner in accordance with flooring manufacturer's recommendations. The dilution ratio depends on light to heavy soil conditions.
- E. Let cleaning solution dwell for 5 to 15 minutes.
- F. Scrub the flooring using floor scrubber equipped with manufacturers recommended pad.
- G. Remove the cleaning solution using a wet vacuum.
- H. Rinse the floor thoroughly with fresh, clean water.
- I. Remove the rinse water and allow the floor to dry completely before allowing foot traffic.
- J. Repeat the rinse process if necessary to move any visible haze.

PART 4 - SUBMITTAL CHECKLIST

- A. Manufacturer's Literature.
- B. Samples.

PROJECT NO. 24-179.000 Harrison REMC - Addition and Renovation Harrison REMC RESILIENT TILE FLOORING 09 6519 - 6 04/24/2025

END OF SECTION 09 6519

SECTION 09 6800 - CARPETING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish labor, materials, equipment, special tools, supervision and services required for floor preparation for carpet installation.
- B. Furnish labor, materials, equipment, special tools, supervision and services required to manufacture, deliver and install all carpet indicated, noted and detailed on the Drawings and as specified herein.

1.2 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installer who can demonstrate successful experience with installations on projects of similar size and scope to this project.
- B. Requirements and Regulatory Agencies:
 - 1. Provide carpet and padding which meets the following requirements.
 - a. Flame Spread: ASTM E84, 75 or less.
 - b. Radiant Panel Test: ASTM E648, .45 watts/CM2, or more.
 - c. Smoke Density Test: ASTM E662, 450 or less.
 - d. Pill Test: DOC FF-1-70, pass.
 - e. Meet local Fire Marshal's requirements.

1.3 SUBMITTALS

- A. Samples:
 - 1. Where colors are specified, submit one full size sample of each color specified.
 - 2. Where colors are not specified or are specified as "to be selected", submit samples showing manufacturer's full range of standard colors for each type of carpet. Submit additional or larger samples of selected colors upon request.
- B. Shop Drawings and Manufacturer's Literature:
 - 1. Seaming diagram indicating:
 - a. Pattern direction.
 - b. Location of edge strips.
 - c. Dimensions of carpeted areas.
- C. Independent Testing Laboratory Test Reports:

- 1. Fire hazard classifications.
- Static control.
- Construction.

D. Certificates:

- 1. Manufacturer's certification that rolls furnished were manufactured in accordance with specification requirements, stating yarn and weight, backing and weight and average tuft bind.
- 2. Installer's list of comparable installations

1.4 DELIVERY, STORAGE AND HANDLING

A. Deliver:

- 1. Deliver carpet in original mill wrappings with register number tabs attached or stenciled on bale.
- 2. Do not deliver materials until installation is ready to begin.

B. Storage:

- 1. Store materials in dry, well ventilated space.
- 2. Do not store carpet rolls on end.

C. Handling:

1. Handle to protect from dirt and stains.

1.5 GUARANTEE / WARRANTY

- A. Warrant the following items for the lifetime of the carpet face:
 - 1. Wear: Not abrasively wear more than 10% face yarn weight under normal use.
 - 2. Static Electricity: Maintain specified levels of static electricity generation.
 - 3. Edge ravel: Will not occur under normal use.
 - 4. Delamination: Will not occur under normal use.
 - 5. Tuft Bind: Average face year tuft bind of 20 lbs.; will not zipper, wet or dry.

B. Adjustment:

1. During project guarantee period and within 15 days written notice from Owner or Architect, repair seams, edges and any other irregularity.

1.6 MAINTENANCE MATERIALS AND DATA

- A. See Specification Section 01 7846 Closeout Maintenance Materials.
- B. Submit maintenance data under provisions of Section 01 7800 Closeout Submittals.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Provide products, as approved by the Architect, from one of the following approved manufacturers:
 - "Interface."

2.2 CARPET

- A. Type:
 - 1. Broadloom Carpeting products as indicated on Drawings.
 - 2. Colors and patterns as indicated on the Drawings. If not indicated, colors and patterns are to be selected by Architect from manufacturer's entire selection for the specific carpet family specified.
- B. Static Electricity Generation (all carpet):
 - 1. Control Fiber: Stainless steel, aluminum, copper, or other metal, blended with carpet fiber, or by specific fiber blend.
- C. Maximum 3,000 volts at 20% relative humidity and 70°F temperature, AATCC-134-75.

2.3 INSTALLATION MATERIALS

- A. Adhesive:
 - 1. Carpet Adhesive:
 - a. Per carpet manufacturer for substrate and warranty requirements.
 - b. Nonflammable.
 - Seam Adhesive:
 - a. Latex base per carpet manufacturer.
- B. Concrete Slab Primers and Sealers:
 - 1. Where existing substrate is unacceptable for adhesion or bonding of new materials: Provide primers and sealers as required by flooring manufacturer to achieve the proper substrate conditions for installation of flooring.
- C. Subfloor Leveler System:
 - 1. Equal to: "Johnsonite", Subfloor Leveler System.
 - 2. Resilient PVC gradual sloping ramped wedged materials.
 - 3. Provide slope, profile, and lengths as required for specific condition.

- D. Seaming Tape:
 - 1. "Orcon", Super-35.
- E. Edge Strips (direct glue-down installation):
 - 1. Extruded, anodized aluminum bar reducer at exposed edges.
 - 2. Undercut, flanged.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Examination: Examine surfaces scheduled to receive carpeting for:
 - 1. Defects that will adversely affect the execution and quality of work.
 - 2. Deviation beyond allowable tolerances for carpet installation over concrete as indicated in Section 03 3000.
- B. Conditions of Surfaces:
 - 1. Do not install carpet over concrete substrate until concrete has cured minimum of 30 days.
 - 2. Check floor moisture content. Seal inverted glass tumbler to floor with putty. If condensation forms in 48 hours, do not install carpet.
 - 3. Do not start until unsatisfactory conditions are corrected.
 - 4. Install carpeting prior to installation of movable partitions and electrical floor outlets.
- C. Carpet: Unroll carpet face up and allow to lay flat at least 24 hours before installation.
- D. Prime floor slab as recommended by manufacturer.
- E. Apply all concrete slab primers and sealers as required to achieve an acceptable substrate for installation of flooring per flooring manufacturer's requirements. Apply when areas are ready or scheduled to receive flooring without delays to the project or schedule, and without any additional costs or change in time. If floor is required to be sandblasted, shot-blasted, scarified, or otherwise prepared, perform this work at no additional cost or change in time. This includes, but is not limited to, floor slabs which are not acceptable due to excessive moisture content.

3.2 INSTALLATION OF DIRECT GLUE DOWN CARPET

- A. Install carpet in accordance with submitted seam diagram, and manufacturer's instructions.
- B. Run all carpet seams in same direction.
- C. Lay carpet with minimum number of seams using minimum carpet sections in each room or space.

1. Fit carpet neatly into breaks and recesses, against bases, around pipes and penetrations, under saddles and thresholds, and around permanent cabinets and equipment.

D. Application of Adhesive:

- 1. Mix and apply adhesives in accord with manufacturer's instructions.
- 2. Do not soil walls, bases, or adjacent areas with adhesive.
- 3. Promptly remove any spillage.
- 4. Apply contact or seam adhesive 6 inches wide along carpet edges abutting walls and at cross-seams.
- E. Roll carpet to remove air bubbles and insure bond.
- F. Install carpeting wall to wall, under all moveable casework and cabinets, under all open counter areas, and up to fixed equipment and casework.

3.3 INSTALLATION OF CARPET WITH CUSHION

- A. Install carpet in accordance with submitted seam diagram and manufacturer's instructions.
- B. Install carpet around all floor outlets or similar obstructions.
- C. On completion, carpet shall be free of wrinkles and buckles, seams straight and well-made.
- D. Install carpeting wall to wall, under all moveable casework and cabinets, under all open counter areas, and up to fixed equipment and casework.

3.4 ADJUST AND CLEAN

A. Cleaning:

- 1. Remove spots and smears of cement from carpet immediately with solvent or adhesive remover.
- 2. Remove rubbish, wrapping paper, salvages and scraps less than 2 square feet or less than 8 inches in any dimensions.
- 3. Upon completion, vacuum with a commercial beater bar type vacuum cleaner.

B. Protection:

- 1. After each area of carpet has been installed, protect from soiling and damage.
- 2. The use of tape to hold down floor protection is prohibited.
- 3. The use of adhesive film floor protection is prohibited.

PART 4 - SUBMITTAL CHECKLIST

- A. Samples.
- B. Shop Drawing.

- C. Testing Laboratory Reports.
- D. Certificate of Manufacturer's Compliance.

END OF SECTION 09 6800

SECTION 09 7216 - WALL PROTECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Wall protection as indicated on Drawings and specified herein.

1.2 QUALITY ASSURANCE

- A. Deliver materials to project site in original packages or containers clearly labeled to identify manufacturer, brand name, quality or grade and fire hazard classification.
- B. Store materials in original undamaged packages or containers. Store materials in a clean, dry location protected against damage of any kind.
- C. Illuminate areas of installation using building's permanent lighting system; temporary lighting alone will not be acceptable.
- D. Installer qualifications
 - 1. Installer shall have a minimum of 3 years in installation of commercial wallcoverings.

1.3 SUBMITTALS

A. Product Data:

- 1. Manufacturer's product data sheets, cutsheets, specifications and installation instructions.
- 2. Include data on physical characteristics, durability, fade resistance and flame resistance characteristics.

B. Samples:

1. Submit actual samples of wall protection selected. If color not selected, submit samples for selection by the Architect from manufacturer's entire selection of type indicated. Printed color chart alone in not acceptable.

1.4 WARRANTY

A. Provide manufacturer's standard 5-year warranty.

PART 2 - PRODUCTS

2.1 MATERIAL

A. Wall Protection:

- 1. Basis of Specification: "J. Josephson, Inc." P3TEC Wall Protection.
 - a. Description:
 - 1) Wall protection with heavy polyester/ cotton knit backing.
 - 2) Roll Length: 15 yard rolls
 - 3) Roll Width: Trims to 48"
 - 4) Material thickness: .032"-.038" (varies by emboss and finish).
 - 5) PVF protective cap film.
 - 6) Flame Resistance: Class A fire rating, when tested in accordance with ASTM E 84.
 - 7) Impact Resistance: ASTM D-5420 Gardner Drop: 24 to 100+ inch-lbs.
 - 8) Abrasion Resistance: ASTM D-4060 Taber CS-10f wheel: 200 cycles, 0.02% weight loss.
 - 9) Cleaning and Stain Resistance: ASTM F-793: after 7 days, no change
 - 10) Fungal and bacterial resistant.
 - 11) Pattern/ design: as noted on Drawings.
 - 12) Color: as noted on Drawings.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Verify that wall surfaces are acceptable to receive the specified guard systems. Do not begin installation until acceptable conditions have been corrected.
- B. Store materials at normal occupied building temperature and humidity for a minimum of 3 days before installation.
- C. Apply primer to all wall surfaces scheduled to receive wall protection, prior to installation, in accordance with manufacturer's instructions. Never apply primer over oil-based paint/ primer.

3.2 INSTALLATION

- A. Install wall protection according to manufacturer's instructions and recommendations.
- B. Install test mock-up for proper adhesion and seam condition for Architect's approval.
- C. Install material under adequate lighting conditions.
- D. Install cuts of wall protection in roll sequence order.
- E. Install wall protection strips plumb.

- F. Apply adhesive to back of material in accordance with manufacturer's instructions.
- G. Ensure materials have made good contact to wall, with no bubbles.
- H. Seams:
 - 1. Install wall protection seams vertical, with tight fit, using overlap/ double-cut technique.
 - 2. Install wall protection seams free from air and paste bubbles.
 - 3. Do not locate seams closer than 6 inches to corners.
 - 4. Obtain commercial color match associated with patterns across seams.
 - 5. Do not wrap outside corners. Install corner guards as indicated on Finish Plans.

3.3 ADJUST AND CLEAN

- A. Remove surplus materials, rubbish, and debris resulting from wall protection installation upon completion of work, and leave areas of installation in neat, clean condition.
- B. Clean wall protection after installation in accordance with manufacturer's instructions.
- C. Do not use hard abrasive cleaning materials, steel wood abrasive cleaners, metal bristled brushes or methods that could damage material. Solvents and strong disinfectants can be used in accordance with manufacturer's instructions.

PART 4 - SUBMITTAL CHECK LIST

- A. Product Data.
- B. Samples.

END OF SECTION 09 7216

SECTION 09 9000 - PAINTING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Extent of painting work as indicated on the Drawings and specified herein including, but not limited to:
 - 1. Surface Inspection and Preparation.
 - 2. Paint System Schedule Exterior Paint Systems.
 - 3. Paint System Schedule Interior Paint Systems.
 - 4.
- B. Additional requirements of the work are to include:
 - 1. Painting and finishing of all interior and exterior items and surfaces throughout the project, except as otherwise indicated. Surface preparation, priming and costs of paint specified are in addition to shop-priming and surface treatment specified under other sections of work.
 - 2. Field painting of exposed steel and ironwork, and primed metal surfaces of equipment installed under mechanical and electrical, except as otherwise indicated.
 - 3. Field painting of all exposed interior and exterior structural steel components, whether indicated or not on the Drawings. Includes painting of galvanized components unless noted otherwise.
 - 4. Painting of exposed mechanical, electrical equipment items as indicated on the Drawings.
 - 5. Paint exposed surfaces except where natural finish of material is specifically noted as a surface not to be painted. Where items or surfaces are not specifically mentioned, paint same as adjacent similar materials or areas.
 - 6. "Paint" as used herein generally refers to all coating systems material, including primers, emulsions, enamels, stains, sealers, fillers, and other applied materials whether used as prime, intermediate or finish coat
 - 7. Painting and finishing of all EXISTING interior and exterior items and surfaces throughout the project, whether they are or are not currently finished, except as otherwise indicated.

1.2 RELATED WORK

- A. Following categories of work are <u>NOT</u> included as part of field-applied finish work specified herein, or are included in other sections of the specifications:
 - 1. Shop Priming:
 - Unless otherwise specified, shop priming of ferrous metal items is included under various sections for structural steel, miscellaneous metal, and shop-fabricated or factory-built mechanical and electrical equipment or accessories.
 - 2. Pre-Finished Items:
 - a. Unless otherwise indicated, do not include painting when factory-finishing or installer finishing is specified for such items including, but not limited to, pre-finished aluminum panels, finished mechanical and electrical equipment, light fixtures, switchgear, distribution cabinets, etc.

Concealed Surfaces:

a. Unless otherwise indicated, painting is not required on surfaces in concealed areas and generally inaccessible areas, such as interstitial spaces; however, doors and door frames in these spaces shall be painted.

4. 4. Finished Metal Surfaces:

- a. Metal surfaces of anodized aluminum, stainless steel, chromium plate, copper, bronze and similar finished materials will not require finish painting, unless otherwise indicated.
- B. Following areas are to be included as special considerations of areas to NOT receive paint:
 - 1. Operating parts and labels, moving parts of operating units, mechanical and electrical parts, such as valve and damper operators, unless otherwise indicated.
 - 2. Any code-required labels, such as Underwriter's Laboratories and Factory Mutual, or any equipment identification, performance rating, name or nomenclature plates.

1.3 SUBMITTALS

A. Product Data:

- 1. Manufacturer's published product data sheets, specifications, materials description and technical information.
- 2. Manufacturer's published installation and application instructions.
- 3. Materials Safety and Data Sheets (MSDS).

B. Samples and Draw Downs:

- 1. If colors and finishes are indicated, submit samples boards (draw downs) for each as selected.
- 2. If colors are not indicated, they will be selected by the Architect from manufacturer's entire selection. Submit complete range of available paint colors, either in the form of a fan set or individual color chips box set.
- 3. If finishes are not indicated, they will be selected by the Architect from manufacturer's entire selection
- 4. Once colors and finishes have been chosen, submit samples boards for each color selected.
- 5. Sample boards to be 8-1/2 inch x 11 inch cardstock, painted with actual product of color and finish as selected by the Architect. Submit three (3) of each color as selected.

Stain samples to be 6 inch x 6 inch minimum on wood specifies and cut as specified. Submit three (3) of each color as selected.

C. Mock-Ups:

- 1. Paint on site, a test sample area of wall, 2 foot x 2 foot minimum in size. Complete test area for each color selected, for each paint system specified, and per each substrate material included, as directed by the Architect.
- 2. Paint one (1) hollow metal door and frame complete, as directed by Architect.
- 3. Stain one (1) wood door complete, as directed by Architect.
- 4. Mock-ups shall indicate color, texture and finish.
- 5. Do not proceed with paint work until mock-ups have been approved by the Architect.

- 6. If deemed unacceptable by the Architect, create another mock-up to correct items of unacceptability. Continue process until an approved mock-up has been achieved.
- 7. Once an approved mock-up has been achieved, use as a standard of comparison for all work.
- 8. Do not destroy or remove mock-up until all paint work is complete and accepted.
- 9. Accepted mock-ups may remain as part of the work or discarded, at the discretion of the Architect.

D. Compatibility Tests:

- 1. Paint on site, (2) 2 foot x 2 foot minimum test sample areas of each existing and/or previously painted surface to receive new painted finish atop. Complete test area for each color selected, for each paint system specified, per each existing color of existing surface, and per each substrate material included, as directed by the Architect.
- 2. Check for compatibility by applying the test sample of the recommended coating system as stated. Allow to dry for one week prior to testing adhesion per procedures of ASTM D3359.
- Test sample areas are to be completed by the installing contractor, reviewed and checked on site by the paint manufacturer's representative. If non-compatibility issues exist, the paint manufacturer shall provide recommendations and solutions to compatibility and/or alterations to the paint system specified.
- 4. Submit all test results and manufacturer's approval in writing to the Architect. Painting manufacturer must certify that they approve the test results and will include the longevity and performance of the paint system in their warranty and guarantees of the paint system.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to job site in original, new, sealed and unopened packages and containers bearing manufacturer's name and product label.
- B. Store and protect products in strict accordance with manufacturer's recommendations and requirements.
- C. Provide physical properties of each product to be used on the project, including:
 - 1. Weight per gallon.
 - 2. Solids by weight.
 - 3. Solids by volume.
 - 4. V.O.C. as supplied.

D. Container labeling to include:

- 1. Date of manufacture.
- 2. Manufacturer's name.
- 3. Product name, type and stock number.
- 4. Color and finish.
- 5. Rate of coverage.
- 6. Application instructions for surface preparation, drying time, cleanup, mixing and reducing.
- E. Store paint materials at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in well ventilated area, unless required otherwise by manufacturer's instructions.

F. Take precautionary measures to prevent fire hazards and spontaneous combustion.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Provide continuous ventilation and heating facilities to maintain surface and ambient temperatures above 50 degrees F for twenty-four (24) hours before, during and forty-eight (48) hours after application of finishes, unless required otherwise by manufacturer's instructions.
- B. Do not apply exterior coatings during rain or snow, or when relative humidity is above 50 percent, unless required otherwise by manufacturer's instructions.
- C. Minimum Application Temperatures for Latex Paint: 50 degrees F for exterior, unless required otherwise by manufacturer's instructions.
- D. Minimum Application Temperatures for Varnish Finishes: 65 degrees F for interior and exterior, unless required otherwise by manufacturer's instructions.
- E. Provide lighting level of 80 foot candles measured mid-height at substrate surface.

1.6 PROJECT CONDITIONS

- A. Apply water-base paints only when temperature of surfaces to be painted and surrounding ambient air temperatures are between 60 degrees F and 85 degrees F, for at least 72 hours prior to beginning of installation, unless otherwise permitted by paint manufacturer's printed instructions.
- B. Apply solvent-thinned paints only when temperature of surfaces to be painted and surrounding ambient air temperatures are between 45 degrees F and 95 degrees F, for at least 72 hours prior to beginning of installation, unless otherwise permitted by paint manufacturer's printed instructions.
- C. Maintain proper ambient air temperatures throughout entire timeframe of installation and cure period.
- D. Do not install until space is enclosed, weathertight, and ambient conditions are controlled and stabilized.
- E. Do not apply in snow, rain, fog or mist; or when relative humidity exceeds 85%; or on damp or wet surfaces.
- F. Provide adequate ventilation at all times for proper drying.

1.7 MAINTENANCE MATERIALS AND DATA

A. See Specification Section 01 7846 - Closeout Maintenance Materials.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Provide products, as approved by the Architect, from one of the following approved manufacturers:
 - 1. "The Sherwin-Williams Company" (S-W).

2.2 MATERIALS

A. Quality:

- 1. Provide best quality grade of various types of coatings as regularly manufactured by acceptable paint materials manufacturers.
- 2. Materials not displaying manufacturer's identification as a standard, "top-of-the-line" product will not be acceptable.

B. Compatibility:

- 1. Provide finish coats which are compatible with prime paints used.
- 2. Review other sections of these specifications in which prime paints or factory coats are to be provided to insure compatibility of total coatings systems for various substrates.
- 3. Upon request from other trades, furnish information on characteristics of finish materials proposed for use, to insure compatible prime coats are used.
- 4. Provide barrier coats over incompatible primers or remove and re-prime as required.
- 5. Provide undercoat paint produced by same manufacturer as finish coats. Where undercoats specified are not considered by the paint manufacturer to be fully compatible with the finish coat, submit recommended undercoat substitution to Architect for acceptance. No additional cost to the Owner will be considered for such a change.
- 6. Use only thinners approved by the paint manufacturer, and use only within recommended limits.
- 7. Notify the Architect in writing of any anticipated problems during bidding with the use of specified coating systems with substrates primed by others.

C. Coatings and Pigments:

- 1. To be pure, non-fading, applicable types to suit substrates and service expectations indicated.
- 2. Ready mixed, except field catalyzed coating.
- 3. Pigments processed to a soft paste consistency, capable of being readily and uniformly dispersed to as a homogeneous coating.
- 4. Good flow and brushing properties; capable of drying or curing free of streaks or sags.

D. Accessory Materials:

- 1. All materials, such as linseed oil, shellac, turpentine, paint thinners, and other materials not specifically indicated but required to achieve the finishes specified.
- 2. All of commercial quality.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine surfaces scheduled to be finished prior to commencement of work.
 - 1. Report any conditions that may potentially affect proper application.
 - 2. Verify that surfaces and substrate conditions are ready to receive work as instructed by the product manufacturer.
 - 3. Do not proceed with work until unsatisfactory conditions have been corrected.
- B. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions otherwise detrimental to formation of a durable paint film or proper adhesion required.
- C. Beginning of installation equates to acceptance of the substrate by the contractor.

3.2 PREPARATION - GENERAL

- A. Perform preparation and cleaning procedures in accordance with paint manufacturer's instructions and as herein specified, for each particular substrate condition.
 - 1. Clean surfaces to be painted before applying paint or surface treatments.
 - 2. Remove oil and grease prior to mechanical cleaning.
 - 3. Program cleaning and painting so that contaminants from cleaning process will not fall onto wet, newly painted surfaces.
- B. Provide all scaffolding and staging required for work in this Section.
 - 1. Coordinate locations to eliminate interference with work of others.
- C. Remove hardware, hardware accessories, machined surfaces, electrical plates, lighting fixtures, trim, clocks, speakers, devices, fittings and similar items which are not to be finish-painted, prior to preparing surfaces or finishing.
- D. Provide surface-applied protection prior to surface preparation and painting operations for all adjacent areas, surfaces, or items to remain.
- E. Correct minor defects and clean surfaces which affect work of this Section.
- F. Shellac and seal marks which may bleed through surface finishes.

3.3 MATERIALS PREPARATION

A. Mix and prepare painting materials in accordance with manufacturer's directions.

B. Store materials not in actual use in tightly covered containers. Maintain containers used in storage, mixing and application of paint in a clean condition, free of foreign materials and residue.

3.4 SURFACE PREPARATION

A. Uncoated Steel and Iron Surfaces:

- 1. Clean ferrous surfaces, which are not galvanized or shop coated, of oil, grease, dirt, loose mill scale and other foreign substances by solvent or mechanical cleaning.
- 2. Where heaving coatings of scale are evident, remove by wire brushing or sandblasting; clean by washing with solvent.
- 3. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned.

B. Shop Primed Steel Surfaces:

- 1. Sand and scrape to remove loose primer and rust.
- 2. Feather edges to make touch-up patches inconspicuous.
- 3. Clean surfaces with solvent.
- 4. Prime bare steel surfaces.
- 5. Touch-up shop-applied prime coats wherever damaged or bare, and where required by other sections of these specifications. Clean and touch-up with same type shop primer.

C. Galvanized Surfaces:

- 1. surface contamination and oils and wash with non-petroleum based solvent.
- 2. Apply coat of etching primer.

D. Unit Masonry Surfaces:

- 1. Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter.
- 2. Remove oil and grease with a solution of tri-sodium phosphate, rinse well and allow to dry.
- 3. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water.
- 4. Allow to dry.

E. Gypsum Board Surfaces:

1. Latex fill minor defects.

F. Plaster Surfaces:

- 1. Fill hairline cracks, small holes, and imperfections with latex patching plaster.
- 2. Make smooth and flush with adjacent surfaces.
- 3. Wash and neutralize high alkali surfaces.

G. Interior Wood Scheduled to Receive Transparent Finish:

1. Remove loose dust, dirt, grit and foreign matter.

- Set nails and screws.
- 3. Fill nail and screw holes, cracks and blemishes after staining with filler to match color wood or stain.
- 4. Sand smooth.

H. Wood Doors, Metal Doors and Metal Frames:

1. Apply one coat of paint to glazing stops and rabbets prior to glazing.

I. Insulated Coverings:

1. Remove dirt, grease and oil from canvas and cotton.

J. Existing Wood:

- 1. Lightly sand and clean to remove dirt, grease, oils, etc.
- 2. Patch and repair any surface damage prior to re-finishing.

K. Previously Coated Surfaces:

- 1. Maintenance painting will frequently not permit or require complete removal of all old coatings prior to repainting. However, all surface contamination such as oil, grease, loose paint, mill scale, dirt, foreign matter, rust, mold, mildew, mortar, efflorescence and sealers must be removed to assure sound bonding to the tightly adhering old paint.
- 2. Feather edges of existing coating to make touch-up patches inconspicuous.
- 3. Glossy surfaces of old paint films must be clean and dull before repainting. Accomplish by sanding or thoroughly washing with an abrasive cleanser.
- 4. Spot prime any bare areas with an appropriate primer.
- 5. Provide compatibility tests per submittal requirements herein.
- 6. If the coating proves incompatible, complete removal is required.

L. Hand Tool Cleaning:

- 1. Hand tool cleaning removes all loose mill scale, loose rust, and other detrimental foreign matter. It is not intended that adherent mill scale, rust and paint be removed by this process.
- 2. Mill scale, rust and paint are considered adherent if they cannot be removed by lifting with a dull putty knife.
- 3. Prior to hand tool cleaning, remove visible oil, grease, soluble residues and salts by the methods outlined in the "Steel Structures Paint Council Surface Preparation Specification No. 2 (SSPC-SP1 and SSPC-SP2).

3.5 PROTECTION

- A. Protect elements surrounding the work of this Section from damage or disfiguration.
- B. Repair damage to other surfaces caused by work of this Section.

- C. Furnish drop cloths, shields, and protective methods to prevent spray or droppings from disfiguring other surfaces.
- D. Remove empty paint containers from site.

3.6 APPLICATION

A. General:

- 1. Apply paint and coatings in strict accordance with manufacturer's published directions.
- 2. Apply all coatings at manufacturer's recommended spreading rates per coat to provide finished wet mil and dry mil coverage per coat between the minimum and maximum microns indicated.
- 3. Apply additional coats when undercoats, stains or other conditions show through final coat of paint, until paint film is of uniform finish, color and appearance. Give special attention to insure that surfaces, including edges, corners, crevices, welds and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces. Paint surfaces behind movable equipment same as similar exposed surfaces.
- 4. Paint back sides of access panels, and removable or hinged covers to match exposed surfaces.
- 5. Sand lightly between each succeeding enamel or varnish coat.
- 6. Omit first coat (primer) on metal surfaces which have been shop-primed and touch-up painted, unless otherwise indicated.

B. Scheduling Painting:

- 1. Apply first-coat material to surfaces that have been cleaned, pretreated or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
- 2. Allow sufficient time between successive coatings to permit proper drying.
- 3. Do not apply finishes to surfaces that are not dry.

C. Technique:

- 1. Apply each coat to uniform finish.
- 2. Apply each coat of paint slightly darker than preceding coat, unless otherwise approved.
- 3. Sand lightly between coats to achieve required finish.
- 4. Allow applied coat to dry before next coat is applied.
- D. Apply paint as recommended by the manufacturer and as approved by the Architect:
 - 1. Apply final coat to concrete, masonry and smooth finished wall and ceiling surfaces with roller.
 - 2. Apply paint to exposed ceiling surfaces and in inaccessible areas by spraying.
 - 3. Do not use spray application on other areas without written approval of Architect.
 - 4. Apply materials at not less than manufacturer's recommended spreading rate, to establish a total dry film thickness as indicated or if not indicated, as recommended by coating manufacturer.
- E. Draw lines of demarcation between different shades or colors to eliminate blurred edges.
- F. Back-prime all surfaces of interior and exterior wood blocking and woodwork, except pressure treated wood, with one coat of aluminum paint.

- G. Prime back surfaces of interior woodwork scheduled to receive stain or varnish finish with gloss varnish reduced 25 percent with mineral spirits.
- H. Where clear finishes are required, tint fillers to match wood.
 - 1. Work fillers into the grain before set.
 - 2. Wipe excess from surface.
- Coat steel items that come in contact with aluminum items with a field coat of bituminous paint.
- J. Mechanical and Electrical Work:
 - 1. Painting of mechanical and electrical work is limited to those items exposed in finished occupied spaces.
 - 2. Mechanical items to be painted include, but are not limited to, ducts, diffusers, piping, pipe hangers, supports and accessory items.
 - 3. Electrical items to be painted include, but are not limited to, the following:
 - a. Conduit and fittings (In finished areas only, unless otherwise indicated).
 - b. Switchgear (In Finished areas only, unless otherwise indicated).
- K. Paint all exposed ceiling construction, including joists, structural members, metal deck and all exposed conduit, pipes, pipe covering and ductwork in these ceiling areas.
- L. Seal, stain and varnish concealed and semi-concealed surfaces of millwork items.
 - 1. Seal internal surfaces of millwork items with two coats of shellac.
 - 2. Brush apply only.

M. Prime Coats:

- 1. Apply prime coat of material which is required to be painted or finished, and which has not been prime coated by others.
- 2. Re-coat primed and sealed surfaces where there is evidence of suction spots or unsealed areas in first coat, to assure a finish coat with no burn-through or other defects due to insufficient sealing.
- N. Pigmented (Opaque) Finishes:
 - 1. Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance and coverage.
 - 2. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness or other surface imperfections will not be acceptable.
- O. Completed Work:
 - 1. Match approved samples for color, texture and coverage.
 - 2. Remove, refinish or repaint work not in compliance with specified requirements.
- P. Renovation and Patching Areas:
 - 1. Prepare and prime new construction portions of surfaces per specifications

- 2. Prepare existing surfaces located in the same plane as renovation or patching per specifications.
- 3. Paint area of renovation and patching entire surface full height, from "floor-to-ceiling" and from "corner-to-corner".

3.7 FINISHING MECHANICAL AND ELECTRICAL EQUIPMENT

- A. Paint shop primed equipment.
- B. Touch up marred or damaged shop prefinished items.
- C. Remove unfinished louvers, grilles, covers and access panels on mechanical and electrical components and paint separately.
- D. Replace identification markings on mechanical or electrical equipment when painted accidentally.
- E. Paint interior surfaces of air ducts and convector and heating cabinets that are visible through grilles and louvers with one coat of flat black paint, to limit sight line.
 - 1. Paint dampers exposed behind louvers, grilles, and convector and heating to match face panels.
- F. Paint exposed conduit and electrical equipment occurring in finished areas.
- G. Paint both sides and all edges of plywood backboards for electrical and telephone equipment with one coat of light to medium gray paint before installation of equipment.
- H. Reinstall electrical plates, hardware, light fixture trim, clocks, speakers and fittings removed prior to finishing.
- I. Paint all equipment located on roofs, including aluminum exhaust fans, gravity relief vents, appliance exhausts and all equipment unless factory finish is acceptable to Architect.
- J. Refer to Division 23 and Division 26 for schedule of color coding and identification banding of equipment, ductwork, piping and conduit.

3.8 CLEANING AND PROTECTION

- A. As work proceeds, promptly remove paint where spilled, splashed or spattered.
- B. During progress of work maintain premises free of unnecessary accumulation of tools, equipment, surplus material and debris.
- C. Collect cotton waste, cloths and material which may constitute a fire hazard, place in closed metal containers and remove daily from site.
- D. During progress of work remove from site discarded paint materials, rubbish, cans and rags at end of each work day. DISPOSE OF ALL MATERIALS IN ACCORDANCE WITH FEDERAL, STATE AND LOCAL REGULATIONS.

E. Upon completion of painting work, clean window glass and other paint-spattered surfaces.

F. Protection:

- 1. Protect work of other trades, whether to be painted or not, against damage by painting and finishing work. Correct any damage by cleaning, repairing or replacing, and repainting.
- 2. Provide "Wet Paint" signs as required to protect newly-painted finishes. Remove temporary protective wrappings provided by others for protection of their work, after completion of painting operations.
- 3. At the completion of work of other trades, touch-up and restore all damaged or defaced painted surfaces.

3.9 PAINT SYSTEM SCHEDULE - EXTERIOR PAINT SYSTEMS

- A. CONCRETE MASONRY UNITS (exterior, new construction, painted finish):
 - 1. 1st Coat Acrylic Block Filler
 - a. "S-W, Heavy-Duty Block Filler, Interior/Exterior Acrylic, B42W150"
 - b. *Apply filler coat at a rate to ensure complete coverage with pores filled.
 - 2. 2nd Coat 100% Acrylic Emulsion Topcoat
 - a. "S-W, Metalatex, Semi-Gloss Coating, B42 Series"
 - 3. 3rd Coat 100% Acrylic Emulsion Topcoat
 - a. "S-W, Metalatex, Semi-Gloss Coating, B42 Series"
- B. STEEL, UNPRIMED (exterior, new construction, painted finish):
 - 1. 1st Coat Rust-Inhibitive Metal Primer
 - a. "S-W, Kem Bond HS, Universal Metal Primer"
 - b. *Color selected as most appropriate beneath finish topcoats.
 - 2. 2nd Coat Urethane Alkyd Topcoat
 - a. "S-W, Industrial Urethane Alkyd Enamel, B54-150 Series, Gloss"
 - 3. 3rd Coat Urethane Alkyd Topcoat
 - a. "S-W. Industrial Urethane Alkvd Enamel, B54-150 Series, Gloss"
 - b. *Not less than 3.0 mils dry film thickness.
- C. STEEL, SHOP PRIMED (exterior, new construction, painted finish):
 - 1. Touch-Up Rust-Inhibitive Metal Primer
 - a. "S-W, Kem Bond HS, Universal Metal Primer"
 - b. *May use original primer if available.
 - c. *Color selected as most appropriate to match primer.

- 2. 2nd Coat Urethane Alkyd Topcoat
 - a. "S-W, Industrial Urethane Alkyd Enamel, B54-150 Series, Gloss"
- 3. 3rd Coat Urethane Alkyd Topcoat
 - a. "S-W, Industrial Urethane Alkyd Enamel, B54-150 Series, Gloss"
 - b. *Not less than 3.0 mils dry film thickness.
- D. STEEL, GALVANIZED (exterior, new construction, painted finish):
 - 1. 1st Coat Universal Primer
 - a. "S-W, PRO Industrial, Pro-Cryl, Universal Primer, B66A00310"
 - b. *Gray.
 - 2. 2nd Coat 100% Acrylic Emulsion
 - a. "S-W, Metalatex, Semi-Gloss Coating, B42W00111"
 - 3. 3rd Coat 100% Acrylic Emulsion
 - a. "S-W, Metalatex, Semi-Gloss Coating, B42W00111"
 - b. *Not less than 3.0 mils dry film thickness.
- E. STEEL, ALL TYPES (exterior, existing and/or previously painted, painted finish):
 - 1. 1st Coat Rust-Inhibitive Metal Primer
 - a. "S-W, Kem Bond HS, Universal Metal Primer"
 - b. *Color selected as most appropriate beneath finish topcoats.
 - c. *Additional coats as required to cover existing color or correct rusting.
 - d. *Painter responsible to visit site and field verify surface prep required.
 - 2. 2nd Coat Urethane Alkyd Topcoat
 - a. "S-W, Industrial Urethane Alkyd Enamel, B54-150 Series, Gloss"
 - 3. 3rd Coat Urethane Alkyd Topcoat
 - a. "S-W, Industrial Urethane Alkyd Enamel, B54-150 Series, Gloss"
 - b. *Not less than 3.0 mils dry film thickness.
- F. METAL DOORS AND FRAMES (exterior, new construction, painted finish):
 - 1. Touch-Up Rust-Inhibitive Metal Primer
 - a. "S-W, Kem Bond HS, Universal Metal Primer"
 - b. *May use original primer if available.
 - c. *Color selected as most appropriate to match primer.
 - 2. 2nd Coat Urethane Alkyd Topcoat
 - a. "S-W, Industrial Urethane Alkyd Enamel, B54-150 Series, Gloss"
 - 3. 3rd Coat Urethane Alkyd Topcoat
 - a. "S-W, Industrial Urethane Alkyd Enamel, B54-150 Series, Gloss"
 - b. *Not less than 3.0 mils dry film thickness.
 - c. *Additional coats as required by Architect to achieve desired and intended result.

- G. METAL DOORS AND FRAMES (exterior, existing and/or previously painted, painted finish):
 - 1. 1st Coat Rust-Inhibitive Metal Primer
 - a. "S-W, Kem Bond HS, Universal Metal Primer"
 - b. *Color selected as most appropriate beneath finish topcoats.
 - c. *Additional coats as required to cover existing color or correct rusting.
 - d. *Painter responsible to visit site and field verify surface prep required.
 - 2. 2nd Coat Urethane Alkyd Topcoat
 - a. "S-W, Industrial Urethane Alkyd Enamel, B54-150 Series, Gloss"
 - 3. 3rd Coat Urethane Alkyd Topcoat
 - a. "S-W, Industrial Urethane Alkyd Enamel, B54-150 Series, Gloss"
 - b. *Not less than 3.0 mils dry film thickness.
 - c. *Additional coats as required by Architect to achieve desired and intended result.
- H. CONCRETE SURFACES (exterior, new construction, painted "rubbed" finish):
 - 1. 1st Coat Surface Prep Conditioning
 - a. *Clean and prep all surfaces per topcoat manufacturer and allow to completely dry.
 - b. *If pH exceeds 9, treat all surfaces with a 5% solution of muratic acid and water, rinse thoroughly and allow to completely dry.
 - c. *Use of a chemical pH reduction product is allowed if compatible with the topcoat.
 - 2. 2nd Coat 100% Elastomeric Coating
 - a. "S-W. Conflex XL. Elastomeric High Build Coating, A5-800 Series"
 - b. "Lanco & Harris, Triko-Plex"
 - c. *Resulting surface to have 10 or less pinholes per square foot.
 - d. *Not less than 12-15 mils dry film thickness.
 - 3. 3rd Coat 100% Elastomeric Coating
 - a. "S-W, Conflex XL, Elastomeric High Build Coating, A5-800 Series"
 - b. "Lanco & Harris, Triko-Plex"
 - c. *Topcoat finish texture to be selected by Architect from Fine, Medium or Coarse.
 - d. *Provide 24"x24" sample boards of each texture for selection of topcoat finish.
 - e. *May be used anywhere "rubbed" concrete surfaces are indicated.
- 3.10 PAINT SYSTEM SCHEDULE INTERIOR PAINT SYSTEMS
 - A. CONCRETE MASONRY UNITS (interior, new construction, painted finish):
 - 1. 1st Coat Acrylic Block Filler
 - a. "S-W, Heavy-Duty Block Filler, Interior/Exterior Acrylic, B42W150"
 - b. *Apply filler coat at a rate to ensure complete coverage with pores filled.

- 2. 2nd Coat Interior Latex Topcoat
 - a. "S-W, ProMar 200 Zero VOC, Interior Latex, Semi-gloss"
- 3. 3rd Coat Interior Latex Topcoat
 - a. "S-W, ProMar 200 Zero VOC, Interior Latex, Semi-gloss"
- B. CONCRETE MASONRY UNITS (interior, existing and/or previously painted, painted finish):
 - 1. 1st Coat Acrylic Block Filler
 - a. "S-W, Heavy-Duty Block Filler, Interior/Exterior Acrylic, B42W150"
 - b. *Painter responsible to visit site and field verify surface prep required.
 - c. *Additional coats as required to cover existing color and texture.
 - 2. 2nd Coat Interior Latex Topcoat
 - a. "S-W, ProMar 200 Zero VOC, Interior Latex, Semi-gloss"
 - 3. 3rd Coat Interior Latex Topcoat
 - a. "S-W, ProMar 200 Zero VOC, Interior Latex, Semi-gloss"
- C. STEEL, UNPRIMED (interior, new construction, painted finish):
 - 1. 1st Coat Rust-Inhibitive Metal Primer
 - a. "S-W, Kem Bond HS, Universal Metal Primer"
 - b. *Color selected as most appropriate beneath finish topcoats.
 - 2. 2nd Coat Urethane Alkyd Topcoat
 - a. "S-W, Industrial Urethane Alkyd Enamel, B54-150 Series, Gloss"
 - 3. 3rd Coat Urethane Alkyd Topcoat
 - a. "S-W, Industrial Urethane Alkyd Enamel, B54-150 Series, Gloss"
 - b. *Not less than 3.0 mils dry film thickness.
- D. STEEL, SHOP PRIMED (interior, new construction, painted finish):
 - 1. Touch-Up Rust-Inhibitive Metal Primer
 - a. "S-W, Kem Bond HS, Universal Metal Primer"
 - b. *May use original primer if available.
 - c. *Color selected as most appropriate to match primer.
 - 2. 2nd Coat Urethane Alkyd Topcoat
 - a. "S-W, Industrial Urethane Alkyd Enamel, B54-150 Series, Gloss"
 - 3. 3rd Coat Urethane Alkyd Topcoat
 - a. "S-W, Industrial Urethane Alkyd Enamel, B54-150 Series, Gloss"
 - b. *Not less than 3.0 mils dry film thickness.
- E. STEEL, GALVANIZED (interior, new construction, painted finish):

- 1. 1st Coat Solvent-Based Acrylic Coating
 - a. "S-W, Galvite HS, B50WZ30"
- 2. 2nd Coat Urethane Alkyd Topcoat
 - a. "S-W, Industrial Urethane Alkyd Enamel, B54-150 Series, Gloss"
- 3. 3rd Coat Urethane Alkyd Topcoat
 - a. "S-W, Industrial Urethane Alkyd Enamel, B54-150 Series, Gloss"
 - b. *Not less than 3.0 mils dry film thickness.
- F. STEEL, ALL TYPES (interior, existing and/or previously painted, painted finish):
 - 1. 1st Coat Rust-Inhibitive Metal Primer
 - a. "S-W. Kem Bond HS. Universal Metal Primer"
 - b. *Color selected as most appropriate beneath finish topcoats.
 - c. *Additional coats as required to cover existing color or correct rusting.
 - d. *Painter responsible to visit site and field verify surface prep required.
 - 2. 2nd Coat Urethane Alkyd Topcoat
 - a. "S-W, Industrial Urethane Alkyd Enamel, B54-150 Series, Gloss"
 - 3. 3rd Coat Urethane Alkyd Topcoat
 - a. "S-W, Industrial Urethane Alkyd Enamel, B54-150 Series, Gloss"
 - b. *Not less than 3.0 mils dry film thickness.
- G. METAL DOORS AND FRAMES (interior, new construction, painted finish):
 - 1. Touch-Up Rust-Inhibitive Metal Primer
 - a. "S-W. Kem Bond HS. Universal Metal Primer"
 - b. *May use original primer if available.
 - c. *Color selected as most appropriate to match primer.
 - 2. 2nd Coat Urethane Alkyd Topcoat
 - a. "S-W, Industrial Urethane Alkyd Enamel, B54-150 Series, Gloss"
 - 3. 3rd Coat Urethane Alkyd Topcoat
 - a. "S-W, Industrial Urethane Alkyd Enamel, B54-150 Series, Gloss"
 - b. *Not less than 3.0 mils dry film thickness.
 - c. *Additional coats as required by Architect to achieve desired and intended result.
- H. METAL DOORS AND FRAMES (interior, existing and/or previously painted, painted finish):
 - 1. 1st Coat Rust-Inhibitive Metal Primer
 - a. "S-W, Kem Bond HS, Universal Metal Primer"
 - b. *Color selected as most appropriate beneath finish topcoats.
 - c. *Additional coats as required to cover existing color or correct rusting.
 - d. *Painter responsible to visit site and field verify surface prep required.
 - 2. 2nd Coat Urethane Alkyd Topcoat
 - a. "S-W, Industrial Urethane Alkyd Enamel, B54-150 Series, Gloss"

- 3. 3rd Coat Urethane Alkyd Topcoat
 - a. "S-W, Industrial Urethane Alkyd Enamel, B54-150 Series, Gloss"
 - b. *Not less than 3.0 mils dry film thickness.
 - c. *Additional coats as required by Architect to achieve desired and intended result.
- I. GYPSUM DRYWALL / PLASTER WALL SURFACES (interior, new construction, painted finish):
 - 1. 1st Coat Latex Primer
 - a. "S-W, ProMar 200 Zero VOC, Interior Latex Primer, B28W02600"
 - b. *Tinted toward final color.
 - 2. 2nd Coat Interior Latex Topcoat
 - a. "S-W, ProMar 200 Zero VOC, Interior Latex, Eg-Shel"
 - 3. 3rd Coat Interior Latex Topcoat
 - a. "S-W, ProMar 200 Zero VOC, Interior Latex, Eg-Shel"
- J. GYPSUM DRYWALL / PLASTER WALL SURFACES (interior, existing and/or previously painted, painted finish):
 - 1. 1st Coat Latex Primer
 - a. "S-W, ProMar 200 Zero VOC, Interior Latex Primer, B28W02600"
 - b. *Painter responsible to visit site and field verify surface prep required.
 - c. *Additional coats as required to cover existing color and texture.
 - 2. 2nd Coat Interior Latex Topcoat
 - a. "S-W, ProMar 200 Zero VOC, Interior Latex, Eg-Shel"
 - 3. 3rd Coat Interior Latex Topcoat
 - a. "S-W, ProMar 200 Zero VOC, Interior Latex, Eg-Shel"
- K. GYPSUM DRYWALL / PLASTER CEILING AND SOFFIT SURFACES (interior, existing and/or previously painted, painted finish):
 - 1st Coat Latex Primer
 - a. "S-W, PrepRite ProBloc, Interior/Exterior Latex Primer/Sealer, B28W02600"
 - b. *Painter responsible to visit site and field verify surface prep required.
 - c. *Additional coats as required to cover existing color and texture.
 - 2. 2nd Coat Interior Latex Topcoat
 - a. "S-W, ProMar 200 Zero VOC, Interior Latex, Flat"
 - 3. 3rd Coat Interior Latex Topcoat
 - a. "S-W, ProMar 200 Zero VOC, Interior Latex, Flat "
- L. WOODWORK (interior, existing and/or previously painted, painted finish):

- 1. 1st Coat Alkyd Primer
 - a. "S-W, ProBlock, Interior Oil-Based Primer, B79W8810"
 - b. *Painter responsible to visit site and field verify surface prep required.
 - c. *Additional coats as required to cover existing color and texture.
- 2. 2nd Coat Interior Latex Topcoat
 - a. "S-W, ProClassic Waterborne Interior Acrylic, Semi-Gloss, B31 Series"
- 3. 3rd Coat Interior Latex Topcoat
 - a. "S-W, ProClassic Waterborne Interior Acrylic, Semi-Gloss, B31 Series"
- M. WOODWORK (interior, new construction, stained/transparent finish):
 - 1. Filler -Pore Filler (for open-grained wood only)
 - a. "S-W, Sher-Wood, Natural Filler"
 - b. *Do not sand filler coat. Allow to completely dry before topcoating.
 - c. *Tint towards shade of stain.
 - 2. 1st Coat Interior Oil Stain
 - a. "S-W, Wood Classics, Interior Oil Stain, A49-200 Series" (quart size)
 - b. "S-W, Wood Classic, Interior Oil Stain 250, A49-800 Series" (gallon size)
 - 3. 2nd Coat Interior Oil Varnish
 - a. "S-W, Wood Classics, Waterborne Polyurethane Varnish, A68 Series, Satin"
 - 4. 3rd Coat Interior Oil Varnish
 - a. "S-W, Wood Classics, Waterborne Polyurethane Varnish, A68 Series, Satin"
 - 5. 4th Coat Interior Oil Varnish
 - a. "S-W, Wood Classics, Waterborne Polyurethane Varnish, A68 Series, Satin"
 - *Sand between each coat, unless otherwise indicated.
- N. WOODWORK (interior, existing and previously stained, stained/transparent finish):
 - 1. 1st Coat Interior Oil Varnish
 - a. "S-W, Wood Classics, Waterborne Polyurethane Varnish, A68 Series, Satin"

PART 4 - SUBMITTAL CHECKLIST

- A. Product Data.
- B. Samples and Draw Downs.
- C. Mock-Ups.
- D. Compatibility Tests.

PROJECT NO. 24-179.000 Harrison REMC - Addition and Renovation Harrison REMC PAINTING 09 9000 - 19 04/24/2025

END OF SECTION 09 9000

SECTION 09 9723 - CONCRETE FLOOR COATING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Extent of concrete floor coating is indicated on Drawings and specified herein.
- B. Slip Resistant Additive for final finish coats and top coats.
- C. All materials and labor required to provide an abrasion, impact and chemical resistant floor system consisting of a polyurea base coat with decorative flakes and polyaspartic topcoats. Monolithic floor coating designed to produce a seamless floor and integral cove base where indicated n drawings.

1.2 QUALITY ASSURANCE

- A. Installer: A firm familiar with work with not less than three years of experience in installing products similar to those required for this project.
- B. Deliver materials to project site in original packages or containers clearly labeled to identify manufacturer, brand name, quality or grade and fire hazard classification.
- C. Store materials in original undamaged packages or containers. Maintain temperature in storage area above 40°F. Store per manufacturer's recommendations.
- D. Illuminate areas of installation using building's permanent lighting system; temporary lighting alone will not be acceptable.

1.3 SUBMITTALS

- A. Full range of samples for Architect's selection of colors.
- B. Manufacturer's literature, installation instructions, and maintenance data.
- C. Mock-Up Panel:
 - 1. Construct on site, sample panels, 4 foot x 4 foot minimum in size.
 - 2. Concrete shall be cured at least 28 days prior to application of the stain, so multiple panel slabs should be cast at the same time to allow for multiple samples opportunities in timeframe required.
 - 3. Panel to be a concrete slab apart from any concrete areas associated within the project.
 - 4. Show proposed color, range, texture, and workmanship of floor coating application, including sealer, to demonstrate the finished product.
 - 5. Do not proceed with floor coating work until sample panel has been approved by the

Architect.

- 6. If deemed unacceptable by the Architect, create another panel to correct items of unacceptability. Continue process until and approved panel has been achieved.
- 7. Once an approved panel has been achieved, use panel as standard of comparison for all floor coating.
- 8. Do not destroy or remove panel until all floor coating work is complete and accepted.
- D. Warranty: Provide manufacturer's 5-year warranty against chipping, flaking and peeling. Provide manufacturer's lifetime UV warranty.

PART 2 - PRODUCTS

2.1 MATERIAL

A. Concrete Floor Coating: Basis of Specification: Products manufactured by "Penntek Industrial Coatings" as indicated below.

Base Coat: "Penntek Industrial Coatings", XP 275 Polyurea Primer/Basecoat. Rate of Application: 270-300 SF/ gallon.

Broadcast: Vinyl Flakes 100% UV Stable to excess at 40 lbs.per 200 square feet.

* Apply decorative broadcast paint flake over base coat while still tacky and not completely cured.

Topcoat/First Application: "Penntek Industrial Coatings", NX300 Polyaspartic topcoat.

Rate of Application: 150-160 SF/ gallon.

Topcoat/Second Application: "Penntek Industrial Coatings", NX300 Polyaspartic topcoat.

Rate of Application: 150-160 SF/ gallon.

- B. Integral Cove Base: Apply cove base to wall surfaces before applying flooring. Apply according to manufacturer's written instructions and details including those for taping, mixing, priming, troweling, sanding and topcoating of cove base. Round internal and external corners.
 - 1. 8" high or as noted on Drawings.
- C. Concrete Mender: "Penntek Industrial Coatings," Mender HD Concrete Repair.
 - 1. To address any cracks and/or pitting in the slab to provide an acceptable substrate for installation of the floor coating system.

D. Color: Coating and decorative flake colors as selected by Architect from manufacturer's entire selection.

E. Finish:

- Gloss finish.
- 2. Withstand heavy industrial traffic, abrasion, and general chemical attack.

F. Concrete Slab Primers and Sealers:

- 1. Where existing substrate is unacceptable for adhesion or bonding of new materials: Provide primers and sealers as required by flooring manufacturer to achieve the proper substrate conditions for installation of flooring.
- 2. Scarify, shot-blast, or sand-blast floor as required within the bid price scope of work.

PART 3 - EXECUTION

3.1 3.01 PREPARATION

- A. Ensure floor surfaces are clean, dry, sound, and fully cured. Remove all form release agents, curing compounds, salts, efflorescence, laitance, oil, dust, grease, dirt, loose rust, and other foreign material to ensure adequate adhesion.
- B. Consult manufacturer's recommendation for substrate prep and cleaning.
- C. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.

Moisture Testing: Perform tests indicated below.

Calcium Chloride Test: Perform anhydrous calcium chloride test per ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lbs. of water/1000 sq. ft. in 24 hours. Perform tests so that each test area does not exceed 1000 sq. ft. and perform 3 tests for the first 1000 sq. ft. and one additional test for every additional 1000 sq ft.

In-Situ Probe Test: Perform relative-humidity test using in-situ probes per ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative-humidity-level measurement

- D. Diamond grind entire floor surface to receive specified floor coatings to the pores (light etching). Required finished profile of CSP1-3 prior to any coating taking place.
- E. Repair concrete imperfections, apply crack fillers, and install joint sealants as required and as compatible with floor coating products.

- F. Clean all surfaces of oil, grease, or other bond-inhibiting materials per manufacturer's recommendations.
- G. Prepare surface and /or apply all concrete slab primers and sealers as required to achieve an acceptable substrate for installation of the floor coating per the manufacturer's requirements.
- H. Apply when areas are ready or scheduled to receive floor coating without delays to the project or schedule, and without any additional costs or change in time.
- I. Surfaces must be clean, dry, sound and offer sufficient profile to achieve adequate adhesion.
- J. Remove all form release agents, curing compounds, salts, efflorescence, laitance, and other foreign matter by sandblasting, shotblasting, mechanical scarification, or suitable chemical means.
- K. Perform this work at no additional cost or change in time. Rinse thoroughly to achieve a final pH as specified by the manufacturer and allow to dry thoroughly prior to coating.

3.2 3.02 INSTALLATION

- A. Install according to manufacturer's instructions and recommendations.
- B. Utilize spike shoes to apply decorative broadcast flakes over concrete coating. Apply flakes to achieve complete coverage of Base Coat.
- C. Apply a 5' x 5' test area to ensure proper adhesion and appearance.
- D. Apply base coat at rate specified above. Install as evenly as possible and avoid excess buildup. Complete coverage is required to ensure no pinholes or voids are left.
- E. Install second application of topcoat at rate specified above. Install as evenly as possible and avoid excess buildup. Complete coverage is required to ensure no pinholes or voids are left.
- F. Remain off of floor surface until completely dried.

3.3 3.03 ADJUST AND CLEAN

- A. Assure finish is uniform and consistent.
- B. Replace removed plates and covers on floors.
- C. Remove surplus materials, rubbish, and debris resulting from installation upon completion of work, and leave areas of installation in neat, clean condition.
- D. Clean surface of all debris. Sweep and mop to a smooth, clean appearance.
- E. Improper installation or improper use of products will result in the final floor coating to have an undesirable result. If the final surfacing is deemed unacceptable by the Architect, the entire system is to be removed

CONCRETE FLOOR COATING 09 9723 - 5 04/24/2025

completely, and the substrate properly re-prepped. The system is to be reapplied to an acceptable final result. All costs associated with this procedure are to be at the expense of the contractor with no additional costs to the Owner. The level of acceptability is at the sole discretion of the Architect.

PART 4 - SUBMITTAL CHECK LIST

- A. Material Samples.
- B. Manufacturer's Literature.
- C. Material Safety and Data Sheets.

END OF SECTION 09 9723

SECTION 10 1300.02 - INTERIOR SIGNS

PART 1 - GENERAL

1.01 WORK INCLUDED

- 1. Interior signage as indicated on the Drawings and specified herein, including:
 - a. Non-illuminated room identification signs.

1.02 SUBMITTALS

A. Product Data:

 Submit manufacturer's product data, cutsheets, specifications and installation details to illustrate conformance with the specifications and for selection and/or verification of all sign layout and construction items.

B. Signage Layout:

- 1. Provide initial layout of signage and lettering, including the actual spacing and layout required for the surface to be installed on.
- 2. Draw and indicate layout to scale, with field verified measurements included.

C. Mounting Template:

1. Once a final layout has been approved, supplier shall provide the Contractor with a full-scale mounting template for proper positioning of studs and fasteners.

D. Samples:

- 1. Submit full size samples of actual sign for each type specified.
- 2. Submit full size paper template of dimensional lettering signs.
- 3. Submit color charts for color selections.
- 4. Submit actual color and finish samples as requested for selection of verification.

1.03 DELIVERY, STORAGE AND HANDLING

- A. Deliver signs in manufacturer's unopened packages, with labels intact.
- B. Store and handle letters so as to prevent damage or deterioration.

PART 2 - PRODUCTS

2.01 ROOM IDENTIFICATION SIGNS

A. Typical Flat Wall Signs:

1. Basis of Specifications: "ASI Sign Systems", InTouch.

B. Type of Graphics:

- 2. Raised etched tactile letters welded to front surface of plaque.
- 3. Letters and numerals shall also be included in raised braille, color same as background.
- 4. Copy to be centered, unless indicated otherwise.

- 5. Signs are to be unframed.
- 6. Typeface: Uppercase 3/4" high; 1-1/2" numerals shall be used for all tactile exit signs.
- 7. Font: As selected from manufacturer's entire standard selection.
- 8. Square corners.
- 9. Size: as shown on Drawings.

2.02 COORDINATION

- A. Colors shall be selected from manufacturer's entire standard selection, panel and type.
- B. Room numbers to be determined during shop drawing submittals, unless otherwise indicated.
- C. Blank Back Plate:
 - 1. Flat and smooth panel.
 - 2. Material and color to match plaque.
 - 3. Size to match plague.
 - 4. Provide for any sign where plaques need to be installed on a glass sidelight, transom or window, or where backside and/or mounting is otherwise exposed to view. Provide when and where directed by Architect, whether indicated or not, for location of sign installation designated.
 - 5. Field verify all locations of signs with Architect prior to mounting. Relocate as required.

2.03 TYPES OF SIGNS

- A. The following signs shall be provided throughout the project, whether indicated or not:
 - 1. All restrooms shall be identified by room name, pictogram, and universal symbol of accessibility.
 - 2. All janitorial and custodial rooms shall be identified by "Custodial", unless otherwise indicated.
 - 3. All mechanical and utility rooms shall be identified by "Mechanical", unless otherwise indicated.
 - 4. All electrical rooms shall be identified by "Electrical", unless otherwise indicated.
 - 5. All fire extinguishers shall be identified by universal symbol for extinguisher.
 - 9. Typical sign elevations may be indicated on Drawings. See miscellaneous details on Drawings.

2.04 SIGN SCHEDULE (ROOM IDENTIFICATION SIGNS)

Architectural Room #	Room/Space	Sign Type	Qty.	Assigned Room#	Sign Text	Symbol	Remarks
evel 1							
001	Corr.	В	1	TBD	FIRE EXTINGUISHER	Fire Extinguisher	N/A
002	Corr.	В	1	TBD	FIRE EXTINGUISHER	Fire Extinguisher	N/A
100	Vestibule	Α	816	TBD	EXIT	N/A	N/A
101A	Restroom	D	1	TBD	RESTROOM	Unisex, ADA	N/A
105	Conference Room 1	F	2	TBD	TBD	N/A	N/A
107	Quiet/Wellness Room	F	1	TBD	TBD	N/A	N/A
108	Women RR	E	1	TBD	WOMEN	Woman, ADA	N/A
109	Men RR	С	1	TBD	MEN	Man, ADA	N/A
110	Employee Lounge	В	1	TBD	FIRE EXTINGUISHER	Fire Extinguisher	N/A
112	Storage	В	1	TBD	FIRE EXTINGUISHER	Fire Extinguisher	N/A
114	Engineering	В	810	TBD	FIRE EXTINGUISHER	Fire Extinguisher	N/A
115	Women RR	Ε	1	TBD	WOMEN	Woman, ADA	N/A
116	Men RR	н	1	TBD	MEN	Man	N/A
117	Mechanical	В	1	TBD	FIRE EXTINGUISHER	Fire Extinguisher	N/A
117	Mechanical	F	1	TBD	TBD	N/A	N/A
118	Conference Room 2	E:	8810	TBD	TBD	N/A	N/A
129	Dispatch	В	1	TBD	FIRE EXTINGUISHER	Fire Extinguisher	N/A
130	Mens Locker	С	1	TBD	MEN	N/A	N/A
133	Lineman Lounge/Lockers	В	1	TBD	FIRE EXTINGUISHER	Fire Extinguisher	N/A
136	Warehouse/Vehicle Garage	В	5	TBD	FIRE EXTINGUISHER	Fire Extinguisher	N/A
139	Vestibule	Α	1	TBD	EXIT	N/A	N/A
139	Vestibule	F	1	TBD	TBD	N/A	N/A
140	Multi-Purpose/Training Room	Α	1	TBD	EXIT	N/A	N/A
140	Multi-Purpose/Training Room	В	1	TBD	FIRE EXTINGUISHER	Fire Extinguisher	N/A
140	Multi-Purpose/Training Room	G	1	TBD	MAX OCCUPANCY XXX	N/A	N/A

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install all signs square, plumb, level, and true.
- B. Adhesive Attachment:
 - 1. Install using manufacturer's standard double-click foam tape, or combination of tape and adhesive.
 - 2. Use for typical installations on gypsum board or like surfaces.

C. Fastener Attachment:

- 1. In addition to the adhesive method above, install one screw fastener through face of sign and into the substrate at all corners. Finish paint screw heads to match face of sign.
- 2. Use for installations on masonry walls, exterior mounting, epoxy paint or areas prone to either wet or vandal conditions.
- 3. Mount sign on wall adjacent to latch side of door, unless otherwise indicated. If wall space does not permit this location, consult Architect for mounting desired.
- 4. Mounting height shall be 60" above finish floor to centerline of the sign, unless otherwise indicated.
- 5. Install blank back plate on opposite side of plaque where applicable.

SUBMITTAL CHECK LIST

- 1. Manufacturer's Literature.
- 2. Signage Layout.
- 3. Mounting Template.
- 4. Samples.

END OF SECTION 10 1300.02

SECTION 10 1416.01 - PLAQUE

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnish labor, materials, equipment, special tools, supervision and services required to fabricate, deliver and install all plaques as noted and detailed on the Drawings and specified herein.
- B. Architect will furnish names and titles of items to be included on plaque during the submittal process.

1.02 SUBMITTALS

- A. Submit manufacturer's product data, cutsheets and specifications to illustrate conformance with the specifications and for selection and/or verification of all plaque layout and construction items.
- B. Provide initial layout of plaque, by including the required identification information herein, so as to provide a proofing copy for review and revision by the Architect. Revise as required until an approved layout and scope of included information is obtained.
- C. Once a final layout has been approved, supplier shall provide the Contractor with a full-scale mounting template for proper positioning of studs and fasteners.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Plaque:

1. Material: Cast Aluminum or Cast Bronze, as selected by Architect.

2. Size: 18" x 24", oriented horizontally or vertically.

3. Border: Standard raised double line.

Background Texture: Sand, Stipple, or Leatherette, as selected by Architect.
 Font: Selected by Architect from all manufacturer's standard fonts.

6. Typestyle: Raised copy, 1/2" size minimum, headings bold type, all others regular

type.

7. Background Finish: Painted, to be selected by Architect from all manufacturer's standard

colors.

8. Edge Color: Same as background.

9. Text/Border Finish: Satin.10. Layout: Centered.

11. Mounting: Blind mount with concealed studs or fasteners.

B. Identification:

PROJECT NO. 24-179.000 Harrison REMC - Addition and Renovation Harrison REMC

PLAQUE 10 1416.01 - 2 04/24/2025

- 1. Name of Project.
- 2. Names of Owners.
- 3. Name of Architect.
- 4. Name of Engineers.
- 5. Name of Prime Contractors.
- 6. Date of Project.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Mount flush to wall with boss and stud concealed type mounting. Utilize manufacturer's mounting hardware as required for the type of wall surface and substrate at area of mounting. Drill hole in wall substrate and fill with silicone or construction adhesive as per the manufacturer's requirements.
- B. Mounting Height: 6'-0" to top from floor.
- C. Mount in location as directed by Architect. Verify final mounting location prior to permanent install.

SUBMITTAL CHECKLIST

- 1. Manufacturer's Literature.
- 2. Plaque Layout.
- 3. Mounting Template.

END OF SECTION 10 1416

SECTION 10 2113.19 - SOLID PLASTIC TOILET PARTITIONS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Furnish labor, materials, equipment, special tools, supervision and services required to furnish and install all toilet partitions and urinal screens indicated, noted and detailed on the drawings and specified herein.

1.02 SUBMITTALS

A. Shop Drawings:

1. Complete shop and erection drawings showing plan layout, all fabrication and erection details, anchorage, hardware and accessories.

B. Manufacturer's Literature:

- 1. Manufacturer's product data and descriptive literature.
- 2. Manufacturer's installation instructions.
- 3. Manufacturer's maintenance instructions.
- 4. Material safety data sheets.

C. Samples:

- 1. Provide colors as specified on drawings.
- 2. If color is not specified, submit samples of manufacturer's entire selection.
- 3. Color charts alone may not be acceptable. Provide actual samples for selection upon request.

1.03 DELIVERY, STORAGE AND HANDLING

A. Delivery:

- 1. Deliver material in original unopened, undamaged packages.
- 2. Identify by contents, color and room number.
- B. Store materials in original protective packaging to prevent soiling, damage or wetting.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Provide materials manufactured by one of the following, or an approved equivalent.

SOLID PLASTIC TOILET PARTITIONS 10 2113.19 - 2 04/24/2025

- 1. "Scranton Products" (Santana Comtec Capitol)
- 2. "Accurate Partitions"
- 3. "Ampco Products"
- 4. "Global Partitions"
- 5. "Rockville Partitions"
- 6. "Metpar"
- 7. "Sanymetal Partitions"
- 8. "Bradley / Mills Partitions"
- 9. "Columbia Partitions"
- 10. "Hadrian"
- B. See Specifications Section 01 6300 Product Options and Substitutions.
- C. If color and/or texture selection is indicated on Drawings, alternate manufacturer's must be able to provide an exact match to that specified in order to be deemed equivalent and acceptable.

2.02 MATERIALS

- A. Doors, Partitions, Pilaster and Screens: High-density polyethylene (HDPE).
 - 1. Surface Texture: Pebble/ Orange Peel
- B. Hardware and Fittings:
 - 1. Connection Brackets:
 - a. 54" long, heavy-duty extruded aluminum.
 - b. Bright anodized finish.
 - c. Stainless steel screws.
 - Wall Brackets:
 - a. 54" long, heavy-duty extruded aluminum.
 - b. Bright anodized finish.
 - c. Stainless steel screws.
 - 3. Aluminum Door Hinges:
 - a. ADA Stall: Continuous cam-action hinge and fabricated from heavy-duty (1/8" thick) extruded aluminum or stainless steel.
 - b. Typical Stall: Standard swing-type concealed hinges, operable parts concealed in door.
 - c. Through bolted with one-way sex bolts.
 - c Hinges: To remain open at approximately 15° when not in use.
 - 4. Pilaster Shoes:
 - a. 3" high, stainless steel.
 - 5. Latches, Strike and Keeper:
 - a. Heavy duty aluminum, brite finish.
 - b. Provide pull on each side of door in each ADA stall or ambulatory stall.
 - c. Emergency outside access feature on latch.
 - d. Provide combination coat hooks and bumpers at each door interior face.

SOLID PLASTIC TOILET PARTITIONS 10 2113.19 - 3 04/24/2025

- 6. Headrail:
 - a. Heavy-duty extruded aluminum.
 - b. Bright anodized finish.
 - c. Stainless steel screws.
 - d. Anti-grip profile.
 - e. Extruded profile to incorporate an integral track to accept a shower/privacy curtain and hooks. Where curtains are to be installed, provide quantity of hooks needed to provide equal and proper support of curtain in the arrangement and layout indicated.
- 7. Fasteners:
 - a. Theft-resistant, finish to match hardware.
- 8. Heat Sync:
 - a. Aluminum strip per manufacturer.
 - b. Continuous on bottom of all doors and panels.
- 9. Coat Hook:
 - a. Provide one hook on inside of each toilet partition stall door.
 - b. Surface mounted, stainless steel, satin finish, with concealed mounting.
 - c. Mount at ADA height at all ADA stalls.
- 10. Shower Stalls and Privacy/Changing Stalls:
 - a. Provide headrail with an extruded profile to incorporate an integral track to accept a shower/privacy curtain and hooks.
 - b. Where curtains are to be installed, provide full quantity of hooks needed to provide equal and proper support of curtain in the arrangement and layout indicated for entire length plus 10%.

2.03 FABRICATION

- A. Design:
 - 1. Floor Mounted, Overhead Braced.
- B. Panels:
 - 1. Pre-pierce panels for fittings and hardware.
 - Conceal reinforcement for hardware.
- C. Thickness:
 - 1. 1 inch thick panels.
 - 2. 1/4 inch corner radius, all edges.
- D. Size:
 - 1. Configuration and layout as indicated on the Drawings.
 - 2. Urinal screen panels to be 3'-6" height X depth shown on Drawings.

SOLID PLASTIC TOILET PARTITIONS 10 2113.19 - 4 04/24/2025

- 3. Pilasters to be 6'-10" height.
- 4. Locate all panels 6" from finished floor as shown on the Drawings for the mounting heights desired.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Assemble using stainless steel screws.
- B. Anchor to wall with connectors appropriate for substrate.
- C. Set plumb and true to line and level, in a rigid substantial manner.
- D. Conceal drilling, cutting and fitting in walls and ceiling.
- E. Clearance at vertical edge of doors shall be uniform top to bottom and not exceed 3/16".

3.02 CLEANING

- A. Upon completion, remove all materials, equipment and debris from the premises.
- B. Wash thoroughly with cleaner recommended by manufacturer.

SUBMITTAL CHECK LIST

- 1. Shop Drawings.
- 2. Manufacturer's Literature.
- 3. Samples.

END OF SECTION 10 2113.19

SECTION 10 2613 – WALL AND CORNER GUARDS

PART 1 – GENERAL

1.01 WORK INCLUDED

A. Extent of wall and corner guards as indicated on Drawings and specified herein.

1.02 QUALITY ASSURANCE

- A. Deliver materials to project site in original packages or containers clearly labeled to identify manufacturer, brand name, quality or grade and fire hazard classification.
- B. Store materials in original undamaged packages or containers. Store materials in a clean, dry location protected against damage of any kind.
- C. Illuminate areas of installation using building's permanent lighting system; temporary lighting alone will not be acceptable.

1.03 SUBMITTALS

A. Product Data:

- 1. Manufacturer's product data sheets, cutsheets, specifications and installation instructions.
- 2. Include data on physical characteristics, durability, fade resistance and flame resistance characteristics.

B. Samples:

1. Submit actual samples of corner guards selected. If color not selected, submit samples for selection by the Architect from manufacturer's entire selection of type indicated. Printed color chart alone is not acceptable.

1.04 WARRANTY

A. Provide manufacturer's standard 5-year warranty.

PART 2 – PRODUCTS

2.01 MATERIAL

A. Provide one of the following approved products as indicated on the Drawings:

2. Surface-mounted Corner Guards (Mounted to continuous aluminum retainer- 3" wing size):

"Construction Specialties;" Acrovyn Corner Guard, SM-20AN.

"In Pro Architectural Products"; 150 High Impact Corner Guard.

- a. Description:
 - 1. Snap-on extruded vinyl corner guards with continuous aluminum retainer.
 - 2. Dimensions: Leg length: 3", Angle: 90 degrees w/ 1/4" radius.
 - 3. Height: As noted on Drawings.
 - 4. Profile: High-impact vinyl acrylic extrusion with rounded corners.
 - 5. Thickness: nominal .080".
 - 6. Flame Resistance: Class A fire rating (ASTM E 84).
 - 7. Texture: Pebble.
 - 8. Provide injection-molded top and bottom caps.

PART 3 - EXECUTION

3.01 PREPARATION

A. Verify that wall surfaces are acceptable to receive the specified guard systems. Do not begin installation until acceptable conditions have been corrected.

3.02 INSTALLATION

- A. Install Corner Guards securely to wall according to manufacturer's instructions and recommendations.
- B. Install Corner Guards accurately in location, alignment, and elevation.
- C. Install Corner Guards full height of door opening or wall opening, unless indicated otherwise.

If desired by the Architect in the field, field cut units to lesser height within openings.

D. Remove excess adhesive along edges.

3.03 ADJUST AND CLEAN

- A. Remove surplus materials, rubbish, and debris resulting from corner guard installation upon completion of work, and leave areas of installation in neat, clean condition.
- B. Clean corner guards and adjacent wall surfaces of all stains, marks and adhesives.

WALL AND CORNER GUARDS 10 2613 - 3 04/24/2025

SUBMITTAL CHECK LIST

- 1. Product Data.
- 2. Samples.

END OF SECTION 10 2613

BULLET RESISTANT FIBERGLASS PANELS 10 2641 - 1 04/24/2025

SECTION 10 2641

BULLET RESISTANT FIBERGLASS PANELS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Furnish labor, materials, equipment, special tools, supervision and services required to complete the installation of bullet resistant fiberglass panels to provide protection at employee from the Lobby as shown on the Drawings and specified herein..

1.2 REFERENCES

- A. Underwriters Laboratory UL 752-Standard for Bullet Resisting Equipment.
- B. ASTM C 1172 Standard Specification for Laminated Architectural Flat Glass.
- C. ASTM E119-98-Standard Test Methods for Fire Tests of Building Construction and Materials,
- D. MIL-P-46593A-Numerical simulation of ballistic impact on composite laminates,
- E. MIL-STD-622F-V50 Ballistic Test for Armor.

1.3 ACTION SUBMITTALS

- A. Product Data: Including manufacturer recommended installation instructions.
- B. Shop Drawings: Include plans, elevations, sections, details, attachment to other work.
- C. Samples: For each exposed glazing type.

1.4 INFORMATION SUBMITTALS

- A. Product Test Reports: Indicating compliance with requirements
- B. Warranty: Sample of warranty

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the project site with the manufacturer's UL Listed Labels intact and legible. Handle the materials with care to prevent damage. Store materials inside and under cover, stack flat and off floor. Project conditions (temperature, humidity, and ventilation) shall be within the maximum limit recommendations provided by manufacturer. Do not install products stored in conditions outside manufacturer's recommended limits.

1.6 WARRANTY

- A. Workmanship Warranty: All materials shall be warranted against defects for a period of [1] year for the date of receipt at the project site. Provide certificates of manufacturer's standard limited warranty with closeout documents.
- B. Finish Warranty: Manufacturer's warranty against deterioration of factory finishes for the period of [1] year from the date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

- A. Basis of Design:
 - 1. Provide products by the following:
 - a. Total Security Solutions, Inc., 935 Garden Lane, Fowlerville, MI 48836, 866 734-6277. Attn: Sales Department, sales@tssbulletproof.com. Web: www.tssbulletproof.com.
 - Subject to compliance with requirements, manufacturers of products of equivalent design may be acceptable if approved in accordance with Section 01 6200 Product Options and Substitutions

2.2 BULLET RESISTANT FIBERGLASS PANELS

- A. Through the design, manufacturing techniques and material application, the Bullet Resistant Fiberglass panels shall be made of multiple layers of woven roving ballistic grade fiberglass cloth impregnated with a thermoset polyester resin and compressed into flat rigid sheets.
- B. Bullet Resistant Fiberglass will be rated and tested for UL 752 and NIJ—0108.01 to provide Level 3 protection.

2.3 FABRICATION

A. Tolerances: All joints and connections shall be tight, providing hairline joints and true alignment of adjacent members.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prior to beginning installation, verify that areas have been prepared as required by the Contract Documents and architectural drawings, and Shop Drawings have been approved.

- B. Notify Architect of any unsatisfactory preparation that is responsibility of others.
- C. Clean and prepare all surfaces per manufacturers recommendations as required for achieving the best results for the substrate under the project conditions.
- D. Do not begin installation of material until all unsatisfactory conditions have been resolved and approved by Architect.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions and UL 752. Set all equipment plumb.
- B. Apply sealant in accordance with manufacturer's recommendations as indicated in installation instructions.
- C. Remove excess sealant and leave exposed surfaces clean and smooth

3.3 PROTECTION

- A. Clean and protect material from damage during ongoing construction operations. If damage occurs, remove and replace as required to provide voice ports in their original, undamaged condition.
- B. Inspection and Cleaning: Verify installation is complete and complies with manufacturer's requirements.
- C. Provide final cleaning of product and accessories, removing excess sealant, labels and protective covers.
- D. Touch-up, repair or replace damaged products prior to Substantial Completion.

END OF SECTION

SECTION 10 2813 - TOILET ACCESSORIES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Toilet accessories as shown on Drawings and specified herein.
- B. Installation of owner-furnished toilet accessories as shown on Drawings and specified herein.

1.02 SUBMITTALS

- A. Manufacturer's Literature:
 - 1. Submit manufacturer's "cut sheets" for each item specified, showing installation details, and product information.

1.03 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to job with manufacturer's unopened packages, with label in tact.
- B. Store and handle products so as to avoid damage. Remove all damaged items from the job site.
- C. Maintain protective covers until Substantial Completion.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Provide products, as approved by the Architect, from one of the following manufacturers:
 - 1. "Bobrick"
 - 2. "Bradley"
 - 3. "ASI"
 - 4. "AJW Architectural Products"
- B. See Specifications Section 01 6200 Product Options and Substitutions.

2.02 MATERIALS

A. Grab Bars:

- 1. "Bobrick" B-6806 Series.
- 2. Surface mounted, stainless steel, safety grip finish, concealed mounting, snap-flange cover.
- 3. Provide 1-1/2" diameter x sizes and configurations as shown on Drawings.
- 4. Provide at locations as shown on Drawings, or if not shown, provide as follows:
 - a. 36" long horizontally on rear wall of all ADA stalls.
 - b. 42" long horizontally on side wall of all ADA stalls and ambulatory stalls.
 - c. 18" long vertically on side wall of all ADA stalls and ambulatory stalls.
 - d. L-shaped horizontal, 2-wall bar configuration at all ADA shower stall locations.
 - e. Need not provide if supplied as integral to a shower stall unit. See Plumbing.
 - f. 19-3/4"x34-3/4" overall for 36"x36" stalls, 40"x58" nominal overall for roll-in stalls.

B. Toilet Paper Dispensers:

- 4. "Bobrick" B-540, Surface-Mounted Toilet Tissue Dispenser and Utility Shelf.
- 5. Dual-roll type.
- 6. Surface-mounted, stainless steel, satin finish.
- 4. Provide at locations as shown on Drawings, or if not shown, provide one per water closet.
- 5. Coordinate location with partition door and other accessories.
- 6. Provide this type of dispenser at all typical height locations, except where other types are specifically indicated for use.

C. Sanitary Napkin Disposals:

- 1. "Bobrick" B-270, "Contura" Series.
- 2. Surface-mounted, stainless steel, satin finish.
- 3. Provide at locations as shown on Drawings, or if not shown, provide one per female water closet.
- 4. Coordinate location with partition door and other accessories.

D. Mirrors (Frameless):

- 1. "Bradley" 747 Series Frameless mirror.
- 2. 1/4" select float glass mirror.
- 3. Edges ground and polished smooth.
- 4. Surface mounted, concealed fasteners.
- 5. Install centered on lavatory or sink.
- 6. Provide sizes as shown on Drawings, or if not shown, provide 24"x36".
- 7. Provide at locations as shown on Drawings, or if not shown, provide one per lavatory or sink.

E. Robe / Coat / Towel Hooks (Double Hook):

- "Bobrick" B-549
- 2. Surface mounted, stainless steel, satin finish, concealed mounting.
- 3. Provide at locations as shown on Drawings.
- 4. Provide one on inside of each toilet partition stall door if partitions do not already include one.
- 5. Provide two at each shower stall.
- 6. Mount one hook at ADA height at all ADA shower stalls.

F. Shower Shelf:

- 1. "MPL Company", Corner Shelf
- 2. Cultured Marble.
- 3. 9" long x 9" wide.
- 4. Provide at locations as shown on Drawings, or if not shown, provide one at each shower.
- 5. Coordinate location with shower controls and other accessories.

G. Shower Curtain Rod:

- 1. "Bobrick" B-1607
- 2. Surface-mounted, stainless steel, satin finish.
- 4. Provide at locations as shown on Drawings, or if not shown, provide one at each shower.
- 5. Coordinate location with shower controls and other accessories.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Finish surfaces shall be complete prior to installation of accessories.
- B. Verify all materials that anchoring devices are compatible with accessories.

3.02 INSTALLATION

- A. Drill holes of proper size for required anchoring devices to be concealed in finish wall behind accessories.
- B. Install accessories plumb and true.
- C. Grab Bars:
 - 1. Anchor grab bars on wall and partition of end toilet compartment and at urinals indicated.
 - 2. Install as recommended by manufacturer to withstand 500lb. downward pull.

3.03 MOUNTING HEIGHTS

- A. See Drawings for mounting heights.
- B. If not shown on Drawings, confer with Architect for heights required.
- C. All mounting heights shall meet all current Codes and ADA requirements.

3.04 ADJUSTING AND CLEANING

- A. Check operation of accessories; make final adjustment as required.
- B. Remove protective covers.
- C. Clean stainless steel of all paints, and other markings, with mild detergent and water.

TOILET ACCESSORIES 10 2813 - 4 04/24/2025

3.05 **PROTECTION**

- Protect accessories from damage until Substantial Completion. Replace any damaged accessories. A.
- B.

SUBMITTAL CHECK LIST

1. Manufacturer's Literature.

END OF SECTION 10 2813

SECTION 10 4400 - FIRE EXTINGUISHERS AND CABINETS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Fire extinguishers, cabinets, and brackets as shown on the Drawings and specified herein.
- B. Re-installation of existing fire extinguisher cabinets and brackets as shown on the Drawings.

1.02 QUALITY ASSURANCE

A. Provide fire extinguishers which are U.L. listed and bear U.L. "Listing Mark" for type, rating, and classification of extinguisher indicated.

1.03 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's product data sheets, cutsheets, specifications, materials description, installation and maintenance instructions.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to job in manufacturer's unopened packages with labels intact.
- B. Store and handle products so as to prevent damage. Remove all damaged items from the job site.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Fire Extinguishers:
 - 1. Dry Chemical Type:
 - a. Basis of Specification: "JL Industries, Inc." Cosmic 10E.
 - b. Fire Class: ABC.
 - c. U.L. Rating: 4A-80BC.
 - d. Capacity: 10 pounds.
- B. Fire Extinguisher Cabinets:
 - 1. Use with Dry Chemical Type Extinguishers (Semi-Recessed Mounted):

- a. Basis of Specification: "JL Industries, Inc." Academy.
- b. Tub: Cold rolled steel with white powder coat finish.
- c. Trim: Semi-recessed 1-1/2" square-edge trim, aluminum, clear anodized finish.
- d. Door Style: Full glazing.
- e. Door Glazing: Clear acrylic with red vertical FE lettering.
- f. Hardware: Continuous hinge, roller catch, pull handle. Match trim finish.
- 4. Provide fire-rated cabinets at all Rated Walls and Smoke Partitions.
- C. Fire Extinguisher Brackets:
 - 1. Manufacturer's standard wall mounted type for each specific extinguisher type.
 - 2. Provide to secure top and bottom of extinguisher.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install extinguishers in cabinets and on brackets as indicated on the Drawings.
- B. Install cabinets and brackets square and plumb, and in accordance with manufacturer's instructions.
- C. Install in compliance with all applicable Federal, State, and local regulations.
- D. Install cabinets recessed in masonry and stud framed walls as applicable.
- F. Install cabinets and brackets so as to locate extinguishers at a height of 3'-8" from floor to top of extinguisher handle (for bracket mounted extinguishers) and to center of door pull (for extinguishers in a cabinet), unless otherwise indicated on the Drawings.

3.02 ADJUSTING AND CLEANING

- A. Check extinguishers for proper charge in operation.
- B. Assure that all doors and hardware operate smoothly and freely.
- C. Adjust or replace defective items as required.

3.03 PROTECTION

A. Protect cabinets and extinguishers from damage and deterioration until time of Substantial Completion. Touch up any marred surfaces.

FIRE EXTINGUISHERS AND CABINETS 10 4400 - 3 04/24/2025

SUBMITTAL CHECK LIST

1. Product Data.

END OF SECTION 10 4400

SECTION 10 5100.01 - LOCKERS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Lockers as indicated on the Drawings and specified herein, of the following types:
 - 1. Metal Athletic Lockers.
 - Solid Plastic Lockers.

1.02 SUBMITTALS

- A. Shop Drawings:
 - 1. Indicate sizes, dimensions, gauges, construction, trim, finish and hardware.
 - 2. Indicate locker numbering sequence.
- B. Samples:
 - 1. Where colors are specified, submit one sample of each color.
 - 2. Where colors are not specified, or are specified as "to be selected", submit samples showing manufacturer's full range of standard colors for each type.

1.03 DELIVERY, STORAGE AND HANDLING

- A. Deliver fully assembled units to site in undamaged condition, with labels intact.
- B. Store and handle materials to avoid damage and exposure to elements. Remove damaged otherwise unsuitable material from job site.

1.04 PROJECT CONDITIONS

A. Do not install lockers until space is enclosed and weather-proof, and until wet-work in space is completed, and until temperature and humidity will be continuously maintained at values near those indicated for final occupancy.

PART 2 - PRODUCTS

2.01 METAL ATHLETIC LOCKERS

- A. Provide products, as approved by the Architect, from one of the following approved manufacturers:
 - 1. "DeBourgh"

- 2. "List Industries", "Superior"
- 3. "Lyon"
- 4. "Penco"
- 5. "Republic"
- 6. "ASI"

B. Type and Size:

- 1. Basis of specification:
 - a. "Republic"; "MVP II Athletic Lockers".
 - b. "Superior"; "All-Star Fully-Framed All-Welded Sport Lockers".
- 2. Width x depth x height as indicated on Drawings.
- 3. If not indicated, provide 24" wide x 24" deep (including seat) x 72" high, 1-tier.
- 4. With open top shelf and lockable foot locker.

C. Doors:

1. Main locker compartment to be open front design, without door.

D. Foot Locker:

- 1. Foot locker compartment at bottom to be open front design, without door.
- 2. Extends 9" past the main locker frame creating a seat.
- 3. Stationary hardwood seat.

E. Upper Compartment:

- 1. 8-1/2" wide open compartment, without door on left.
- 2. Secured storage with hinged door on right.
 - a. Built-in recessed stainless steel hasp area for removable padlock.

E. Frame:

1. 16 gauge steel angle, tee, or channel.

F. Panels:

- 1. Sides: 16 gauge sheet steel box ends, diamond perforated steel for ventilation.
- 2. Backs: 18 gauge sheet steel.

G. Tops, Bottoms, Shelves:

- 1. 16 gauge sheet steel.
- 2. Flanged four (4) sides.

H. Hooks and Rods:

- 1. Chrome plated brass or stainless steel coat rod, full width of locker.
- 2. 4 total hooks, 1 located on each side and 2 on back.

- I. Hinges:
 - 1. 5 knuckle, recessed.
 - 2. 2 on each box type locker.
- J. Silencer:
 - 1. Air cushion rubber bumpers.
 - 2. 2 on each box type locker.
- K. Number Plate:
 - 1. Riveted.
 - 2. Numbered in sequence.
 - 3. Provide at each opening location.
- L. Finish:
 - 1. Baked epoxy enamel.
 - 2. Color as indicated on drawings, or as selected from manufacturer's entire selection.
- M. Handicapped Accessible Lockers:
 - 1. Provide at locations as indicated on the Drawings or if not indicated, provide a minimum of 5% but not less than one of each type specified.
 - 2. Manufacturer is responsible to provide all modifications as required to meet all requirements of the accessibility Code and ADA.
 - 3. Provide all items within reach heights required.
 - Provide accessible access control for entry into door without use of combination lock.
 May be accomplished via key fob, card swipe or other method as approved by the Architect.
 - 5. Provide universal symbol of accessibility on exterior of locker to identify locker meeting these requirements for use by disabled students.

2.02 SOLID PLASTIC LOCKERS

- A. Provide products, as approved by the Architect, from one of the following approved manufacturers:
 - 1. "Scranton Products" Tufftec
 - 2. "Bradley" Lennox
 - 3. "ASI" Plastic Traditional Collection
- B. Type and Size:
 - 1. Basis of specification: "Bradley"; "Lennox Lockers"
 - 2. Width x depth x height as indicated on Drawings.
 - 3. If not indicated, provide 12" wide x 12" deep x 72" high, 3-tier.
- C. Doors:

- 1. High impact, high density polyethylene.
- 2. 1/2" thick.
- 3. Homogeneous color throughout.
- 4. Lattice venting.
- D. Sides, Tops, Bottoms, Back and Shelves:
 - 1. High impact high density polyethylene.
 - 2. 3/8" thick.
 - 3. Homogeneous color throughout.
- E. Components:
 - 1. Machined edges to accept assembly brackets.
- F. Hinge:
 - 1. Continuous, full length.
 - 2. PVC plastic with no metal parts.
 - 3. Provide at each opening location.
- G. Latch:
 - 1. Continuous PVC plastic.
 - 2. Snap-fit connection.
 - 3. Provide at each opening location.
- H. Hooks:
 - 1. 3 total, 1 located on each side and back.
 - 2. Provide at each opening location.
- I. Number Plate:
 - 1. Riveted.
 - 2. Numbered in sequence.
 - 3. Provide at each opening location.
- J. Locking Device:
 - 1. Built-in hasp for removable padlock.
 - 2. Provide at each opening location.
- K. Finish:
 - 1. Doors, accessories and all exposed surfaces: Integrally colored, solid through body.
 - 2. Body and concealed surfaces: Integrally colored white.
 - 3. Smooth "Orange Peel".
 - 4. Color as indicated on drawings, or as selected from manufacturer's entire selection.

- L. Handicapped Accessible Lockers:
 - 1. Provide at locations as indicated on the Drawings or if not indicated, provide a minimum of 5% but not less than one of each type specified.
 - 2. Manufacturer is responsible to provide all modifications as required to meet all requirements of the accessibility Code and ADA.
 - 3. Provide all items within reach heights required.
 - 4. Provide accessible access control for entry into door without use of combination lock.

 May be accomplished via key fob, card swipe or other method as approved by the Architect.
 - 5. Provide universal symbol of accessibility on exterior of locker to identify locker meeting these requirements for use by disabled students

2.03 FABRICATION

- A. Square and rigid.
- B. Interlocked intermediate cross members.
- C. All steel to have one-coat electroplated zinc carbon primer. Finish coat as specified.
- D. Fabricate filler panels from same material as locker units.

PART 3 - EXECUTION

3.01 PREPARATION

A. Field verify all dimensions prior to fabrication.

3.02 INSTALLATION

- A. Install lockers in accordance with manufacturer's instructions and shop drawings.
- B. Provide all anchor bolts and other fasteners as required.
- C. Provide manufacturer's standard trim at bottom and sides.
- D. Provide filler panels as required.

1.03.1 ADJUSTING AND CLEANING

- A. Adjust hardware to ensure that all doors operate smoothly.
- B. Clean lockers according to manufacturer's recommendations.

LOCKERS 10 5100.01 - 6 04/24/2025

3.04 PROTECTION

A. Protect lockers from damage and deterioration until Substantial completion.

SUBMITTAL CHECK LIST

- 1. Shop Drawings.
- 2. Samples.

END OF SECTION 10 5100.01

SECTION 10 7300 - WALKWAY COVERS AND CANOPIES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Prefabricated, pre-engineered, pre-finished cantilevered aluminum canopies as indicated on the Drawings and specified herein.
- B. Drawings indicate dimensions and design intent.

1.02 QUALITY ASSURANCE

- A. Provide cantilevered canopy fabricated and erected in accordance with designs prepared under the supervision and bearing the seal of a Registered Professional Engineer.
- B. Comply with all applicable state and local building codes.

1.03 SUBMITTALS

- A. Shop Drawings:
 - 1. Submit shop drawings for review of profiles and overall dimensions.
 - 2. Review is to verify conformance with design intent and not for structural capability or design.
- B. Samples:
 - 1. Minimum 12" x 12" samples of roof deck and trim, showing finish and color specified.
- C. Warranty.

1.04 DELIVER, STORAGE AND HANDLING

- A. Deliver, store and handle materials in accordance with manufacturer's recommendations, and to prevent damage and deterioration.
- B. Remove damaged material from the job site.

1.05 WARRANTY

A. Provide manufacturer's written warranty covering materials and workmanship for a period of one year from date of substantial completion.

ALUMINUM CANOPIES 10 7300 - 2 04/24/2025

PART 2 - PRODUCTS

2.1 BASIS OF SPECIFICATION

- A. Provide basis of specification or approved equivalent product:
- B. "MapesCanopies", SuperLumideck Lincoln, Nebraska Phone:1-888-273-1132.

2.2 MATERIALS

A. Canopy

- 1. Decking shall consist of 3" extruded flat soffit .078 decking.
- 2. Intermediate framing members shall be extruded aluminum, alloy 6063-T6, in profile and thickness shown in current Mapes brochures.
- 3. Cantilever supported brackets shall be standard finish.
- 4. Fascia shall be standard extruded 8" J style.

B. Finishes

1. Finish type shall be 2-Coat Kynar Finish.

2.3 FABRICATION

- A. All Mapes Super Lumideck extruded aluminum canopies are shipped with the materials precut to size for field assembly.
- B. All connections shall be mechanically assembled utilizing 3/16 fasteners with a minimum shear stress of 350 lb. Pre-welded or factory-welded connections are not acceptable.
- C. Concealed drainage. Water shall drain from covered surfaces into intermediate trough and be directed to Downspout From Rear Gutter.

PART 3 - EXECUTION

3.1 Inspection

- A. Confirm that surrounding area is ready for the canopy installation.
- B. Installer shall confirm dimensions and elevations to be as shown on drawings provided by Mapes Industries.
- C. Erection shall be performed by an approved installer and scheduled after all concrete, masonry and roofing in the area is completed

3.2 Installation

- A. Installation shall be in strict accordance with manufacturer's shop drawings. Particular attention should be given to protecting the finish during handling and erection.
- B. After installation, entire system shall be left in a clean condition.

END OF SECTION 10 7300

SECTION 11 1300 - LOADING DOCK EQUIPMENT

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Loading Dock Equipment as shown on the Drawings and specified herein, including:
 - 1. Molded Dock Bumpers.
 - 2. Mechanical Dock Leveler with Dock Lock.
 - Dock Seal.

1.02 QUALITY ASSURANCE

- A. Provide mechanical and hydraulic dock levelers from one manufacturer.
- B. Drawings are based on products of one manufacturer. Field coordinate all dimensions, rough openings, power requirements and cast-in-place items with selected manufacturer's product.

1.03 SUBMITTALS

- A. Shop Drawings:
 - 1. Indicate dimensions, part, critical installation clearances and anchorage.
- B. Installation Instructions.
- C. Manufacturer's Warranty:
 - 1. Cover all defects in workmanship or materials for a period of 5 years.
 - 2. Replace or make all corrections at no additional costs to the Owner.

1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle products so as to prevent damage and deterioration.

PART 2 - PRODUCTS

2.01 PRODUCTS

- A. Molded Dock Bumpers:
 - 1. "Durable Corporation", B4510 Series, Extra-Length Laminated Dock Bumper.

- 2. Reinforced rubber pads laminated between heavy structural steel angles.
 - a. Thickness: 4-1/2".b. Height: 10".

c. Length: As indicated on Drawings or as specified herein.
d. Angles: 1/4" thickness x 9-1/2" height x 3" minimum legs.

- 3. Provide extended bumpers at sloping dock applications.
- B. Mechanical Dock Leveler With Dock Lock:
 - 1. "RiteHite", RH-1000.
 - 2. Size: 7'x8' platform with 20 inch lip.
 - 3. Nominal Capacity: 35,000 lbs.
 - 4. Loads: 8 truckloads per 24 hour period.
 - 5. Activation: "Soft release" pull chain activation.
 - 6. Automatic Tension Relief of Ramp Control.
 - 7. Needle bearings and grease fittings on Lifter Arm.
 - 8. Grease fittings on lip hinge.
 - 9. Weatherseal.
 - 10. Full operating range toe guard.
 - 11. Two 4" thick tire fabric dock bumpers.
 - 12. Automatic night locks.
 - 13. Low-Profile Dock Lock Trailer Restraint:
 - a. "RiteHite", Model RHR-600.

C. Dock Seal:

1. "Gensys", Model GDSC, with optional side wear pleats.

PART 3 - EXECUTION

3.01 PREPARATION

A. Field verify all rough dimensions and cast-in place anchors with manufacturer's specific product.

3.02 INSTALLATION

- A. Install in strict accordance with the manufacturer's instructions.
- B. Dock Bumpers:
 - 1. Install bumper angles onto anchor bolts cast into concrete dock surface.
 - 2. Bolt size as per manufacturer, 1/2" minimum.
- C. Coordinate with foundation work to provide embed plate of proper size and location for mounting of vehicle restraint.

LOADING DOCK EQUIPMENT 11 1300 - 3 04/24/2025

- D. Provide final inspection by manufacturer's representative.
 - Correct all deficiencies at no additional cost to the Owner.
- E. Turn over installation instructions and signed warranty to the Owner.

SUBMITTAL CHECKLIST

- 1. Shop Drawings.
- 2. Installation Instructions.
- 3. Manufacturer's Warranty.

END OF SECTION 11 1300

BULLET RESISTANT DEAL TRAY – RECESSED FLAT BOTTOM 11 2216.33 - 1 04/24/2025

SECTION 11 2216.33

BULLET RESISTANT DEAL TRAY - RECESSED FLAT BOTTOM

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. Bullet resistant recessed currency tray with a flat bottom.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For recessed currency tray.
 - 1. Include plans, sections, details, and attachments to other work. Detail fabrication and installation, including field joints.
 - 2. Show locations and sizes of cutouts and holes for items installed in countertops.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver product only after casework and supports on which it will be installed have been completed in installation areas.
- B. Store product in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.
- C. Keep Tray covered with protective covering during handling and installation.

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install countertop-mounted trays until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.
- B. Field Measurements: Where countertop-mounted items are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Established Dimensions: Where countertop-mounted trays are indicated to fit to other construction, establish dimensions for areas where countertops are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 FABRICATORS

- A. Fabricators: Subject to compliance with requirements, provide products by the following:
 - 1. Total Security Solutions, Inc., 935 Garden Lane, Fowlerville, MI 48836, 866-734-6277. Attn: Sales Department, sales@tssbulletproof.com. Web: www.tssbulletproof.com.

2.2 FLAT BOTTOM RECESSED CURRENCY TRAY

- A. Flat Bottom Recessed Currency Tray shall be designed to permit passing of materials under transaction area windows without sacrificing security of the system.
- B. Each transaction position shall have a stainless-steel dip tray as shown on shop drawings.
- C. Material: Tray shall be fabricated from minimum 18-gauge stainless steel and with No. 4 finish.
- D. Tray size: Standard size of tray to be 16 inches by 10 inches from the outside edge of flanges with a clear open depth under the glazing no less than 1-1/2 inch.

E. Bullet Resistance:

1. Tray shall include a bullet trap enclosure to meet UL ballistics requirements as indicated.

- 2. Level 3 in accordance with UL 752 Testing for Ballistic Resistance for the complete assembly.
- F. Components shall be manufactured in strict accordance with the specifications, design and details, to be in conformance with required UL ballistics level indicated.
- G. No field alterations to the construction of the units fabricated under the acceptable standards shall be allowed unless approved by the manufacturer and the architect.
- H. Standard manufacturing tolerances shall be +/- 1/16".

2.3 FABRICATION

- A. Fabricate tray to dimensions, profiles, and details indicated. If applicable, insert subparagraph here to describe conditions where eased edges are not required.
- B. Complete fabrication to maximum extent possible before shipment to Project site.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition tray and countertop to receive tray to average prevailing humidity conditions in installation areas.
- B. Prior to installing the bullet resistive material, the contractor shall verify that all supports have been installed as required by the contract documents and architectural drawings, and approved shop/CAD drawings, if required. Installer shall notify architect of any unsatisfactory preparation that is responsibility of another installer.
- C. Clean and prepare all surfaces per manufacturers recommendations for achieving the best results for the substrate under the project conditions

3.2 INSTALLATION

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective material, where possible, to eliminate functional and visual defects. Where not possible to repair, replace material. Adjust joinery for uniform appearance.
- B. Clean exposed and semi exposed surfaces.
- C. Protection: Provide Kraft paper or other suitable covering over countertop mounted tray surfaces, taped to underside of countertop at a minimum of 48 inches o.c.

Remove protection at Substantial Completion.

END OF SECTION

SECTION 12 2400 - WINDOW SHADES

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Work covered by this section includes furnishing of and paying for all materials, labor, equipment, mounting hardware and other items required for execution and completion of roll-up fabric window shades.
- B. Work covered by this Section includes:
 - 1. Single-Roller Window Shades, with a screen fabric shade.
 - 2. Dual-Roller Window Shades, with a screen fabric shade and a light blocking fabric shade.

1.02 SUBMITTALS

- A. Window Shades Schedule:
 - Indicate locations including room numbers, quantities and field measurements of dimensions for all window blinds.
 - 2. Indicate proposed mounting and fastening procedurals.
- B. Product Data:
 - 1. Manufacturer's product data sheets, cutsheets, specifications, materials description, installation and maintenance instructions.
- C. Samples:
 - 1. Actual samples of all items needed for colors and finishes.
 - 2. Colors and finishes to be selected by Architect from manufacturer's entire selection.

1.03 DELIVERY

A. Deliver materials in manufacturer's original, unopened, containers, labeled so as to allow easy identification.

1.04 WARRANTY

- A. Mounting hardware, headbox, fascia, chain and clutch operator Twenty-five (25) years.
- B. Shade Fabric Ten (10) years.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Provide products, as approved by the Architect, from one of the following approved manufacturers:
 - 1. "Hunter Douglas Contract"
 - 2. "Draper"
 - 3. "Mecho Shade"

2.02 SINGLE ROLLER WINDOW SHADES

- A. Provide one of the following approved products:
 - 1. "Hunter Douglas Contract", FR Roller Shade.
 - 2. "Draper", Flexshade.
 - 3. "MechoSystems", Mecho/5 Manual Shades.

B. Description:

1. Manually operated, vertical roll-up, fabric window shade with bead chain and clutch operating mechanism.

C. Mounting Style:

1. Inside of window opening and extending from head to sill and jamb to joint.

D. Operation:

- 1. Bead chain and clutch operating mechanism allowing shade to stop when chain is released.
- 2. Designed never to need adjustment or lubrication.
- 3. Provide preset limit stops to prevent shade from being raised or lowered too far.
- 4. Clutch mechanism to be fabricated from high carbon steel and molded fiberglass reinforced polyester or injected molded nylon.
- 5. Control loop to be stainless steel bead chain hanging at side of window.

E. Fascia:

- 1. L-shaped aluminum extrusion to conceal shade roller and hardware.
- 2. Finish: Baked enamel.
- 3. As indicated on the Drawings, or if not indicated, to be selected by Architect from manufacturer's entire selection.

F. Color:

1. As indicated on the Drawings, or if not indicated, to be selected by Architect from manufacturer's entire selection.

2.03 DUAL-ROLLER WINDOW SHADES

A. Provide one of the following approved products

- 1. "Hunter Douglas Contract", FR Roller Shade.
- 2. "Draper", Flexshade.
- 3. "MechoSystems", Mecho/5 Manual Shades.

B. Description:

- 1. Manually operated, dual vertical roll-up, fabric window shades with bead chain and clutch operating mechanism.
- 2. One roller with screen fabric shade.
- 3. One roller with light blocking fabric shade.

C. Mounting Style:

1. Inside of window opening and extending from head to sill and jamb to joint.

D. Side and Sill Channels:

- 1. Rear, light blocking shade only.
- 2. 2-chambers; one for fabric and fabric retainer, and the other for fabric guide/channel locator.

E. Operation:

- 1. Bead chain and clutch operating mechanism allowing shade to stop when chain is released.
- 2. Designed never to need adjustment or lubrication.
- 3. Provide preset limit stops to prevent shade from being raised or lowered too far.
- 4. Clutch mechanism to be fabricated from high carbon steel and molded fiberglass reinforced polyester or injected molded nylon.
- 5. Control loop to be stainless steel bead chain hanging at side of window.

F. Fascia:

- 1. L-shaped aluminum extrusion to conceal shade roller and hardware.
- 2. Finish: Baked enamel.
- As indicated on the Drawings, or if not indicated, to be selected by Architect from manufacturer's entire selection.

G. Color:

1. As indicated on the Drawings, or if not indicated, to be selected by Architect from manufacturer's entire selection.

2.04 SCREEN FABRIC

- A. Basis of Specification: "Sheerweave" 2360.
- B. Description:
 - 1. Interior sun control, PVC coated fiberglass woven full basketweave.
- C. Attributes:

1. Weight: 11.9 ounces per square yard

Thickness: .017 inches
 Roll Width: 63" or 98 inches
 Openness: 10 percent

- 5. Class A Fire Rating
- 6. Bacteria and fungal resistant.
- D. Color:
 - 1. As indicated on the Drawings, or if not indicated, to be selected by Architect from manufacturer's entire selection.

2.06 LIGHT BLOCKING FABRIC

- A. Basis of Specification: "Sheerweave" 7100.
- B. Cotton/poly blend fabric.
- C. Fire Retardant.
- D. Color:
 - 1. As indicated on the Drawings, or if not indicated, to be selected by Architect from manufacturer's entire selection.

PART 3 - EXECUTION

3.01 INSPECTION AND PREPARATION

- A. Contractor shall be responsible for inspection of site, approval of mounting surfaces, installation conditions and field measurements for this work.
- B. Field measure all openings and conditions.

3.02 INSTALLATION

A. Install shades level and plumb, allow clearance for proper operation, and demonstrate blinds to be in uniform and smooth working order.

PRODUCT DATA SHEET 1 - Provide clearance between sash and shades to permit unencumbered operation of sash hardware.

PRODUCT DATA SHEET 2 - Install the fascia, closure panels and end caps with to conceal roller and operating mechanisms. Exposed fasteners are unacceptable.

- A. Isolate metal parts from concrete and mortar to prevent galvanic action.
- B. Protect installed units to ensure their being in operating condition, without damage, blemish, or indication of use at Substantial Completion of project. Correct non-conforming damaged unit.

Replace units that cannot be field corrected.

3.03 CLEANING

A. Clean finished installation of dirt and finger marks. Leave work area clean and free of debris.

1.2 SUBMITTAL CHECK LIST

- 1. Window Shades Schedule.
- 2. Product Data.
- 3. Samples.

END OF SECTION 12 2400

SECTION 13 3419.01 - METAL BUILDING SYSTEMS - STRUCTURAL FRAMING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes design, shop-fabrication and erection of pre-engineered steel building structural frame, as shown on drawings including plans, notes and details showing size and location of members.
- B. Design and provision of crane support girders and columns are to be included under this contract. Refer to related specification sections for additional requirements.
- C. Work supplied but installed under other Sections:
 - 1. Division 3 Section "Cast-in-Place Concrete" for anchor bolts.
- D. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 1 Section "Structural Inspection."
 - 2. Division 3 Section "Cast-in-Place Concrete."
 - 3. Division 8 Section "Overhead Coiling Doors."
 - 4. Division 8 Section "Overhead Sectional Doors."
 - 5. Division 9 Section "Painting."
 - 6. Division 13 Section "Pre-Engineered Building Components."

1.3 DEFINITIONS

- A. Terminology Standard: See MBMA's "Metal Building Systems Manual" for definitions of terms for metal building system construction not otherwise defined in this Section or in referenced standards.
- B. IAS: International Accreditation Service.

1.4 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Engineer, fabricate, and install pre-engineered structural steel frame to withstand design loadings indicated within limits and under conditions required.
 - 1. The design of the pre-engineered building frame shall be in accordance with the 2014 Indiana Building Code, with Indiana Amendments ((2012 International Building Code).
 - 2. Manufacturer shall use contract drawing information indicating maximum depth, size, and spacing limitations.
 - 3. Concentrated loads, resulting from bearing walls or other conventional structural steel framed into pre-engineered building components (designed and provide by others), are shown with diagrammatic sketches of the member, showing the placement and magnitude of the concentrated load. Pre-engineered building designer shall incorporate such loads into the design of the pre-engineered building frame.
 - 4. The magnitude of the structure's mass dead load (W) for seismic calculations shall be

METAL BUILDING SYSTEMS - STRUCTURAL FRAME 13 3419.01 - 2 04/24/2025

determined by the engineer responsible for the design of the pre-engineered building structure. The pre-engineered building structure is the sole lateral force resisting system and shall be designed as such. All components of the building including , but not limited to, the exterior brick veneer and metal stud wall system, mechanical units, ceiling components, interior partitions, floor structures (even when designed by others), etc. shall be considered when calculating W.

- 5. Pre-engineered building frame supplier shall design and provide connections for conventional structural steel members framed into the pre-engineered building columns.
- B. Engineering Responsibility: Engage a fabricator who uses a qualified professional engineer to prepare design calculations, shop drawings, and other structural data.
- C. Wind loads shall be in accordance with chapter 16 of the 2018 KBC, chapters 26 through 30 of the ASCE 7-10 *Minimum Design Loads for Buildings and Other Structures*, and the following:
 - 1. Ultimate Design Wind Speed: 115 mph
 - 2. Nominal Design Wind Speed: 89 mph
 - 3. Risk Category: II
 - 4. Exposure category: C
 - 5. Enclosure Classification: Enclosed6. Internal Pressure Coefficient: + 0.18
- D. Seismic loads shall be in accordance with chapter 16 of the 2014 Indiana Building Code, chapters 11 and 12 of ASCE 7-10 *Minimum Design Loads for Buildings and Other Structures*, and the following:
 - 1. Seismic Risk Category: II
 - 2. Importance factor: 1.0
 - 3. Site Class: C
 - 4. Short period mapped spectral acceleration (S_S): 0.194
 - 5. 1 second period mapped spectral acceleration (S_1) : 0.132
 - 6. Design for structural systems not complying with AISC-Seismic Provisions for Structural Steel Buildings (where allowed by the 2018 KBC) shall utilize Response Modification Coefficient, System Overstrength Factor, and Deflection Amplification Factor for "Structural Steel Systems not Specifically Detailed for Seismic Resistance" as shown in ACSE 7-10 Table 12.2-1.
- E. Snow loads shall be in accordance with chapter 16 of the 2014 Indiana Building Code, chapter 7 of ASCE 7-10 *Minimum Design Loads for Buildings and Other Structures*, and the following:
 - 1. Importance factor: 1.0
 - 2. Exposure factor: 1.0
 - 3. Thermal factor: 1.2
 - 4. Ground snow load: 15 psf
- F. Live loads shall be in accordance with the 2018 KBC.
 - 1. Live loads on roofs shall not be reduced for tributary live load reduction.
- G. Dead loads shall include the self-weight of the pre-engineered building components, any roof supported mechanical equipment, and a collateral dead load for dead load imposed by ceilings, lights, mechanical ductwork, etc. as follows:
 - 1. Roof Collateral Dead Load: 10 psf.

METAL BUILDING SYSTEMS - STRUCTURAL FRAME 13 3419.01 - 3 04/24/2025

- H. Building drift shall be limited to a maximum of H/300, where H equals the building height, for load combinations which include wind.
 - 1. Drift limitations for seismic loading shall be as defined in the Kentucky Building Code. Use of Building Code exemption to drift design for buildings with partitions designed to accommodate story drift is prohibited.
- I. Deflection of structural members shall be limited to the following:
 - 1. Wind spandrel beams: Horizontal deflection of L/600 due to wind load, where L is the member length.
 - 2. Wind girts and wind columns: Horizontal deflection of L/180 due to wind load, where L is the member length.
 - 3. Primary and Secondary roof framing members: L/120 due to total load and L/180 due to live load, where L is the member length or horizontal distance from eave to eave.
 - 4. Design secondary-framing system to accommodate deflection of primary framing and construction tolerances, and to maintain clearances at openings.
- J. Thermal Movements: Allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss when subjected to a temperature range of 125 degrees F.

1.5 ACTION SUBMITTALS

- A. General: Furnish submittals in quantity, format, and other Conditions of the Contract and as specified in Division 1 of the Project Manual.
 - 1. Shop drawings which show the Architect's or Engineer's title block, logo and/or seal will be rejected and returned unchecked.
 - 2. Computer generated electronic structural construction document files (ACAD) will be made available to the Contractor. The Contractor will be required to sign the Engineer's standard release of liability form prior to receiving the drawing files.
 - 3. Shop drawing resubmittals are reviewed for conformance with review marks only. Any changes or questions originating on a resubmittal shall be clearly clouded.
 - 4. Architect's and Engineer's review of the calculations is for general conformance with the contract documents. Actual calculations are the responsibility of the Metal Building System design engineer and shall not be reviewed for content or accuracy by the Architect or Engineer.
- B. Building Permit Issuance: Contractor shall submit Anchor Bolt Plans and Reactions, calculations, and Shop Drawings to the Building Official. Submittal must be signed and sealed by a professional engineer registered in the state where the project is situated. Submittal typically must be received prior to processing of the building permit by the plans reviewer.
- C. Anchor-Bolt Plans: Submit anchor-bolt plans and templates before foundation work begins.
 - 1. Provide setting drawings, templates, and directions for installation of anchor rods and other anchorages.
 - 2. Include location, diameter, and projection of anchor bolts required to attach metal building to foundation
 - 3. Indicate design criteria and loading (wind, snow, seismic, live) as specified in section 1603 of the Indiana Building Code on the shop drawing cover sheet.
 - 4. Provide foundation reactions for each load type.

METAL BUILDING SYSTEMS - STRUCTURAL FRAME 13 3419.01 - 4 04/24/2025

- D. Shop Drawings detailing fabrication and erection of pre-engineered building structural components. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes
 - 1. Indicate profiles, sizes, spacing, and locations of structural members, connections, attachments, openings, fasteners, and ASTM specifications for materials.
 - 2. Indicate field welds by standard AWS symbols, showing size, length, and type of each weld.
 - 3. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Include erection plans and details.
 - 4. Include ASTM material specifications and grade of steel.
 - 5. Provide erection details of all field connections.
 - 6. Indicate surface preparation for primer, primer, and galvanizing to be used.
 - 7. To the extent pre-engineered building design considerations are indicated as fabricator's responsibility, provide shop drawings signed and sealed by the qualified professional engineer, registered in the State of Indiana, responsible for their preparation. The shop drawings will be reviewed for design intent only. Engineering and detailing shall be solely the responsibility of the manufacturer and the professional engineer responsible for their preparation.
 - 8. Shop drawing resubmittals are reviewed for conformance with review marks only. Any changes or questions originating on a resubmittal shall be clearly clouded.

1.6 INFORMATIONAL SUBMITTALS

- A. General: Furnish submittals in quantity, format, and other Conditions of the Contract and as specified in Division 1 of the Project Manual.
- B. Fabricator shall participate in the certified Quality Certification Program and shall submit, at the completion of fabrication, a certificate of compliance stating that the work was performed in accordance with the approved construction documents.
- C. Metal Building System Certificates: For each type of metal building system, from manufacturer.
 - 1. Letter of Design Certification: Signed and sealed by a qualified professional engineer. Include the following:
 - a. Name and location of Project.
 - b. Order number.
 - c. Name of manufacturer.
 - d. Name of Contractor.
 - e. Building dimensions including width, length, height, and roof slope.
 - f. Indicate compliance with AISC standards for hot-rolled steel and AISI standards for cold-rolled steel, including edition dates of each standard.
 - g. Governing building code and year of edition.
 - h. Design Loads: Include dead load, roof live load, collateral loads, roof snow load, deflection, wind loads/speeds and exposure, seismic design category or effective peak velocity-related acceleration/peak acceleration, and auxiliary loads (cranes).
 - i. Load Combinations: Indicate that loads were applied acting simultaneously with concentrated loads, according to governing building code.
 - j. Building-Use Category: Indicate category of building use and its effect on load importance factors.
 - 2. IAS Certification: Copy of IAS certification.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who has completed pre-engineered building structure work similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Fabricator Qualifications: Engage a firm experienced in fabricating pre-engineered building structure similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to fabricate structural steel without delaying the Work.
 - 1. Fabricator must participate in and be accredited by the International Accreditation Service, Inc (IAS) Inspection Programs for Manufacturers of Metal Building Systems, AC472.
- C. Erector Qualifications: An experienced erector who specializes in erecting and installing work similar in material, design, and extent to that indicated for this Project and who is acceptable to manufacturer.
- D. Professional Engineer Qualifications: A professional engineer who is legally authorized to practice in the State of Indiana and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for projects with structural steel framing that are similar to that indicated for this Project in material, design, and extent.
- E. Comply with applicable provisions of the following specifications and documents:
 - 1. AISC 360 "Specification for Structural Steel Buildings."
 - 2. AISC 303 "Code of Standard Practice for Steel Buildings and Bridges."
 - 3. AISC Design Guide 7 "Industrial Buildings Roofs to Anchor Rods", Second Edition.
 - 4. Research Council on Structural Connections' (RCSC) "The Specification for Structural Joints Using High-Strength Bolts, 2009."
 - 5. American Welding Society's (AWS) D1.1-2010 "Structural Welding Code Steel."
 - 6. ASTM A 6 "Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling."
 - 7. AGA American Galvanizers Association publication "Recommended Details for Galvanized Structures".
 - 8. AWS "AWS Standard for Certification AWS Certified Welders" AWS QC7-93.
 - 9. AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" for design requirements and allowable stresses.
 - 10. SSPC Steel Structures Painting Manual, Volume 1 and 2, latest edition.
 - 11. SSPC Surface Preparation Specification, SP1 through SP15.
- F. Welding Standards: Comply with applicable provisions of AWS D1.1 "Structural Welding Code Steel."

1.8 PROJECT CONDITIONS

- A. Shop Drawings: Comply with established column layout and grid, column base elevation, and frame type shown on the Drawings establishing foundation dimensions.
- B. Established Dimensions for Foundations: Install anchor rods per established dimensions on approved anchor-bolt plans, proceeding with fabricating structural framing without field measurements. Coordinate anchor-bolt installation to ensure that actual anchorage dimensions correspond to established dimensions.
- 1.9 DELIVERY, STORAGE, AND HANDLING

METAL BUILDING SYSTEMS - STRUCTURAL FRAME 13 3419.01 - 6 04/24/2025

- A. Deliver pre-engineered building structure components to Project site in such quantities and at such times to ensure continuity of installation.
- B. Store materials to permit easy access for inspection and identification. Keep steel members off ground by using pallets, platforms, or other supports. Protect steel members and packaged materials from erosion and deterioration.
 - Store fasteners in a protected place. Clean and relubricate bolts and nuts that become dry or rusty before use.
 - Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. A&S Building Systems, Inc.; Division of NCI Building Systems, L.P.
 - 2. American Steel Building Co., Inc.
 - 3. Butler Manufacturing Company; a BlueScope Steel company.
 - 4. Ceco Building Systems; Division of NCI Building Systems, L.P.
 - 5. Chief Buildings; Division of Chief Industries, Inc.
 - 6. Gulf States Manufacturers, Inc.; Division of Magnatrax Corp.
 - 7. Kirby Building Systems; Division of Magnatrax Corp.
 - 8. Metallic Building Company; Division of NCI Building Systems, L.P.
 - 9. Nucor Building Systems.
 - 10. Star Building Systems; an NCI company.
 - 11. USA. Inc
 - 12. VP Buildings; a United Dominion company.

2.2 SYSTEM DESCRIPTION

- A. Description: Provide a complete, integrated set of metal building system manufacturer's standard mutually dependent components and assemblies that form a metal building system capable of withstanding structural and other loads, thermally induced movement, and exposure to weather without failure or infiltration of water into building interior
- B. Primary Framing: Manufacturer's standard primary-framing system, designed to withstand required loads and specified requirements. Primary framing includes transverse and lean-to frames; rafter, rake, and canopy beams; sidewall, intermediate, end-wall, and corner columns; and wind bracing.
 - 1. General: Provide frames with attachment plates, bearing plates, and splice members. Factory drill for field-bolted assembly. Provide frame span and spacing indicated.
 - 2. Primary framing to be prime painted.
 - 3. Rigid Clear-Span Frames: I-shaped frame sections fabricated from shop-welded, built-up steel plates or structural-steel shapes. Interior columns are not permitted.
- C. Endwall Framing: Endwall framing shall include the corner columns and endwall columns and wind girts, and shall be manufactured of I-shaped sections fabricated from structural-steel shapes; shopwelded, built-up steel plates; or C-shaped, cold-formed, structural-steel sheet according to the following:

METAL BUILDING SYSTEMS - STRUCTURAL FRAME 13 3419.01 - 7 04/24/2025

- 1. Structural members to be prime painted . All cold- or roll-formed sheet (gauge) material to be galvanized with clear acrylic secondary coating.
- 2. Load-bearing end-wall and corner columns with rafters capable of supporting the tributary one-half bay design load. Lateral X-bracing of rods are permitted where shown.
- D. Secondary Framing: Manufacturer's standard secondary framing, including purlins, girts, eave struts, flange bracing, base members, gable angles, clips, headers, jambs, and other miscellaneous structural members. Unless otherwise indicated, fabricate framing from either cold-formed, structural-steel sheet or roll-formed, steel sheet to comply with the following:
 - 1. Structural members to be prime painted. All cold- or roll-formed sheet (gauge) material to be galvanized with clear acrylic secondary coating [prime painted].
 - 2. Wall girts shall be nominal 8" deep "C" or "Z" shaped members fabricated from built-up steel plates, steel sheet, or structural-steel shapes. Form edges of sections with stiffening lips angled 40 to 50 degrees from flange, with minimum 2-1/2-inch wide flanges. Design as simple span, continuous, or partially continuous for the specified loads. Wall girts shall be fabricated to be run outside the primary frame columns.
 - 3. Roof purlins shall be manufacturer's standard depth "C" or "Z" shaped members fabricated from built-up steel plates, steel sheet, or structural-steel shapes. Form edges of sections with stiffening lips angled 40 to 50 degrees from flange, with minimum 2-1/2-inch wide flanges. Design as simple span, continuous, or partially continuous for the specified loads.
 - 4. Eave Struts: Unequal-flange, C-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes; to provide adequate backup for metal panels.
 - 5. Flange Bracing: Minimum 2-by-2-by-1/8-inch structural-steel angles or 1-inch diameter, cold-formed structural tubing to stiffen primary-frame flanges.
 - 6. Sag Bracing: Minimum 1-by-1-by-1/8-inch structural-steel angles.
 - 7. Base or Sill Angles: Minimum 3-by-2-inch (76-by-51-mm) zinc-coated (galvanized) steel sheet
 - 8. Purlin and Girt Clips: Manufacturer's standard clips fabricated from steel sheet. Provide galvanized clips where clips are connected to galvanized framing members.
 - 9. Secondary End-Wall Framing: Manufacturer's standard sections.
 - Framing for Openings: Channel shapes; fabricated from cold-formed, structural-steel sheet or structural-steel shapes. Frame head and jamb of door openings and head, jamb, and sill of other openings.
 - 11. Miscellaneous Structural Members: Manufacturer's standard sections fabricated from coldformed, structural-steel sheet; built-up steel plates; or zinc-coated (galvanized) steel sheet; designed to withstand required loads.
 - 12. Wind bracing shall be a system of diagonal cable/rod bracing. Unless otherwise noted, column bases shall be designed as pinned as to not transfer moment into the foundations.
 - 13. Metal roofing shall be assumed to have zero capacity for diaphragm action. Cable or rod bracing shall be utilized in the plane of the roof to transfer lateral loads into the primary and secondary frames.
- E. Column Type
 - 1. Tapered column.
- F. Bay Spacing: As shown.
- G. Eave Height: As shown.
- H. Roof Slope
 - 1. Dual slope as shown on drawings.
- 2.3 MATERIALS

METAL BUILDING SYSTEMS - STRUCTURAL FRAME 13 3419.01 - 8 04/24/2025

- A. All structural steel shapes shall be new, unused and perfect stock, free from millscale, rust, flake, pitting, and imperfections, without bends, kinks, and distortions.
- B. Wide Flange and Tee Shapes (Designated as W and WT): ASTM A36 or ASTM A992.
- C. Channels, Angles, M-Shapes, and S-Shapes: ASTM A36.
- D. Plates and Bars: ASTM A36; ASTM A572, Grade 50 or 55; or ASTM A529, Grade 50 or 55.
- E. Cold-Formed Structural Steel Tubing: ASTM A500, Grade B.
- F. Steel Pipe: ASTM A53, Grade B.
- G. Structural-Steel Sheet: Hot-rolled, ASTM A 1011, Structural Steel (SS), Grades 30 through 55, or High-Strength Low-Alloy Steel (HSLAS), Grades 45 through 70; or cold-rolled, ASTM A 1008, Structural Steel (SS), Grades 25 through 80, or High-Strength Low-Alloy Steel (HSLAS), Grades 45 through 70. Prime painted [hot dip galvanized].
- H. Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process with clear acrylic to comply with ASTM A 755.
 - Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653, Structural Steel (SS), Grades 33 through 80; or High-Strength Low-Alloy Steel (HSLAS), Grades 50 through 80; with G30 coating designation.
- I. Non-High-Strength Bolts, Nuts, and Washers: ASTM A 307, Grade A, carbon-steel, hex-head bolts; ASTM A 563 carbon-steel hex nuts; and ASTM F 844 plain (flat) steel washers.
 - 1. Finish: Plain].
- J. High-Strength Bolts, Nuts, and Washers: ASTM A325 or A490, Type 1, heavy hex steel structural bolts or tension-control, bolt-nut-washer assemblies with spline ends; ASTM A563 heavy hex carbon-steel nuts; and ASTM F436 hardened carbon-steel washers.
 - 1. Finish: Plain.
- K. Welding Electrodes: Comply with AWS requirements.

2.4 PRIMER

A. Primer: SSPC-Paint 15.

PART 3 - EXECUTION

3.1 FABRICATION

- A. General: Design components and field connections required for erection to permit easy assembly.
 - 1. Mark each piece and part of the assembly to correspond with previously prepared erection drawings, diagrams, and instruction manuals.
 - 2. Fabricate structural framing to produce clean, smooth cuts and bends. Punch holes of proper size, shape, and location. Members shall be free of cracks, tears, and ruptures.
 - 3. Anchor rods shall not be located closer than 4" to any edge of concrete from centerline of rod.

METAL BUILDING SYSTEMS - STRUCTURAL FRAME 13 3419.01 - 9 04/24/2025

- B. Tolerances: Comply with MBMA's "Metal Building Systems Manual" for fabrication and erection tolerances.
- C. Fabricate and assemble pre-engineered building structure in shop to greatest extent possible.
- D. Fabricate building structure components exposed to view with exposed surfaces smooth, square, and free of surface blemishes, including pitting, rust and scale seam marks, roller marks, rolled trade names, and roughness.
 - 1. Remove blemishes by filling, grinding, or by welding and grinding, prior to cleaning, treating and shop priming.
- E. Primary Framing: Shop fabricate framing components to indicated size and section, with baseplates, bearing plates, stiffeners, and other items required for erection welded into place. Cut, form, punch, drill, and weld framing for bolted field assembly.
 - 1. Make shop connections by welding or by using high-strength bolts.
 - 2. Join flanges to webs of built-up members by a continuous, submerged arc-welding process.
 - 3. Brace compression flange of primary framing with steel angles or cold-formed structural tubing between frame web and purlin web or girt web, so flange compressive strength is within allowable limits for any combination of loadings.
 - 4. Weld clips to frames for attaching secondary framing.
- F. Secondary Framing: Shop fabricate framing components to indicated size and section by roll-forming or break-forming, with baseplates, bearing plates, stiffeners, and other plates required for erection welded into place. Cut, form, punch, drill, and weld secondary framing for bolted field connections to primary framing.
 - 1. Make shop connections by welding or by using non-high-strength bolts.

3.2 SHOP PRIMING

- A. Shop prime steel surfaces, except the following:
 - 1. Surfaces embedded in concrete or mortar other than column bases. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
 - 2. Surfaces to be field welded.
 - 3. Surfaces to be high-strength bolted with slip-critical connections.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust, loose mill scale, and spatter, slag, or flux deposits. Prepare surfaces according to SSPC specifications as follows:
 - 1. SSPC-SP 2 "Hand Tool Cleaning," all steel except as otherwise specified.
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's instructions and at rate recommended by SSPC to provide a dry film thickness of not less than 1.0 mils (0.025 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

3.3 EXAMINATION

- A. Before erection proceeds, and with the erector present, verify elevations of concrete bearing surfaces and locations of anchorages for compliance with requirements.
- B. Do not proceed with erection until unsatisfactory conditions have been corrected.

3.4 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep pre-engineered building structure secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent building structure, connections, and bracing are in place, unless otherwise indicated.

3.5 ERECTION

- A. Erect metal building system according to manufacturer's written erection instructions and erection drawings.
- B. Set pre-engineered building structure accurately in locations and to elevations indicated and according to AISC specifications referenced in this Section.
- C. Maintain structural stability of frame during erection.
- D. Do not field cut, drill, or alter structural members without written approval from metal building system manufacturer's professional engineer.
- E. Base Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 - 3. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- F. Align and adjust structural framing before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with framing. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure.
 - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure will be completed and in service.
- G. Primary Framing and End Walls: Erect framing level, plumb, rigid, secure, and true to line. Level baseplates to a true even plane with full bearing to supporting structures, set with double-nutted anchor bolts. Use grout to obtain uniform bearing and to maintain a level base-line elevation. Moist-cure grout for not less than seven days after placement.
 - Make field connections using high-strength bolts installed according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for bolt type and joint type specified.
- H. Secondary Framing: Erect framing level, plumb, rigid, secure, and true to line. Field bolt secondary framing to clips attached to primary framing.
 - 1. Provide rake or gable purlins with tight-fitting closure channels and fasciae.
 - 2. Locate and space wall girts to suit openings such as doors and windows.
 - 3. Locate canopy framing as indicated.
 - 4. Provide supplemental framing at entire perimeter of openings, including doors, windows,

louvers, ventilators, and other penetrations of roof and walls.

- I. Bracing: Install bracing in roof and sidewalls where indicated on erection drawings.
 - 1. Tighten rod and cable bracing to avoid sag.
 - 2. Locate interior end-bay bracing only where indicated.
- J. Framing for Openings: Provide shapes of proper design and size to reinforce openings and to carry loads and vibrations imposed, including equipment furnished under mechanical and electrical work. Securely attach to structural framing.
- K. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

3.6 QUALITY CONTROL

- A. General: The Owner will engage an independent testing and inspecting agency to perform inspections and tests and to prepare test reports. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from requirements. Failure to detect any defective materials shall not prevent later rejection when such defect is discovered, or obligate the Architect or Owner for final acceptance.
 - 1. See Section 01 4120 Structural Inspections for testing and inspection to be performed.
 - 2. Provide access for testing agency to places where structural framing work is being installed so that required inspection and testing can be accomplished.
 - 3. The General Contractor shall provide the testing agency a complete set of approved shop drawings.
 - 4. Reports will be delivered to the Architect, Engineer, and the General Contractor within one week of inspection.
 - 5. Deviations from requirements of the contract documents will be reported in writing to the General Contractor within 24 hours.
- B. Correct deficiencies in or remove and replace structural steel that inspections and test reports indicate do not comply with specified requirements.

3.7 CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint. Apply paint to exposed areas using same material as used for shop painting.
 - 1. Apply by brush or spray to provide a minimum dry film thickness of 1.5 mils.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and apply galvanizing repair paint according to ASTM A780. Minimum thickness requirements for the repair are those described in ASTM A123, Section 4.6.

END OF SECTION 13 3419

SECTION 13 3419 - PRE-ENGINEERED METAL BUILDING SYSTEM

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Furnish labor, materials, equipment, special tools, supervision and services required to fabricate, deliver and erect a complete pre-engineered metal building system indicated, noted and detailed on the drawings and specified herein.

1.02 QUALITY ASSURANCE

- A. Design of pre-engineered metal building system must be certified by a Registered Structural Engineer, licensed to practice in the state where the building will be erected.
- B. Provide prefabricated metal buildings as produced by a manufacturer who is regularly engaged in fabrication of pre-engineered metal structures of type and quality indicated.

1.03 REFERENCES

- A. Publications of the following institutes, associations, societies and agencies are referred to in this section.
 - 1. Metal Building Manufacturer's Association, MBMA.
 - 2. American Society for Testing & Materials, ASTM.
 - 3. American Institute of Steel Construction, AISC.
 - 4. Steel Structures Painting Council, SSPC.
 - 5. American Welding Society, AWS.
- B. Comply with the applicable portions of the following publications.
 - 1. Manual of Steel Construction, AISC.
 - 2. Specifications for Design, Fabrication, and Erection of Structural Steel for Buildings, AISC.
 - 3. Specification for the Design of Cold-Formed Steel Structural Members, AISC.
 - 4. Recommended Design Practices Manual, MBMA.
- C. All structural steel and accessories shall be domestic products. Imported products will not be approved for use.

1.04 SUBMITTALS

- A. Furnish to the Architect/Engineer for his approval complete shop and field erection drawings.
 - 1. Submit drawings certified by Manufacturer's Engineer prior to fabrication and erection of structural steel.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Arrange deliveries and quantities to permit continuity of installation.
- B. Store on blocks off ground and cover to prevent rusting, denting and damage to materials or structure.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Provide products from one of the following manufacturers, or an approved equivalent:
 - 1. A&S Building Systems, Inc.; Division of NCI Building Systems, L.P.
 - 2. American Steel Building Co., Inc.
 - 3. Butler Manufacturing Company; a BlueScope Steel company.
 - 4. Ceco Building Systems; Division of NCI Building Systems, L.P.
 - 5. Chief Buildings; Division of Chief Industries, Inc.
 - 6. Gulf States Manufacturers, Inc.; Division of Magnatrax Corp.
 - 7. Kirby Building Systems; Division of Magnatrax Corp.
 - 8. Metallic Building Company; Division of NCI Building Systems, L.P.
 - 9. Nucor Building Systems.
 - 10. Star Building Systems; an NCI company.
 - 11. USA, Inc.
 - 12. VP Buildings; a United Dominion company.

2.02 STRUCTURAL FRAMING MATERIALS

A. Refer to Section 13 3419.01 for structural framing requirements.

2.03 STRUCTURAL STANDING SEAM METAL ROOF SYSTEM

A. Panels:

- 1. Roll formed 24 gauge steel in continuous lengths.
- 2. .60 ounce minimum Galvalume coated.
- 3. 24" nominal width.
- 4. Minimum tensile strength 50,000 psi.
- B. Ribs: Ribs to have continuous anchor reveals to allow anchor clips to resist positive and negative loading and allow expansion and contraction of panels due to thermal changes. Furnish four intermediate stiffer ribs in flat of panel to minimize oil canning and telegraphing of structural members.

PRE-ENGINEERED METAL BUILDING SYSTEM 13 3419.02 - 3 04/24/2025

- C. Panel Edge: A continuous, male/female system to allow interlocking along the full panel length. Seaming by machine on job site. Continuous sealant factory applied along female edge.
- D. Anchor clips: 16 gauge aluminized steel. To be one piece with positioning legs to hold adjacent panel secure. Clips to have projecting legs for additional panel alignment and provision to allow three (3) inches of thermal movement each direction long the longitudinal dimension.
- E. Fasteners: Screws holding anchor clips into structure to be #14 stainless steel sheet metal screws. Exposed fasteners to be stainless steel waterproofed with a neoprene washer minimum #14 size.
- F. Finish: Galvalume coating, 20-year warranty.

2.04 METAL WALL PANELS

- A. Manufacturer's "Architectural Panel" with concealed fasteners.
- B. Panel:
 - 1. 26 gauge galvanized steel.
 - 2. Zinc coating per ASTM A446, Grade D. G90.
 - 3. 36 inch nominal width.
- C. Ribs:
 - 1. Major ribs at 18" center to center, 2" high.
 - 2. Intermediate low profile ribs.
- D. Cover Strip: All fasteners to be concealed with a continuous cover strip. Cover strip to be a snap-on type and secured with a retainer clip at each wall panel fastener.
- E. Fasteners: 14 gauge x 3/4" stainless steel sheet metal screw with neoprene washer.
- F. Finish: Factory applied baked enamel, 5-year warranty. Color to be selected from manufacturer's entire color range available.

2.05 GUTTERS AND DOWNSPOUTS

- A. Manufacturer's standard gutter profile; size to properly discharge roof storm drainage.
- B. Manufacturer's standard gutter profile; size to properly discharge roof storm drainage.
- C. Color to be selected from manufacturer's entire color range available.

PROJECT NO. 24-179.000 Harrison REMC - Addition and Renovation Harrison REMC

PRE-ENGINEERED METAL BUILDING SYSTEM 13 3419.02 - 4 04/24/2025

PART 3 - EXECUTION

3.01 FIELD MEASUREMENT & COORDINATION

A. The contractor is responsible for obtaining all necessary field measurements at the job site and will be held responsible for their accuracy and for the accurate fitting of this work with the work of others.

3.02 ERECTION OF PRIMARY STRUCTURE

A. Refer to Section 13 3419.01 for requirements.

3.03 ROOFING AND SIDING INSTALLATION

A. Arrange and nest sidelap joints so that prevailing winds blow over, not into, lapped joints. Lap ribbed or fluted sheets one full rib corrugation. Apply panels and associated items for neat and weather-tight enclosure. Avoid "panel creep" or application not true to line. Protect factory finishes from damage. Provide weather seal under ridge cap; flash and seal roof panels at eave and rake with rubber, neoprene or other closures to exclude weather.

B. Roof Sheets:

- Provide sealant at lapped joints of roof sheets and between roof sheeting and protruding equipment, vents and accessories. Apply sealant tape continuous to clean, dry surface of weather side of fastenings on end laps and on sidelaps of corrugated or nesting type, ribbed or fluted panels and elsewhere to make weatherproof to driving rains.
- 2. Seaming of standing seam roofs shall be done with an electrically operating seaming machine. Finished joint shall be a double fold.
- 3. Install screw fasteners with power tool having controlled torque adjusted to compress neoprene washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.

C. Wall Sheets:

- 1. Apply elastomeric sealant continuous between metal base channel (sill angle) and concrete and elsewhere as necessary for waterproofing. Handle and apply sealant and back-up in accordance with sealant manufacturer's recommendations.
- 2. Align bottom of wall panels and fasten panels with blind rivets, bolts or self-tapping screws. Fasten flashing, trim around openings, etc. with self-tapping screws; fasten window and door frames with welding or bolts. When building height requires two rows of panels at gable ends, align lap of gable panels over wall panels at eave height.
- 3. Install screw fasteners with power tool having controlled torque adjusted to compress neoprene washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
- D. Install thermal insulation specified in Section 07 2100 in accordance with manufacturer's published directions, performed concurrently with installation of roof and wall panels. Install blankets straight and true in one-piece length and both set of tabs sealed to provide a complete vapor barrier. Install retainer strips at each longitudinal joint straight and taut, nesting with roof rib to hold insulation in place.

PROJECT NO. 24-179.000 Harrison REMC - Addition and Renovation Harrison REMC

PRE-ENGINEERED METAL BUILDING SYSTEM 13 3419.02 - 5 04/24/2025

SUBMITTAL CHECK LIST

- 1. Shop Drawings with Engineer Certification
- 2. Finish warranties

END OF SECTION 13 3419

General Provisions 20 0100 - 1 04/24/2025

SECTION 20 0100 - GENERAL PROVISIONS - MECHANICAL

PART 1 – GENERAL:

- 1.1 The Advertisement for Bid, Instructions to Bidders, Bidding Requirements, General, Special and Supplementary Conditions, and all other Contract Documents shall apply to the Contractor's work as well as to each of their Sub-Contractor's work.
- All manufacturers, suppliers, fabricators, contractors, etc. submitting proposals for any part of the work, services, materials, or equipment to be used on or applied to this project are hereby directed to familiarize themselves with the Contract Documents. In case of conflict between these General Provisions and the General and/or Special Conditions, the Contractor shall contact the Engineer for clarification and final determination prior to the Bid.
- 1.3 The work included in this Division consists of the furnishing of all labor, equipment, transportation, excavation, backfill, supplies, material, appurtenances, and services necessary for the satisfactory installation of the complete and operating Mechanical Systems indicated or specified in the Contract Documents.
- 1.4 Any materials, labor, equipment, or services not mentioned specifically herein which may be necessary to complete any part of the Mechanical Systems in a substantial manner, in compliance with the requirements stated, implied, or intended in the Plans and/or Specifications, shall be included in the Bid as part of this Contract.
- 1.5 It is not the intent of this Section of the Specifications to make any Contractor, other than the General Contractor, responsible to the Owner. All transactions such as submittal of shop drawings, claims for extra costs, requests for equipment or materials substitution, shall be routed through the General Contractor to the Architect, then to the Engineer. Also, this Section of the Specifications shall not be construed as an attempt to arbitrarily assign responsibility of work, material, equipment or services to a particular trade or Contractor. Unless stated otherwise, the subdivision and assignment of work under the various sections shall be optional.
- The Architect and Engineer do not define the scope of individual trades, subcontractors, material suppliers and vendors. Any sheet numbering system or specification numbering system used which identifies disciplines is solely for the Architect and Engineer's convenience and is not intended to define a subcontractor's scope of work. Information regarding individual trades, subcontractors, material suppliers and vendors may be detailed, described, and indicated at different locations throughout the Contract Documents. No consideration will be given to requests for change orders for failure to obtain and review the complete set of Contract Documents when preparing Bids, prices, and quotations. Unless stated otherwise, the subdivision and assignment of work under the various sections shall be the responsibility of the Contractor holding the prime contract.
- 1.7 It is the intent of the Contract Documents to deliver to the Owner a new, complete, and operational project once the work is complete. Although Plans and Specifications are complete to the extent possible, it shall be the responsibility of the Contractors involved to remove and/or relocate or re-attach any existing or new systems which interfere with new equipment or materials required for the complete installation without additional cost to the Owner.

- 1.8 In general, all work shall be accomplished without interruption of existing facilities operations. The Contractor shall advise the Owner at least seven (7) days prior to the interruption of any services (gas, domestic water, heating, etc.). The Owner shall be advised of the exact time that interruption will occur and the length of time the interruption will last. Failure to comply with this requirement may result in complete work stoppage for the Contractors involved until a complete schedule of interruptions can be developed.
- 1.9 Whenever utilities are interrupted, either deliberately or accidentally, the Contractor shall work continuously to restore said service. The Contractor shall provide tools, materials, skilled journeymen of Bidder/Proposer's own and other trades as necessary, premium time as needed and coordination with all applicable utilities, including payment of utility company charges (if any), all without requests for extra compensation from the Owner.
- 1.10 Each Bidder/Proposer shall also be governed by any unit prices and Addenda insofar as they may affect part of their work or services.

1.11 DEFINITIONS AND ABBREVIATIONS:

- Contractor Any Contractor whether bidding, proposing, or working independently or under the supervision of a General Contractor, Prime Contractor, Construction Manager and who installs any type of Mechanical Work as specified in the Contract Documents or, the General Contractor.
- Engineer The Consulting Mechanical-Electrical Engineer either consulting to the Owner, Architect, or Other, etc. In this case: CMTA, Inc., Consulting Engineers.
- Architect The Architect of Record for the project.
- Contract Documents All documents pertinent to the quality and quantity of work to be performed on this project. Includes, but not limited to: Plans, Specifications, Instructions to Bidders, General and Special Conditions, Addenda, Alternates, Lists of Materials, Lists of Sub-Contractors, Unit Prices, Shop Drawings, Field Orders, Change Orders, Cost Breakdowns, Schedules of Value, Periodical Payment Requests, Construction Contract with Owner, etc.
- Bidder/Proposer Any person, agency or entity submitting a proposal to any person, agency, or entity for any part of the work required under this contract.
- The Project All of the work required under this Contract.
- Furnish Deliver to the site in good condition and turn over to the Contractor who is to install.
- Provide Furnish and install complete, tested, and ready for operation.
- Install Receive and place in satisfactory operation.
- Indicated Listed in the Specifications, shown on the Plans or Addenda thereto.
- Typical or Typ.- Where indicated repeat this work, method or means each time the same or similar condition occurs whether indicated or not.
- ADA Americans with Disabilities Act.
- ANSI American National Standards Institute.
- ASHRAE American Society of Heating, Refrigeration and Air Conditioning Engineers.
- ASME American Society of Mechanical Engineers.
- IBC International Building Code.
- NEC National Electrical Code.
- NEMA National Electrical Manufacturers Association.
- NFPA National Fire Protection Association.
- OSHA Office of Safety and Health Administration.
- SMACNA Sheet Metal and Air Conditioning Contractors National Association.
- UL Underwriters Laboratories.

General Provisions 20 0100 - 3 04/24/2025

PART 2 – INTENT AND INTERPRETATION:

- 2.1 It is the intention of the Contract Documents to call for a complete and operational system, including all components, accessories, finish work, etc as necessary for trouble free operation, tested and ready for operation. Anything that may be required, implied, or inferred by the Contract Documents shall be provided and included as part of the Bid.
- 2.2 All Contractors and Vendors providing a bid for this project shall review the Plans and Specifications and determine any modifications and/or adjustments necessary relative to the proposed equipment and materials with specific manufacturer's installation requirements. Include in the bid any necessary installation methods, features, options, accessories, etc. necessary to install the proposed equipment and materials, regardless of whether used as basis of design or being offered as a substitution in accordance with the specific manufacturer's installation requirements whether specifically detailed or not within the Plans and Specifications.
- 2.3 Details not usually shown or specified, but necessary for the proper installation and operation of systems, equipment, materials, etc., shall be included in the work, the same as if herein specified or indicated.
- 2.4 The Bidder/Proposer shall completely review the Contract Documents. Any interpretation as to design intent or scope shall be provided by the Engineer / Architect. Should an interpretation be required, the Bidder/Proposer shall request a clarification not less than ten (10) days prior to the submission of the proposal so that the condition may be clarified by Addendum. In the event of any conflict, discrepancy, or inconsistency develops; the interpretation of the Engineer shall be final.
- 2.5 The Contractor shall give written notice of any materials or apparatus believed inadequate or unsuitable; in violation of laws, ordinances, rules or regulations of authorities having jurisdiction; and any necessary items of work omitted a minimum of ten (10) days prior to bid. In the absence of such written notice and by the act of submitting a bid, it shall be understood that the Contractor has included the cost of all required items in the bid, and that will be responsible for the approved satisfactory functioning of the entire system without extra compensations.

PART 3 – INDEMNIFICATION:

3.1 The Contractor shall hold harmless and indemnify the Engineer, employees, officers, agents and consultants from all claims, loss, damage, actions, causes of actions, expense and/or liability resulting from, brought for, or on account of any personal injury or property damage received or sustained by any person, persons, (including third parties), or any property growing out of, occurring, or attributable to any work performed under or related to this contract, resulting in whole or in part from the negligence of the Contractor, any subcontractor, any employee, agent or representative.

PART 4 – PLANS AND SPECIFICATIONS:

4.1 The Plans are diagrammatic only and indicate the general arrangement of the systems and are to be followed. If deviations from the layouts are necessitated by field conditions, detailed layouts of the proposed departures shall be submitted to the Engineer for approval before proceeding with the work. The Plans are not intended to show every item which may be necessary to complete the systems. All Bidder/Proposers shall anticipate that additional items may be required and submit their Bid accordingly.

- 4.2 The Plans and Specifications are intended to supplement each other. No Bidder/Proposer shall take advantage of conflict between them, or between parts of either. Should this condition exist, the Bidder/Proposer shall request a clarification not less than ten (10) days prior to the submission of the proposal so that the condition may be clarified by Addendum. In the event that such a condition arises after work is started, the interpretation of the Engineer shall be final.
- 4.3 The Plans and Specifications shall be considered to be cooperative and anything appearing in the Specifications which may not be indicated on the Plans or conversely, shall be considered as part of the Contract and must be executed the same as though indicated by both.
- 4.4 Contractor shall make all of their own measurements in the field and shall be responsible for correct fitting. The work shall be coordinated with all other branches of work in such a manner as to cause a minimum of conflict or delay.
- The Engineer shall reserve the right to make adjustments in location of piping, ductwork, equipment, etc. where such adjustments are in the interest of improving the project.
- 4.6 Should conflict, overlap or duplication of work between the various trades become evident, this shall be called to the attention of the Engineer. In such event neither trade shall assume to be relieved of the work which is specified under their branch until instructions in writing are received from the Engineer.
- 4.7 Unless dimensioned, the Plans only indicate approximate locations of equipment, piping, ductwork, etc. Dimensions given in figures on the Plans shall take precedence over scaled dimensions and all dimensions, whether given in figures or scaled, shall be verified in the field to ensure no conflict with other work.
- 4.8 Each Bidder/Proposer shall review all Plans in the Contract Documents to ensure that the work they intend to provide does not create a conflict with or affect the work of others in any way. Where such effect does occur, it shall be the Bidder/Proposer's responsibility to satisfactorily eliminate any such conflict or effect prior to the submission of their proposal. Each Bidder/Proposer shall in particular ensure that there is adequate space to install their equipment and materials. Failure to do so shall result in the correction of such encroachment conflict or effect of any work awarded the Bidder/Proposer and shall be accomplished fully without expense to others and that they are reasonably accessible for maintenance. Check closely all mechanical and electrical closets, chases, ceiling voids, wall voids, crawl spaces, etc., to ensure adequate spaces.
- 4.9 Where on the Plans a portion of the work is drawn out and the remainder is indicated in outline, or not indicated at all, the parts drawn out shall apply to all other like portions of the work. Where ornamentation or other detail is indicated by starting only, such detail shall be continued throughout the courses or parts in which it occurs and shall also apply to all other similar parts of the work, unless otherwise indicated.
- 4.10 Details not usually shown or specified, but necessary for the proper installation and operation of systems, equipment, materials, etc., shall be included in the work, the same as if herein specified or indicated.
- 4.11 Where within the Contract Documents the word "typical" or "typ." is used, it shall mean that the work method or means indicated as typical shall be repeated in and each time it occurs whether indicated or not.

General Provisions 20 0100 - 5 04/24/2025

4.12 Each Contractor shall evaluate ceiling heights specified on Architectural Plans. Where the location of equipment or systems may interfere with ceiling heights or maintenance and access of equipment or systems, the Contractor shall call this to the attention of the Engineer in writing prior to making the installation. Do not install equipment or systems in the affected area until the conflict is resolved. Any such changes shall be anticipated and requested sufficiently in advance so as to not cause extra work or cost incurred on the part of the Contractor or unduly delay the work.

PART 5 - EXAMINATION OF SITE AND CONDITIONS:

- 5.1 Each Bidder/Proposer shall inform themselves of all of the conditions under which the work is to be performed, the site of the work, the structure of the ground, above and below grade, the obstacles that may be encountered, the availability and location of necessary facilities and all relevant matters concerning the work.
- 5.2 Each Bidder/Proposer shall also fully acquaint themselves with all existing conditions as to ingress and egress, distance of haul from supply points, routes for transportation of materials, facilities and services, availability of utilities, etc. A proposal shall cover all expenses or disbursements in connection with such matters and conditions. No allowance will be made for lack of knowledge concerning such conditions after Bids are accepted.

PART 6 - EQUIPMENT AND MATERIALS SUBSTITUTIONS OR DEVIATIONS:

- When any Contractor requests approval of materials and/or equipment of different physical size, weight, capacity, function, color, access, then the design allows for it shall be understood that such substitution, if approved, will be made without additional cost to anyone other than the Contractor requesting the change regardless of changes in connections, space requirements, electrical characteristics, etc. from that indicated, electrical service, etc. In all cases where substitutions affect other trades, the Contractor requesting such substitutions shall advise all such Contractors of the change and shall compensate them for all necessary changes in their work. Any Plans, Specifications, Diagrams, etc., required to describe and coordinate such substitutions or deviations shall be professionally prepared at the responsible Contractor's expense. Review of Shop Drawings by the Engineer does not in any way absolve the Contractor of this responsibility.
- Notwithstanding any reference in the Specifications to any article, device, product, material, fixture, form, or type of construction by name, make or catalog number, such reference shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition; any devices, products, materials, fixtures, forms, or types of construction which, in the judgment of the Engineer, are equivalent to those specified are acceptable, provided the provisions of this Part are met. Requested substitutions shall be submitted to the Engineer a minimum of ten (10) days prior to Bid. If this procedure is not followed, the substitution will be rejected. If prevailing laws of cities, towns, states or countries are more stringent than these specifications regarding such substitutions, then those laws shall prevail over these requirements.
- 6.3 Wherever any equipment and material are specified exclusively only such items shall be used unless substitution is accepted in writing by the Engineer.
- Each Bidder/Proposer shall furnish along with their proposal a list of specified equipment and materials which is to be provided. Where several makes are mentioned in the Specifications and the Contractor fails to state which, they propose to furnish, the Engineer shall choose any of the makes mentioned without change in price. Inclusion in this list shall not ensure that the Engineer will approve shop drawings unless

General Provisions 20 0100 - 6 04/24/2025

the equipment, materials, etc., submitted in shop drawings are satisfactorily comparable to the items specified and/or indicated.

PART 7 – CODES, RULES, PERMITS, FEES, INSPECTIONS, REGULATIONS, ETC.:

- 7.1 The Contractor shall give all necessary notices, obtain, and pay for all permits, government sales taxes, fees, inspections, and other costs, including all utility connections, meters, meter settings, taps, tap fees, extensions, etc. in connection with their work. They shall also file all necessary plans, prepare all documents, and obtain all necessary approvals of all governmental departments and/or the appropriate municipality or utility company having jurisdiction, whether indicated or specified or not. They shall also obtain all required certificates of inspection for their work and deliver same to the Engineer before request for acceptance and final payment for the work.
- 7.2 Ignorance of Codes, Rules, regulations, utility company requirements, laws, etc., shall not diminish or absolve Contractor's responsibilities to provide and complete all work in compliance with such.
- 7.3 The Contractor shall include in their work, without extra cost, any labor, materials, services, apparatus, and Plans in order to comply with all applicable laws, ordinances, rules, and regulations, whether or not indicated or specified.
- 7.4 All materials furnished and all work installed shall comply with the National Fire Codes of the National Fire Protection Association, with the requirements of local utility companies, or municipalities and with the requirements of all governmental agencies having jurisdiction.
- 7.5 All materials and equipment so indicated and all equipment and materials for the electrical portion of the mechanical systems shall bear the approval label of or shall be listed by the Underwriters' Laboratories (UL), Incorporated. Each packaged assembly shall be approved as a package. Approval of components of a package shall not be acceptable.
- 7.6 All plumbing work is to be constructed and installed in accordance with applicable codes, Plans and Specifications which have been approved in their entirety and/or reflect any changes requested by the Authority Having Jurisdiction. Plumbing work shall not commence until such Plans are in the possession of the Plumbing Contractor.
- 7.7 All Heating, Ventilation and Air Conditioning work shall be accomplished in accordance with the Building Code and amendments thereto, the latest standards recognized by the American Society of Heating, Refrigerating and Air Conditioning and the National Fire Protection Association.
- 7.8 The Contractor shall furnish three (3) copies of all Final Inspection Certificates obtained to the Engineer when work is complete. Final payment for work will be contingent upon compliance with this requirement.
- 7.9 Where minimum code requirements are exceeded in the Design, the Design shall govern.
- 7.10 The Contractor shall ensure that their work is accomplished in accord with the OSHA Standards and that they conduct their work and the work of their personnel in accord with same.
- 7.11 All work relating to the handicapped shall be in accord with regulations currently enforced by the Authority Having Jurisdiction and the American Disabilities Act.

- 7.12 All work in relation to domestic water systems shall, in addition to all other Codes, Rules, Regulations and Standards, be in compliance with the requirements of the local water utility company.
- 7.13 All work in relation to the installation of sanitary or storm sewers shall, in addition to all other Codes, Rules, Regulations and Standards, be in compliance with the local agency governing such installations.
- 7.14 Discharge of any toxic, odorous, or otherwise noxious materials into the atmosphere or any system shall be subject to regulations of the Environmental Protection Agency (EPA) and/or the air pollution control commission. If in doubt, contact the State Department for Environmental Protection.
- 7.15 Where conflict arises between any code and the Plans and/or Specifications, the code shall apply except in the instance where the Plans and Specifications exceed the requirements of the code. Any changes required as a result of these conflicts shall be brought to the attention of the Engineer at least ten (10) days prior to bid date, otherwise the Contractor shall make the required changes at their own expense.

PART 8 – QUALIFICATIONS OF CONTRACTOR/WORKERS:

- 8.1 All Mechanical Contractors and their subcontractors bidding this project must have been a licensed company for a minimum of three (3) years to qualify to Bid this project. Individual employee experience does not supersede this requirement.
- 8.2 All mechanical subcontractors bidding the mechanical work must have completed one project of 70% this subcontract cost size and two projects of 50% this subcontract cost size.
- All mechanical work shall be accomplished by qualified workers competent in the area of work for which they are responsible. Untrained and incompetent workers, as evidenced by their workmanship, shall be summarily relieved of their responsibilities in areas of incompetency. The Engineer shall reserve the right to determine the quality of workmanship of any workers and unqualified or incompetent workers shall refrain from work in areas not deemed satisfactory. Requests for relief of workers shall be made through the normal channels of Architect, Contractor, etc.
- The Contractor shall hold all required licenses in the State which the work is to be performed.
- 8.5 All plumbing work shall be accomplished by Journeymen Plumbers under the direct supervision of a Master Plumber as defined under State Plumbing Law Regulations and Code. Proof and Certification may be requested by the Engineer.
- The installation of all Heating, Ventilating and Air-Conditioning Systems (HVAC) by any Contractor, whether in existing or new building construction shall be performed by a Licensed Master HVAC Contractor. This includes any Contractor installing HVAC systems, piping, and ductwork.
- 8.7 All sheet metal, insulation and pipe fitting work shall be installed by workers normally engaged in this type work.
- 8.8 All automatic control systems shall be installed by workers normally engaged or employed in this type work, except in the case of minor control requirements (residential type furnaces, packaged HVAC equipment with integral controls, etc.) in which case, if a competent worker is the employee of this Contractor, the worker may be utilized subject to review of their qualifications by the Engineer and after written approval from same.

- 8.9 All special systems (Medical Gases, Automatic Sprinkler Equipment, etc.) shall be installed only by workers normally engaged in such services. Exception to this specification may only be made in writing by the Engineer.
- 8.10 All electrical work shall be accomplished by Licensed Journeymen electricians under the direct supervision of a licensed Electrician. All applicable codes, utility company regulations, laws and permitting authority of the locality shall be fully complied with by the Contractor.

PART 9 - SUPERVISION OF WORK:

9.1 The Contractor shall personally supervise the work for which they are responsible or have a competent superintendent, approved by the Engineer, on the work at all times during progress with full authority to act on behalf of the Contractor.

PART 10 – CONDUCT OF WORKERS:

10.1 The Contractor shall be responsible for the conduct of all workers under their supervision. Misconduct on the part of any worker to the extent of creating a safety hazard, or endangering the lives and property of others, shall result in the prompt removal of that worker. The consumption of alcoholic beverages or other intoxicants, narcotics, barbiturates, hallucinogens, or rehabilitating drugs on the job site is strictly forbidden.

PART 11 - COOPERATION AND COORDINATION WITH OTHER TRADES:

- 11.1 The Contractor shall give full cooperation to all other trades and shall furnish in writing with copies to the Engineer, any information necessary to permit the work of other trades to be installed satisfactorily and with the least possible interference or delay.
- Where any work is to be installed in close proximity to, or will interfere with work of other trades, each shall cooperate in working out space conditions to make a satisfactory adjustment. If so, directed by the Engineer, the Contractor shall prepare composite working drawings and sections at a suitable scale not less than 1/4" = 1'-0", clearly indicating how their work is to be installed in relation to the work of other trades, or so as not to cause any interference with work of other trades. Make the necessary changes in the work to correct the condition without extra charge.
- The Contractor shall furnish to other trades, as required, all necessary templates, patterns, setting plans, and shop details for the proper installation of work and for the purpose of coordinating adjacent work.

PART 12 – GUARANTEES AND WARRANTIES:

12.1 The Contractor shall guarantee all equipment, apparatus, materials, and workmanship entering into their Contract to the best of its respective kind and shall replace all parts at their own expense, which are proven defective within the time frame outlined in the General Conditions of the Contract. The effective date of completion of the work shall be the date of the Project's Statement of Substantial Completion. Items of equipment which have longer guarantees, as called for in these Specifications, shall have warranties and guarantees completed in order, and shall be in effect at the time of final acceptance of the work by the Engineer. The Contractor shall present the Engineer with such warranties and guarantees at the time of final acceptance of the work. The Engineer shall then submit these warranties, etc. to the Owner. The Owner reserves the right to use equipment installed by the Contractor prior to date of final acceptance. Such use of equipment shall not invalidate the guarantee except that the Owner shall be liable for any

- damage to equipment during this period, due to negligence of their operator or other employees. Refer to other sections for any special or extra warranty requirements.
- 12.2 All compressors shall have five year warranty. (1st year parts and labor, 2nd thru 5th year compressor parts only).
- 12.3 All VFD's shall have a two year warranty. (Parts and Labor).
- 12.4 Provide all warranty certificates to Owner. All warranties begin starting at the substantial completion date, submit warranty certificates accordingly.

PART 13 - COST BREAKDOWNS (SCHEDULE OF VALUES):

Within thirty (30) days after acceptance of the Contract, the Contractor shall furnish to the Engineer, one copy of a detailed cost breakdown on each respective area of work. These cost breakdowns shall be made in a format approved by the Engineer. Payments will not be made until satisfactory cost breakdowns are submitted.

PART 14 – CHANGES IN MECHANICAL WORK:

14.1 REFER TO GENERAL AND SPECIAL CONDITIONS.

PART 15 – CLAIMS FOR EXTRA COST:

15.1 REFER TO GENERAL AND SPECIAL CONDITIONS.

PART 16 - MATERIALS AND WORKMANSHIP:

- All equipment, materials and articles incorporated in the work shall be new and of comparable quality to that specified. Each Bidder/Proposer shall determine that the materials and/or equipment they propose to furnish can be brought into the building(s) and installed within the space available. In certain cases, it may be necessary to remove and replace walls, floors and/or ceilings and/or disassemble/reassemble the materials and equipment and this work shall be the responsibility of the Contractor, whether specifically initiated or not.
- All equipment shall be installed so that all parts are readily accessible for inspection, maintenance, replacement of fans, motors, coils, filters, etc. Extra compensation will not be allowed for relocation of equipment for accessibility or for dismantling equipment to obtain entrance into the building(s). Ensure, through coordination that no other Contractor seals off access to space required for equipment materials, etc.
- 16.3 Materials and equipment shall bear Underwriters' Laboratories label where such a standard has been established, where applicable.
- 16.4 Each length of pipe, fitting, trap, fixture, and device used in the plumbing or drainage systems shall be stamped or indelibly marked with the weight or quality thereof and with the manufacturer's mark or name.
- All equipment shall bear the manufacturer's name and address. All electrically operated equipment shall bear a name plate indicating required horsepower, voltage, phase, and ampacity. Pumps and fans shall have a data plate indicating horsepower, pressure, and flow rate.

PART 17 - HAZARDOUS MATERIALS:

17.1 No asbestos or mercury containing materials shall be installed in this project.

PART 18 - TEMPORARY SERVICES:

- 18.1 The Contractor shall arrange any temporary water, electrical and other services which may be required to accomplish the work. Refer also to General and Special Conditions.
- 18.2 All temporary services shall be removed by Contractor prior to completion of work.

PART 19 - SURVEY, MEASUREMENTS AND GRADE:

- 19.1 The Contractor shall lay out their work and be responsible for all necessary lines, levels, inverts, elevations, and measurements. The Contractor must verify the figures shown on the Plans before laying out the work and will be held responsible for any error resulting from failure to do so.
- 19.2 The Contractor shall base all measurements, both horizontal and vertical from established benchmarks. All work shall agree with these established lines and levels. Verify all measurements at the site and check the correctness of same as related to the work.
- 19.3 Should the Contractor discover any discrepancy between actual measurements and those indicated which prevents following good practice or the intent of the contract documents, the Contractor shall promptly notify the Engineer and shall not proceed with this work until the Contractor has received instructions from the Engineer on the disposition of the work.

PART 20 - PROTECTION OF EQUIPMENT:

20.1 The Contractor shall be entirely responsible for all material and equipment they furnish in connection with their work and special care shall be taken to properly protect all parts thereof from damage during the construction period. Such protection shall be by a means acceptable to the Engineer. All piping, etc., shall be properly plugged or capped during construction in a manner approved by the Engineer. Equipment damaged, stolen, or vandalized while stored on site, either before or after installation, shall be repaired or replaced by the Contractor at their expense. All ductwork with open ends shall be covered with plastic during construction.

PART 21 – REQUIRED CLEARANCES FOR ELECTRICAL EQUIPMENT:

21.1 The NEC has specific required clearances above, in front, and around electrical gear, panels etc. The Contractor shall not install any piping, ductwork, etc., in the required clearance. If any appurtenance is located in the NEC required clearance, it shall be relocated at no additional cost. Coordinate with the Electrical Contractor prior to any work.

PART 22 - EQUIPMENT SUPPORT:

22.1 Each piece of equipment, apparatus, piping, or conduit suspended from the ceiling or mounted above the floor level shall be provided with suitable structural support, pipe stand, platform, or carrier in accordance with the best recognized practice. Such supporting or mounting means shall be provided by the Contractor for all equipment and piping. Exercise extreme care that structural members of building are not overloaded

General Provisions 20 0100 - 11 04/24/2025

by such equipment. Provide any required additional bracing, cross members, angles, support, etc. Do not support items from roof/floor deck or bridging.

PART 23 - DUCT AND PIPE MOUNTING HEIGHTS:

All exposed or concealed ductwork, piping, etc., shall be held as high as possible unless otherwise noted and coordinated with all other trades. Exposed piping and ductwork shall, insofar as possible, run perpendicular or parallel to the building structure. Refer to Plans for minimum heights of ducts and piping. Minimum height above ceilings shall be 6" clear including insulation, unless otherwise noted.

PART 24 – BROKEN LINES AND PROTECTION AGAINST FREEZING:

24.1 No conduits, piping, etc. carrying water or any other fluid subject to freezing shall be installed in any part of the building where danger of freezing may exist without adequate protection being given by the Contractor whether or not insulation is specified or indicated on the particular piping. All damages resulting from broken and/or leaking lines shall be replaced or repaired at the Contractor's own expense. Do not install piping across or near openings to the outside whether or not they are carrying static or moving fluids. Insulation on piping does not necessarily ensure that freezing will not occur. If in doubt, contact the Engineer.

PART 25 – WEATHERPROOFING:

- Where any work pierces waterproofing including waterproof concrete, the method of installation shall be as specified and approved by the Architect and Engineer before work is performed. The Contractor shall furnish all necessary sleeves, caulking and flashing required to make openings permanently watertight.
- Wherever work penetrates roofing, it shall be done in a manner that will not diminish or void the roofing guarantee or warranty in any way. Coordinate all such work with the roofing installer.

PART 26 - FINAL CONNECTIONS TO EQUIPMENT:

26.1 The Contractor shall finally connect mechanical services (water, sanitary, gas, air, etc.), to any terminal equipment, appliances, kitchen equipment, etc., provided under this and/or other divisions of the work. Various equipment connections indicated are based upon "basis of design" equipment selections. Should alternate equipment be purchased by the General Contractor, then this Contractor shall make the necessary provisions in the Bid for any and all differences. Change Orders shall not be considered for any differences due to alternate equipment purchase. Such connections shall be made in strict accord with current codes, safety regulations and the equipment manufacturer's recommendations. If in doubt, contact the Engineer prior to installation.

PART 27 – ACCESSIBILITY:

- 27.1 The Contractor shall be responsible for the sufficiency of the size of shafts and chases, the adequate clearance in double partitions and ceilings for the proper installation of their work. They shall cooperate with all others whose work is in the same space. Such spaces and clearances shall, however, be kept to the minimum size required.
- 27.2 The Contractor shall locate and install all equipment so that it may be serviced and maintained as recommended by the manufacturer. Allow ready access and removal of the entire unit and/or parts such as valves, filters, fan belts, motors, prime shafts, controls, coils, etc.

27.3 Whether shown on the Plans or not, the Contractor shall provide in the Bid access panels for each concealed shut-off valve, motorized control damper, manual air damper or other device requiring service as shown on Engineer's Plans or as required. Locations of these panels shall be identified in sufficient time to be installed in the normal course of work. Change orders for access panels will not be accepted.

PART 28 – SCAFFOLDING, RIGGING AND HOISTING:

28.1 The Contractor shall furnish all scaffolding, rigging, hoisting and services necessary for erection and delivery onto the premises of any equipment and apparatus furnished. All such temporary appurtenances shall be set up in strict accord with OSHA Standards and Requirements. Remove same from premises when no longer required.

PART 29 – CONCRETE WORK:

- 29.1 The Contractor shall be responsible for the provisions of all concrete work required for the installation of any of their systems or equipment. The Contractor may, at their option, arrange with the others to provide the work. This option, however, will not relieve the Contractor of their responsibilities relative to dimensions, quality of workmanship, locations, etc.
- 29.2 In the absence of other concrete Specifications, all concrete related to Mechanical work shall be 3500 psi minimum compression strength at 28 days curing, slump: 4" ± 1", air entrainment 4.5% water to cement ratio 0.5 and shall conform to the standards of the American Concrete Institute Publication AC1-318. Heavy equipment shall not be installed on pads for at least seven (7) days after pour.
- All concrete pads shall be complete with all pipe sleeves, anchor bolts, reinforcing steel, concrete, etc. as required. Pads larger than 18" in width shall be reinforced with ½" deformed round bars on 6" centers both ways. Bars shall be approximately 2" above the bottom of the pad. All parts of pads and foundations shall be properly rodded or vibrated. If exposed parts of the pads and foundations are rough or show honeycomb after removing forms, all surfaces shall be rubbed to a smooth surface. Chamfer all vertical edges ¾" and tool horizontal edges with ¾" radius.
- 29.4 In general, unless otherwise noted, concrete pads for equipment shall be 4" thick, extend six (6) inches beyond the equipment's base dimensions. Where necessary, extend pads 30 inches beyond base or overall dimensions to allow walking and servicing space. Insert 6-inch steel dowel rods into new and existing floors to anchor pads.
- 29.5 Exterior concrete pads shall be 8" thick with four (4) inches minimum above grade and four (4) inches below grade on a compacted four (4) inch dense grade rock base unless otherwise indicated or specified. Surfaces of all foundations and bases shall have a smooth finish with one-half (½) inch chamfer on exposed edges. Turn down edges 18" below grade.

PART 30 - RESTORATION OF NEW OR EXISTING LANDSCAPING. PAVING. SURFACES. ETC.:

30.1 The Contractor shall at their expense restore to their original conditions all paving, curbing, surfaces, drainage ditches, structures, fences, landscaping, existing or new building surfaces and appurtenances, and any other items damaged or removed by their operations. Replacement and repairs shall be in accordance with good construction practice; by qualified tradesman and shall match materials employed in the original construction of the item and shall be to the satisfaction of the Owner and/or Engineer.

PART 31 - MAINTENANCE OF EXISTING UTILITIES AND LINES:

- The locations of all piping, conduits, cables, utilities, and manholes existing, or otherwise, that comes within the contract construction site, shall be subject to continuous uninterrupted service with no other exception than the Owner of the utilities permission to interrupt same temporarily. Provide a seven (7) day written notice to Engineer, Architect and Owner prior to interrupting any utility service or line.
- 31.2 Known utilities and lines as available to the Engineer are shown on the Plans. However, it is additionally required that, prior to any excavation being performed, each Contractor ascertain and mark all utilities or lines that would be endangered by the excavation. Hand dig if required to locate. Contractor shall bear costs of repairing damaged utilities.
- 31.3 If utilities or lines occur in the earth within the construction site, the Contractor shall probe and locate the lines prior to machine excavation in the respective area. Hand dig if required to locate.
- Cutting into existing utilities and services shall be performed in coordination with and as designated by the Owner of the utility. The Contractor shall work continuously to restore service(s) upon deliberate or accidental interruption, providing premium time and materials as needed without extra claim to the Owner.
- The Contractor shall repair to the satisfaction of the Owner and Engineer, any surfaces or subsurface improvements damaged during the course of the work, unless such improvement is shown to be abandoned or removed.
- 31.6 Machine excavation shall not be permitted with ten feet of gas lines, fuel lines, electrical lines or lines carrying combustible and/or explosive materials. Hand excavate only in accord with utility company, agency or other applicable laws, standards or regulations.
- Protect all new or existing lines from damage by traffic, etc. during construction. Repairs or replacement of such damage shall be at the sole expense of the party responsible.
- Protect existing trees, indicated to remain with fencing or other approved method. Hold all new subsurface lines outside the drip line of trees, offsetting as necessary to protect root structures. Refer to planting or landscaping plans, or in their absence, consult with the Architect.

PART 32 - CLEANING:

- 32.1 The Contractor shall, at all times, keep the area of their work presentable to the public and clear from rubbish and debris caused by their operations; and at the completion of the work, they shall remove all rubbish, debris, all of their tools, equipment, temporary work and surplus materials from and about the premises, and shall leave the area clean and ready for use. If the Contractor does not attend to such cleaning upon request, the Engineer may cause cleaning to be done by others and charge the cost of same to the Contractor. The Contractor shall be responsible for all damage from fire which originates in, or is propagated by, accumulations of their rubbish or debris.
- After completion of all work and before final acceptance of the work, the Contractor shall thoroughly clean all equipment and materials and shall remove all foreign matter such as grease, dirt, plaster, labels, stickers, etc., from the exterior of piping, equipment, fixtures and all other associated or adjacent fabrication.

32.3 Ductwork and piping shall be kept clean at all times. Ductwork stored on the job site shall be placed a minimum of 4" above the floor and the open ends shall be completely covered in plastic. Open ends of installed ductwork shall be protected with plastic. Do not install the ductwork or insulation (pipe or duct) if the building is not "dried-in". The Owner/Engineer shall periodically inspect that these procedures are followed. If deemed unacceptable, the Contractor shall be required to clean the duct system utilizing a NADCA certified Contractor.

PART 33 - TEMPORARY USE OF EQUIPMENT:

- The permanent heating and plumbing equipment, when installed, may be used for temporary services, with the consent of the Engineer. Use of the permanent equipment shall be dependent upon the cleanliness of the job site as determined by Owner, Architect and Engineer. Should the permanent systems be used for this purpose the Contractors shall make all temporary connections required at their expense. They shall also make any replacement required due to damage wear and tear, etc., leaving the same in "as new" condition.
- Permission to use the permanent equipment does not relieve the Contractors from the responsibility for any damages to the building construction and/or equipment which might result because of its use.
- 33.3 Warranties shall begin at substantial completion regardless of temporary use of equipment or not.
- 33.4 A pre-start-up conference shall be held in accordance with EQUIPMENT/CONTROLS START-UP AND VERIFICATION in this section.
- 33.5 For Heat Pump Units during all phases of construction:
 - At a minimum, four complete sets of filter media are required for each unit. In each unit, install two sets
 of filter media during construction (more shall be required if construction activities dictate more frequent
 changes). In each unit, install one set of filter media at substantial completion. Leave one set of filter
 media in boxes in appropriate mechanical room as a spare set for the Owner. All other filters shall be
 used by the Contractor during construction. Dispose of all construction filter media.
 - On the outside of all exhaust air openings install a minimum of two sets of fiberglass filter media, such
 as cheesecloth, to be utilized as pre-filters for the "construction" filters. Install first set upon start-up and
 then install second set when first set is dirty. Dispose of all dirty construction filters. Change filters as
 often as necessary to keep units from becoming dirty at no additional cost.
 - At substantial completion of the project the entire unit shall be cleaned to present a like "new" unit for the Owner and all filters shall be replaced with new.
- 33.6 For Outside Air Units during all phases of construction:
 - These units shall not be used for temporary heating and cooling by the Contractor. They shall, however, be made operational, tested, etc. as specified during construction by the Contractor. Three complete sets of filters are required for each unit. In each unit, install one set of filters during construction. In each unit, install one set of filters at substantial completion. For each unit, leave third set of filters in boxes in appropriate mechanical room as a spare set for the Owner. Dispose of all construction filters.
 - At substantial completion of the project the entire unit shall be cleaned to present a like "new" unit for the Owner and all filters shall be replaced with new.

General Provisions 20 0100 - 15 04/24/2025

PART 34 – NOISE, VIBRATION OR OSCILLATION:

- 34.1 All work shall operate under all conditions of load without any sound or vibration which is objectionable in the opinion of the Engineer. In case of moving machinery, sound, or vibration noticeable outside of room in which it is installed, or annoyingly noticeable inside its own room, will be considered objectionable. Sound or vibration conditions considered objectionable by the Engineer shall be corrected in an approved manner by the Contractor at their expense.
- All equipment subject to vibration and/or oscillation shall be mounted on vibration supports whether indicated or not suitable for the purpose of minimizing noise and vibration transmission and shall be isolated from external connections such as piping, ducts, etc. by means of flexible connectors, vibration absorbers, or other approved means.
- Unitary equipment, such as room units, exhaust fans, etc., shall be rigidly braced and mounted to wall, floor or ceiling as required and tightly gasketed and sealed to mounting surface to prevent air leakage and to obtain quiet operation. Flush and surface mounted equipment such as diffusers, grilles, etc., shall be gasketed and affixed tightly to their mounting surface.
- 34.4 The Contractor shall provide supports for all equipment they furnish. Supports shall be liberally sized and adequate to carry the load of the equipment and the loads of attached equipment, piping, etc. All equipment shall be securely fastened to the structure either directly or indirectly through supporting members by means of bolts or equally effective means. If strength of supporting structural members is questionable, contact Engineer.

PART 35 – EQUIPMENT/CONTROLS STARTUP & VERIFICATION:

- The Contractor and their Subcontractors shall include in the bid to provide equipment and controls startup and verification for ALL Mechanical Systems specified for this project.
- A pre-start-up conference shall be held with the Architect, Engineer, Owner, General Contractor, Mechanical Contractor, Electrical Contractor, Controls Contractor, Test and Balance Contractor, and the Manufacturer's providing startup services. The purpose of this meeting will be to discuss the goals, procedures, etc. for start-up.
- 35.3 Specific line-items shall be included on the schedule of values by each Trade for "equipment and controls startup". These line-item values shall be approved by the Engineer. The Engineer, Owner and the Engineer's Field Inspector(s) shall closely monitor progress and quality of the equipment and controls startup and may withhold pay requests as deemed appropriate until satisfactorily completed.
- 35.4 Specific startup/verification specifications are included throughout the Mechanical Specifications. In general, as part of the verification process, equipment suppliers shall perform start-up by their factory authorized technicians, not third party Contractors, and shall complete and submit start-up reports/checklists. The Contractor shall have appropriate trades on site to correct all deficiencies noted by the factory representative. For each deficiency noted, documentation of corrective action (including date and time) shall be submitted to the Engineer and Owner. Where factory start-up is not specified for a particular piece of equipment or system, the Contractor shall be responsible to perform start-up. All information shall be completed by the Contractor and submitted to the Owner/Engineer prior to acceptance of the equipment.

- 35.5 The Contractor shall be responsible for completion of System Verification Checklists/Manufacturer's Checklists. Factory startup is required for all HVAC equipment noted. Unless noted otherwise, as part of the verification process, equipment suppliers shall perform start-up by their factory authorized technicians and shall complete and submit start-up reports/checklists. This shall include the following:
 - Heat Pumps (Use the attached forms no exceptions)
 - Variable Frequency Drives
 - Water Flow Meters/BTUH Meters
- 35.6 Except for the specific equipment specified in this Specification Section, the manufacturer's recommended startup procedures and checklists will be acceptable for use in the project. Where "manufacturer" startup is not specified, then this Contractor shall perform startup services in strict accordance with manufacturer's instructions. All startup/verification process shall be thoroughly documented by the Contractor and shall include the time and date when performed.
- 35.7 The Contractor shall "zip-tie" a start-up report to each piece of equipment in a clear plastic cover. Once start-up completion is verified by the Engineer the Contractor shall remove all reports and consolidate them into close-out documentation. The Contractor shall be responsible for completion of System Verification Checklist (SVC) / Manufacturer's Checklists.

PART 36 - INSPECTION, APPROVALS AND TESTS:

- 36.1 Before requesting a final review of the installation from the Architect and/or Engineer, each Contractor shall thoroughly inspect their installations to assure that the work is complete in every detail and that all requirements of the Contract Documents have been fulfilled. Failure to accomplish this may result in charges from the Architect and/or Engineer for unnecessary and undue work on their part.
- The Contractor shall provide as a part of this Contract any required Agency inspection, licensed and qualified to provide such services. All costs incidental to the provisions of inspections shall be borne by the Contractor.
- 36.3 The Contractor shall advise each Inspecting Agency in writing, with an informational copy of the correspondence to the Architect and/or Engineer, when they anticipate commencing the work. Inspections shall be scheduled for rough-in as well as finished work. The rough-in inspections shall be divided into as many inspections as may be necessary to cover all rough-in without fail. Failure of the Inspecting Agency to inspect the work in a timely manner and submit the related reports may result in the Contractor having to expose concealed work not so inspected. Such exposure will be at the expense of the responsible Contractor.
- Approval by an Agency Inspector does not relieve the Contractor from the responsibilities of furnishing equipment having a quality of performance equivalent to the requirements set forth in these Plans and Specifications. All work under this contract is subject to the review of the Architect and/or Engineer, whose decision is binding.
- 36.5 Before final acceptance, the Contractor shall furnish the original and three (3) copies of the certificates of final approval by the Agency Inspector to the Engineer with one copy of each to the appropriate government agencies, as applicable. Final payment for the work shall be contingent upon completion of this requirement.

PART 37 - ABOVE-CEILING AND FINAL PUNCH LISTS:

- 37.1 The Contractor shall review each area and prepare and complete their own punch list for each of the subcontractors as required for the Project Schedule.
- 37.2 Seven (7) days notice shall be given to the Engineer for review of above ceiling work that will be concealed by tile or other materials. Seven (7) days notice shall be given to the Engineer for review of below ceiling work and final inspection.
- When all work from the Contractor's punch list is complete at each of the major Project Stages and prior to completing ceiling installations (or at the final punch list stage), the Contractor shall request that the Engineer develop a punch list. This request is to be made in writing seven (7) days prior to the proposed date. After all corrections have been made from the Engineer's punch list, the Contractor shall review and initial off on each item. This signed-off punch list shall be submitted to the Engineer. The Engineer shall return to the site once to review each punch list and all work prior to the ceilings being installed and at the final punch list review. The Contractor's representative may be requested at the inspections.
- 37.4 If additional visits are required by the Engineer to review work not completed by this review, the Engineer shall be reimbursed directly by the Contractor by check or money order (due net 10 days from date of each additional visit) at a rate of \$125.00 per hour plus travel expense for extra trips required to complete either of the above ceiling, below ceiling or final punch lists.

PART 38 – OPERATING INSTRUCTIONS:

- 38.1 Upon completion of all work and all tests, each Contractor shall furnish the necessary skilled labor and helpers for operating the systems and equipment for a period of three (3) days of eight (8) hours each, or as otherwise specified. Refer to Section HVAC EQUIPMENT for additional requirements. During this period, instruct the Owner or their representatives fully in the operations, adjustment, and maintenance of all equipment furnished. Give at least seven (7) days written notice to the Owner, Architect and Engineer in advance of this training period. The Engineer may attend any such training sessions or operational demonstrations. The Contractor shall certify in writing to the Engineer that such demonstrations have taken place, noting the date, time and names of the Owner's representatives that were present.
- 38.2 Each Contractor shall furnish three complete bound sets for approval to the Engineer instructions for operating and maintaining all systems and equipment included in this contract. All instructions shall be submitted in draft form, for approval, prior to final issue. Manufacturer's advertising literature or catalogs will not be acceptable for operating and maintenance instructions. Refer to Specification Section SHOP DRAWINGS for additional detail.
- 38.3 Each Contractor, in the above mentioned instructions, shall include the maintenance schedule for the principal items of equipment furnished under this contract and a detailed, easy to read parts list and the name and address of the nearest source of supply.

PART 39 – RECORD DRAWINGS:

39.1 The Contractor shall ensure that any deviations from the Design are as they occur recorded in red, erasable pencil on record drawings kept at the jobsite. The Engineer shall review the record documents from time to time to ensure compliance with this specification. Compliance shall be a contingency of final payment. Pay particular attention to the location of under floor sanitary and water lines, shut-off valves, cleanouts, and

other appurtenances important to the maintenance and operation of Mechanical Systems. Also, pay particular attention to Deviations in the Control Systems and all exterior utilities. Keep information in a set of drawings set aside at the job site especially for this purpose and deliver to the Engineer upon completion of the work.

All underground utilities/piping installed as part of this project shall be surveyed by a land surveyor licensed in the State in which the project is being constructed. This shall include underground geothermal piping mains, vaults and vertical bore locations. The survey shall include actual pipe depths to top of pipe every 100 feet in length. The survey shall also include benchmarks dimensions relative to above grade, fixed structures. The survey shall be furnished on a compact disc in AutoCad ".dwg" format and ".pdf" format. The survey information shall be included in the closeout documentation.

PART 40 - COMMISSIONING: CONTRACTOR RESPONSIBILITIES:

- 40.1 Contractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:
 - Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
 - Cooperate with the CxA for resolution of issues recorded in the Issues Log.
 - Attend commissioning team meetings.
 - Integrate and coordinate commissioning process activities with construction schedule.
 - Complete electronic construction checklists as Work is completed and provide to the Commissioning Authority.
 - Review and accept commissioning process test procedures provided by the Commissioning Authority.
 - Complete commissioning process test procedures.

END OF SECTION 20-0100

Heat Pump - SVC 20 0100.1 - 23 04/24/2025

HEAT PUMP UNIT SYSTEM VERIFICATION CHECKLIST

Project:	Date:		
Tag:	Time:		
Area Served:	Technician:		
Heat Pump Syster	m	√	Comments
Preliminary Checklist			
Installed Unit Matches Submitted Model			
Units are installed on pad			
Verify pipe routing matches piping scher	matic		
Condensate drain piping installed to dra	in		
Ductwork completed, insulated, sealed a	and cleaned		
Flexible connections utilized at all conne	ection points		
Mechanical Room clean			
Piping			
Specified pipe/valve materials/fittings ins	stalled		
Dielectric fittings provided			
Water piping complete and labeled			
Strainer is installed on supply side			
Isolation valves are installed on supply &	& return piping		
Bypass with valve is installed "above" is	olation valves		
Pete's Plugs are installed "above" bypas	s on both supply and		
return piping			
Thermometer dials are installed on supply and return piping			
Correct hose kit and automatic balance	valve installed.		
Filters			
Temporary start-up pre-filter installed			
Final filter holding frame installed (no filt	ers)		
Differential magnahelic taps on filter hou	sing with gauge		
Filters accessible/removable			
Electrical			
Voltage and power supply correct per name plate			
Maximum overcurrent protection ampera	age correct		
Disconnect switch installed and accessil	ole		
Start Up			
Attach Start Up Report from Manufactur	er Representative		
Attach Start Up Report from Control's Contractor			

PROJECT NO. 24-179.000 Harrison REMC - Addition and Renovation Harrison REMC

Occupancy Sensor Interlock

Heat Pump Start-up 20 0100.2 - 24 04/24/2025

HEAT PUMP UNIT SYSTEM START-UP REPORT

Project:	Date/Time:				
Tag:	Contractor: Technician:			_	
System:					
Heat Pump Unit		Pass	Fail	Comments	
Equipment Schedule Verified with Owner					
Voltage and Power Supply Correct per Name	Plate				
Check Unit Voltage and Amps					
Phasing is Correct Per Compressor Rotation					
Maximum Overcurrent Protection Correct					
Low Voltage Wiring Correct					
Verify Water Flow and Direction Through Unit					
Cooling Mode					
Call for Cooling					
Main Pump On					
Fan On					
Compressor/Compressors On					
Supply Air Temperature					
Return Air Temperature					
Space Temperature Satisfied					
Fan Off					
Compressor/Compressors Off					
Heating Mode					
Automatic Changeover to Heating					
Call for Heating					
Main Pump On					
Fan On					
Compressor/Compressors On					
Space Temperature Satisfied					
Supply Air Temperature					
Return Air Temperature					
Fan Off					
Compressor/Compressors Off					
Unoccupied Mode					
Unit Off					
Cooling Setpoint 85°F					
Heating Setpoint 55°F					
Other Items					
Duct Smoke Detector (If Applicable)					
Check, Clean and Note Strainer Condition					
Test Condensate Drain / Pump Operation					
Check and Note Air Filter Condition			l		

PROJECT NO. 24-179.000 Harrison REMC - Addition and Renovation Harrison REMC Heat Pump Start-up 20 0100.2 - 25 04/24/2025

Heat Pump Unit	Pass	Fail	Comments
Temp. Control Network Communication Status Verification			

SECTION 20 0200 - SCOPE OF THE MECHANICAL WORK

PART 1 – GENERAL:

- 1.1 The Contractor's attention is directed to the General and Special Conditions, GENERAL PROVISIONS MECHANICAL and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section, and which are hereby made a part of the work specified in this section.
- 1.2 The Mechanical work for this Contract shall include all labor, materials, equipment, fixtures, excavation, backfill and related items required to completely install, test, place in service and deliver to the Owner the complete mechanical systems in accordance with the accompanying plans and all provisions of these specifications. This work shall primarily include but is not necessarily limited to the following paragraphs.
- 1.3 All applicable services and work specified in GENERAL PROVISIONS MECHANICAL.
- 1.4 Installation of all equipment per the manufacturer's instruction, whether specifically detailed or not.
- 1.5 Provide all required motor starters, etc. not provided under the electrical sections.
- 1.6 Thorough instruction of the Owner's maintenance personnel in the operation and maintenance of all mechanical equipment.
- 1.7 Thorough coordination of the installation of all piping, ductwork, equipment, and any other material with other trades to ensure no conflict in installation.
- 1.8 Approved supervision of the mechanical work.
- 1.9 Procurement of all required inspections, including fees for all inspection services and submission of final certificates of inspection to the Engineers.
- 1.10 Excavation, backfilling, cutting, patching, sleeving, concrete work, etc., required to construct the mechanical systems.
- 1.11 Equipment and controls start-up, verification and documentation as specified.
- 1.12 Record drawings, final inspection certificates, test results, O & M documentation, warranty certification, spare parts, and other specified closeout documentation.
- 1.13 Required schedule of values breakdown.
- 1.14 Pipe, duct, and equipment identifications.
- 1.15 Preinstallation meetings and equipment mockups.
- 1.16 Specified Commissioning activities.

- 1.17 Complete fire sprinkler service main to 5'-0" beyond building footprint. Refer to Civil Drawings/Specifications for additional requirements.
- 1.18 Complete sanitary sewer service to 5'-0" beyond building footprint. Refer to Civil Drawings/Specifications for additional requirements.
- 1.19 Complete interior and exterior geothermal system and required test results.
- 1.20 Domestic hot, cold, and recirculating hot water system.
- 1.21 Soil, waste, and vent systems.
- 1.22 All plumbing equipment, fixtures, and fittings.
- 1.23 Complete heating, ventilation, and air conditioning systems.
- 1.24 All insulation associated with mechanical systems.
- 1.25 Condensate drainage systems.
- 1.26 All required pressure testing, flushing, purging, pressure and flow testing requirements.
- 1.27 Final coordination and connection of all mechanical equipment furnished by others (e.g., kitchen equipment, appliances, medical equipment).
- 1.28 All required controls, including self checkout and commissioning.

SECTION 20 0300 - SHOP DRAWINGS. MAINTENANCE MANUALS AND PARTS LISTS

PART 1 – GENERAL:

- 1.1 The Contractor's attention is directed to the General and Special Conditions, GENERAL PROVISIONS MECHANICAL and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section, and which are hereby made a part of the work specified in this section.
- 1.2 The Contractor shall prepare and submit to the Engineer, through the Prime Contractor and the Architect within thirty (30) days after the date of the Contract, required copies of all shop drawings, certified equipment drawings, installation, operating and maintenance instructions, samples, wiring diagrams, etc. on all items of equipment specified hereinafter. Refer to Division 1 requirements for shop drawing submittal requirements.
- 1.3 Provide all shops in electronic/PDF format. The Engineer's comments will be returned in electronic format.
- 1.4 Each shop drawing and/or manufacturers descriptive literature shall have the proper notation indicated on it selecting equipment, accessories and features and shall be clearly referenced to the specifications, schedules, fixture numbers, etc., so that the Engineer may readily determine what the Contractor proposes to furnish. All data and information schedules indicated or specified shall be noted on each copy of each submittal.
- 1.5 Submittal data shall include specification data including metal gauges, finishes, accessories, etc. Also, the submittal data shall include certified performance data, wiring diagrams, dimensional data, and a spare parts list. Submittal data shall be reviewed by the Engineer before any equipment or materials is ordered or any work is begun in the area requiring the equipment.
- 1.6 All submittal data shall have the stamp of approval of the Contractor submitting the data as well as the Prime Contractor and the Architect to show that the drawings have been reviewed by the Contractor. Any drawings submitted without these stamps of approval may not be considered and will be returned for proper resubmission.
- 1.7 The Contractor shall make any corrections or changes required by the Engineer and shall re-submit for final review as outlined above.
- 1.8 It shall be noted that review of shop drawings by the Engineer applies only to conformance with the design concept of the project and general compliance with the information given in the Contract Documents. In all cases, the Contractor alone shall be responsible for furnishing the proper quantity of equipment and/or materials required, for seeing that all equipment fits the available space in a satisfactory manner and that piping, electrical and all other connections are suitably located. The Contractor shall also coordinate piping side connections.
- 1.9 The Engineer's review of shop drawings, schedules or other required submittal data shall not relieve the Contractor from responsibility for adaptability of the item to the project; compliance with applicable codes, rules, regulations, and information that pertains to fabrication and installation; dimensions. weight and quantities; electrical characteristics; and coordination of the work with all other trades involved in this project.

- 1.10 Prior to ordering any materials or rough-in of any kind, the Mechanical Contractor shall be responsible for final coordination of all electrical requirements (i.e., voltage, phase, circuit breaker, wire sizing, etc.) with the Electrical Contractor. There will be no change in the Contract Amount for any discrepancies. A final coordination meeting shall be held with the Architect, Owner, Engineer, Prime Contractor, Mechanical Contractor, Electrical Contractor, and their sub-contractors.
- 1.11 Equipment shall not be ordered and no final rough-in connections, etc., shall be accomplished until reviewed equipment shop drawings are in the hands of the Contractor. It shall be the Contractor's responsibility to obtain reviewed shop drawings and to make all connections, etc. in the neatest and most workmanlike manner possible. The Contractor shall coordinate with all the other trades having any connections, roughing-in, etc. to the equipment.
- 1.12 If the Contractor fails to comply with the requirements set forth above, the Engineer shall have the option of selecting any or all items listed in the Specifications or on the Drawings; and the Contractor shall be required to furnish all materials in accordance with this list.
- 1.13 Colors for equipment in other than mechanical spaces shall be selected from the Manufacturer's standard and factory optional colors unless noted otherwise on the Plans. Color samples shall be furnished with the shop drawing submission for such equipment.
- 1.14 All submittals for mechanical equipment shall include all information specified and scheduled. This shall include air and water pressure drops, RPM, noise data, face velocities, horsepower, voltage motor type, steel or aluminum construction, and all accessories clearly marked.
- 1.15 All items listed in the schedules shall be submitted for review in a tabular form similar to the equipment schedule. All items submitted shall be designated with the same identifying tag as specified on each sheet.
- 1.16 Any submittals received in an unorganized manner without options to be provided specifically noted and with incomplete data will be returned for resubmittal.

PART 2 - SHOP DRAWINGS:

2.1 Shop Drawings, descriptive literature, technical data and required schedules shall be submitted on the following:

Access Doors
Air Filtration & Components
Chemical Treatment and Test Reports
Ductwork Accessories/Volume Dampers
Floor and Trench Drains
Wall & Yard Hydrants
Geothermal Piping, Specialties
Heat Pump Units
Insulation
Exhaust Fans
Outside Air ERV Units
Plumbing Fixtures, Fittings and Trim
Plumbing Specialties including Hose Bibs
Pumps and Hydronic Specialties
Register, Grilles, Diffusers and Louvers

Electric Heaters
Temperature Controls & Components
Valves
Variable Frequency Drives
Fire Sprinkler System including Fire Pump

2.2 SPECIAL NOTES:

- 2.2.1 For all items above, upon substantial completion of the project, the Contractor shall deliver to the Engineer (in addition to the required Shop Drawings) three (3) complete copies of operation and maintenance instructions and parts lists for each item above. Where available, documents shall include at least:
 - Detailed operating instructions
 - Detailed maintenance instructions including preventive maintenance schedules.
 - Addresses and phone numbers indicating where parts may be purchased.
 - Expanded parts drawings, parts lists, service manuals, schematics, wiring diagrams.
 - Master air filter list including equipment identification, filter size, filter quantity, and supplier contact information.
 - Start-up reports, service records and test reports.
- 2.2.2 Shop drawings for the Temperature Control Systems shall include detailed, scaled plans and schematic diagrams indicating the function and operation of the system. Refer to Specification Section CONTROLS for additional requirements.
- 2.2.3 Shop drawings for the Building Fire Protection System shall be prepared and stamped by a Certified Contractor and shall meet the criteria of the authority having jurisdiction and submitted to the Engineer. After the Engineer's review, they shall be submitted by the Contractor to the proper state authorities along with the required agency review fee. Refer to Specification Section FIRE PROTECTION for additional requirements.
- 2.2.4 The Contractor shall submit project specific UL listed firestopping installation drawings to the authority having jurisdiction where required for their approval as required.

SECTION 20 1100 - SLEEVING, CUTTING, PATCHING, REPAIRING AND FIRESTOPPING

PART 1 – GENERAL:

- 1.1 The Contractor's attention is directed to the General and Special Conditions, GENERAL PROVISIONS MECHANICAL and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section, and which are hereby made a part of the work specified in this section.
- 1.2 The Contractor shall be responsible for all openings, sleeves, trenches, etc., that may be required in floors, roofs, ceilings, walls, etc., and shall coordinate all such work with the General Contractor and all other trades. Coordinate with the General Contractor, any openings which they are to provide before submitting a bid proposal in order to avoid conflict and disagreement during construction. Improperly located openings shall be reworked at the expense of the Contractor.
- 1.3 The Contractor shall plan their work ahead and shall place sleeves, frames or forms through all walls, floors and ceilings during the initial construction, where it is necessary for piping, ductwork, conduit, etc., to route through; however, when this is not coordinated, the Contractor shall then do all cutting and patching required for the installation of their work, or pay other trades for doing this work when so directed by the Engineer. Any damage caused to the building by this Contractor shall be corrected or rectified at their expense.
- 1.4 The Contractor shall notify other trades in due time where they will require openings or chases in new concrete, masonry, etc. Set all concrete inserts and sleeves for their work. Failing to coordinate, Contractor shall cut openings for the work and patch same as required at their expense with qualified tradesman.
- 1.5 The Contractor shall be responsible for properly shoring, bracing, supporting, etc., any existing and/or new construction to guard against cracking, settling, collapsing, displacing, or weakening while openings are being made. Any damage occurring to the existing and/or new structures, due to failure to exercise proper precautions or due to action of the elements shall be promptly and properly corrected to the satisfaction of the Engineer.
- 1.6 All work improperly performed or not performed as required in this section, shall be corrected by the General Contractor at the responsible Contractor's expense.

PART 2 – SLEEVES:

- 2.1 Cast iron or Schedule 40 steel sleeves shall be installed through all walls where pipe enters the building below grade. Sleeves shall be flush with each face of the wall and shall be sufficiently larger than the entering pipe to permit thorough caulking between pipe and sleeve for water proofing. Horizontal sleeves passing through exterior walls or where there is a possibility of water leakage and damage shall be caulked watertight. Utilize "Link-Seal" at these locations.
- In all cases, sleeves shall be at least two pipe sizes larger than nominal pipe diameter plus insulation. Sleeves through walls and floors shall be cut off flush with inside surface unless otherwise indicated.

- 2.3 Vertical sleeves in roofs shall be flashed and counterflashed with lead (4 lb.) or 16 oz. copper and welded or soldered to piping, lapped over sleeve and properly weather sealed. Where sleeves pass through roof construction, sleeves shall extend minimum of 12" above the roof.
- 2.4 Cast iron or Schedule 40 steel sleeves shall be installed through all walls where pipe enters the building below grade. Sleeves shall be flush with each face of the wall and shall be sufficiently larger than the entering pipe to permit thorough caulking between pipe and sleeve for water proofing. Horizontal sleeves passing through exterior walls or where there is a possibility of water leakage and damage shall be caulked watertight. Utilize "Link-Seal" at these locations.
- 2.5 Provide pipe sleeves through all interior wall penetrations. Sleeve shall be cast iron or schedule 40 steel. In all cases, sleeves shall be at least two pipe sizes larger than nominal pipe diameter plus insulation. Sleeves through walls and floors shall be cut off flush with inside surface unless otherwise indicated. Reference Part 5 for firestopping requirements in rated walls. Sleeves and annular space between pipe and sleeve in non-rated walls shall be sealed completely with acoustical non-shrink caulk.
- 2.6 Vertical sleeves in roofs shall be flashed and counterflashed with lead (4 lb.) or 16 oz. copper and welded or soldered to piping, lapped over sleeve and properly weather sealed. Where sleeves pass through roof construction, sleeves shall extend minimum of 12" above the roof.

PART 3 – CUTTING:

- 3.1 All openings in plaster, gypsum board or similar materials, shall be framed by means of plaster frames, casing beads, or angle members as required. The intent of this requirement is to provide smooth, even termination of wall, floor, and ceiling finishes as well as to provide a fastening means for devices, etc.
- 3.2 The Mechanical Contractor shall coordinate all openings in masonry walls with the General Contractor; and, unless otherwise indicated in the Contract Documents, shall provide lintels for all openings required for the mechanical work such as louvers, exhaust fans, etc. Prime paint all lintels. Lintels shall be sized as follows: Unless noted otherwise in the Structural Drawings.
- 3.2.1 New Openings under 48" in width: Provide one 3½"x3½"x3/8" steel angle for each 4" of masonry width. Lintel shall have 8" bearing on each end.
- 3.2.2 New Openings over 48" in width: Consult with Structural Engineer.
- 3.3 No cutting shall be performed at location that will weaken the structure and unnecessary cutting must be avoided. If in doubt, contact the Engineer.
- 3.4 Pipe openings in slabs and walls shall be cut with core drill. Hammer devices will not be permitted. Edges of trenches and large openings shall be scribe-cut with a masonry saw.

PART 4 – PATCHING. REPAIRING AND FINISHING:

- 4.1 Patching and repairing made necessary by work performed under this Division shall be included as a part of the work and shall be done by skilled workers of the trade. The work shall be performed in strict accordance with the provisions herein before specified to match adjacent surfaces and in a manner acceptable to the Engineer.
- 4.2 Where portions of existing sites, lawns, shrubs, paving, etc. are disturbed for installation of work of this

Division, such items shall be repaired and/or replaced back to original or better condition to the satisfaction of the Engineer.

- 4.3 Piping and ductwork passing through floors, ceilings and walls in finished areas shall be fitted with chrome plated brass escutcheon trim pieces of sufficient outside diameter to amply cover the sleeved openings and an inside diameter to closely fit the pipe/duct around which it is installed.
- 4.4 Flanged metal collars shall be provided around all ducts, flues, pipes, etc. at all wall penetrations, both sides. Penetrations through any wall will require the installation of flanged collars. Openings shall not be any larger than 2" in any direction than the piping/duct passing through the wall. Openings larger than this requirement shall also be infilled to match adjacent construction. Fill void with insulation for sound reduction.

PART 5 – FIRESTOPPING:

- Provide shop drawings indicating penetration detail for each type of wall and floor construction. Shop drawings must be specific for each individual type of penetration (one hour fire rated gypsum wall board with insulated metal pipe penetration, etc.) Provide copies to the authority having jurisdiction if required.
- All mechanical pipes and ducts penetrating fire rated floors and walls shall be firestopped by this Contractor. All firestopping products and assemblies installed shall be UL listed.
- 5.3 Where the installation of conduit, ducts, piping, etc. requires the penetration of fire or smoke rated walls, ceilings or floors, the space around such conduit, duct, pipe, etc., shall be tightly filled with an approved non-combustible fire insulating material and properly sealed to maintain the rating integrity of the wall, floor or ceilings affected.
- 5.4 Where the installation of ductwork requires the penetration of non-rated floors, the space around the duct or pipe shall be tightly filled with an approved non-combustible material.
- The manufacturer of the firestopping materials shall provide on site training for the installing Contractor. The training session shall demonstrate to the Contractor the proper installation techniques for all the firestopping materials.
- 5.6 Firestopping materials include (but are not limited to) wraps, strips, caulks, moldable putties, restricting collars with steel hose clamps, damming materials, composite sheets, fire dam caulks, steel sleeves, etc.
- 5.7 The following indicates the 3M penetration details for uninsulated pipe penetration of various wall and floor construction types (the list is not inclusive):
 - One, two or three hour fire rated concrete floor 3M #5300-MPC8.
 - One, two or three hour fire rated solid or block concrete wall 3M #5300-MPC16 or 3M #5300-MPC26.
 - One hour fire rated gypsum wallboard 3M #5300-MPC7.
 - Two hour fire rated gypsum wallboard 3M #5300-MPC7.
- The following indicates the 3M penetration details for insulated pipe penetrations of various wall and floor construction types (the list is not inclusive):

- One, two and three hour fire rated concrete floor 3M #5300-IMP2.
- One, two and three hour concrete block wall 3M #5300-IMP2.
- One hour fire rated gypsum wallboard 3M #5300-IMP4.
- Two hour fire rated gypsum wallboard 3M #IMP7.
- 5.9 HVAC ducts penetrating a one or two hour fire rated wall or floor shall be firestopped per 3M #5300-HVD1.
- 5.10 Multiple pipes penetrating fire rated floors and walls may be firestopped as a group. Submit details for specific applications if this method of firestopping is chosen.

SECTION 20 1200 - EXCAVATION, TRENCHING, BACKFILLING AND GRADING

PART 1 – GENERAL:

- 1.1 The Contractor's attention is directed to the General and Special Conditions, GENERAL PROVISIONS MECHANICAL and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section, and which are hereby made a part of the work specified in this section.
- 1.2 The Contractor shall include all excavating, filling, grading, and related items required to complete their work as shown on the drawings and specified herein or as required to complete, connect, and place all mechanical systems in satisfactory operation.

PART 2 - EARTHWORK CLASSIFICATION:

- 2.1 Without regard to the materials encountered, all excavation and materials excavated shall be unclassified. Materials to be excavated shall include earth, rock, concrete, or any other obstructions encountered in excavation and/or trenching to install underground utility pipes, tanks, vaults, or other equipment.
- 2.2 Include all costs for rock removal, including mass rock and trench rock in the bids. No adjustment in the contract sum will be made on account of the presence or absence of rock, shale, debris, obstructions, or other materials encountered in the excavating. The Contractor shall be responsible for the removal of all materials encountered as required for the installation of the work.
- 2.3 It shall be distinctly understood that references to rock, earth, topsoil or any other excavated or non-excavated material or other material on the construction plans, cross section, contract documents, technical specification, or provisions, whether in numbers, words, letters, lines or graphically shown, is solely for information for the Engineer and Owner. This information shall not be taken as an indication of the classification of the material to be excavated, bored, or removed by any method, including drilling and blasting, or materials not removed. This information shall not be taken as to the quantity of either rock, earth, topsoil, or any other material involved, or the quality of the material such as hardness, wetness, workability, or suitability of the material either during excavation and construction or as a material to be reused during construction.
- 2.4 The Contractor shall draw their own conclusions as to the surface and sub-surface conditions to be encountered during construction of this project. The Engineer and Owner do not give any guarantee or warranty as to the accuracy of the data shown and no claim will be considered for additional compensation when the materials encountered are not in accord with the information shown.
- 2.5 Refer to Specification Division EARTHWORK located in the Site Work portions of the Specifications and Civil Drawings for additional information. Also refer to the GEOTECHNICAL report (provided for informational purposes only) included in the Front End of the Specifications.

PART 3 – EXCAVATION:

- 3.1 Unless otherwise shown or required, provide separate trenches for sewers, water lines and other underground raceways, with a minimum of 10 feet measured from outside diameter between pipes. In locations, such as close to buildings where separate trenches for sewers and water lines are impractical, lay the water pipe on a solid shelf at least 2'-0" above the top of the sewer and 2'-0" to the side.
- 3.2 Water lines crossing under sewer lines, or crossing less than 2 feet above sewer lines, must be concrete encased for a distance not less than 5 feet on either side of the point of crossover.
- 3.3 Excavate trenches of sufficient width for proper installation of the work. Excavate to 6" below the bottom of new pipes for installation of compacted fill.
- 3.4 Sheet and brace trenches as necessary to protect workers and adjacent structures. Comply with local regulations or, in the absence thereof, with the latest version of "Manual of Accident Prevention in Construction" by the Associated General Contractors of America and current OSHA Standards. Do not remove sheeting until trench is backfilled sufficiently to protect pipe and/or equipment and prevent injurious caving. Where removal of sheeting and/or bracing is hazardous, leave in place. Cut off such sheeting not to be removed at least 3 feet below finished grade.
- 3.5 Rules and regulations governing the respective utilities shall be observed in executing all work under this Division. Active utilities discovered in the course of excavation shall be protected or relocated in accordance with written instructions from the Engineer. Inactive and abandoned utilities encountered in trenching operations shall be removed and abandoned with ends plugged or capped in accord with current codes and safe practice. If in doubt, contact Engineer.
- 3.6 Machine excavation shall not be allowed within ten (10) feet of electric lines, natural gas lines or other lines carrying combustible materials. Use only hand tool excavation methods.
- 3.7 The removal of rock shall be accomplished by use of hand or power tools only. Blasting shall not be permitted. Any damage to existing structures, piping services, or rock intended for bearing, shall be corrected at the responsible Contractor's expense.
- Perform final grading of trench bottoms by hand tools; carry machine excavation only to such depth that soil bearing for pipes and raceways will not be disturbed. Grade the bottom of trenches evenly to ensure uniform bearing for all piping and raceways. Cut bell holes as necessary for joints and jointmaking. Except as hereinafter specified, bottom of trenches for bell and spigot pipe, flanged pipe, etc. shall be shaped to the lower quadrant of pipe with additional excavation for bell or flange. Piping installed where it rests on bell or flange and/or is supported with blocks or wedges will not be accepted.
- 3.9 Keep trenches free from water while construction is in progress. Under no circumstances lay pipe or appurtenances in water. Pump or bail water from bell holes to permit proper joining of pipe. Any dewatering from this Contractor's trenches which is required during construction, shall be included in this Contract.
- 3.10 In no case shall excavation work be accomplished that will damage in any way the new structure, existing structures, equipment, utility lines, landscaping to remain, etc. The Contractor shall take the necessary steps to prevent flow of eroded earth by water or landslide onto the property of others, or against the structures. The repair of all such damage or any other damage incurred in the course of excavation shall be at the responsible Contractor's expense.

- 3.11 Use surveyor's level to establish elevations and grades.
- 3.12 Machine excavation shall be held a sufficient distance from foundations and footings to ensure no damage to same. Contractor shall accept full responsibility and pay for repairs and/or replacement of structural members, footings, etc.
- 3.13 The Contractor shall accept the site as it is. Remove all trash, rubbish, and unsuitable material from the site at the completion of excavation work.
- 3.14 The Contractor shall provide and maintain barricades, trench plates and temporary bridges around excavations as required for safety. Temporary plates or bridges shall be provided where excavations cross paved areas and walks. The Contractor shall maintain these plates and bridges in a safe and passable condition for all traffic until removal. Refer to OSHA Standards for such installations and comply with same in all details.
- 3.15 Pay particular attention to existing utilities and lines to avoid damage. The locations of existing lines which are indicated on the plans were taken unconfirmed from drawings prepared for previous construction and locations are approximate only. Also, certain water, gas, electric, storm and sanitary sewer lines and other underground appurtenances, active or abandoned, may not appear on the drawings. It shall be each Contractor's responsibility to ascertain the location of all lines and excavate with caution in their area.
- 3.16 Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be at Contractor's expense.
- 3.17 Maintain carefully all benchmarks, monuments and other reference points. If disturbed or destroyed, replace as directed.

PART 4 – BACKFILL, COMPACTION AND SURFACE REPAIR:

- 4.1 Backfilling for Mechanical Work shall include all trenches, manhole pits, tanks and/or any other earth and/or rock openings which are excavated under this Contract. Backfilling shall be carefully performed, and the surface restored to its original level to receive new finish. Wherever trenches and earth openings have not been properly filled and/or settlement occurs, they shall be re-excavated, re-filled and properly compacted, smoothed off and finally made to conform to the level of the original ground surface.
- 4.2 All trenches shall be backfilled with a bedding of 6" of manufactured sand or #8 crushed stone after finished excavation. Install the new pipe on the compacted fill material. Install tracer wire on all pipe. Apply any special coatings to the pipe. Also perform all required pressure tests and check the grade of the pipe to ensure that it is correct and free of swags, bows or bends. Once coatings and testing are complete, backfill the pipe bed to 12" above the top of the pipe with specified compacted fill material. Backfill the remainder of the trench with earth (rock and debris free) tamped at 6" intervals. Water settling of backfill is permitted only as an aid to mechanical compacting.
- 4.3 Backfill and compact beneath areas to be seeded or sodded within six (6) inches of finished grade. The remaining six (6) inches shall be backfilled with clean topsoil.
- 4.4 Backfill and compact beneath concrete slabs, paved areas, walks, etc. shall be brought to proper grade to receive the sub-base, concrete slab, or paving. No concrete or paving shall be placed on uncompacted fill or unstable soil.

- Wherever, in the opinion of the Engineer, the soil at or below the requisite pipe grade is unsuitable for supporting piping, special support shall be provided as directed by the Engineer.
- Backfill and compaction for natural gas lines shall be in strict accordance with the local utility company or local municipality's requirements. If in doubt, contact the utility company or local municipality.
- 4.7 Unsuitable material and surplus excavated material not required for backfill shall be removed from the site. The location of dump and length of haul shall be the affected Contractor's responsibility.
- 4.8 Provide and place any additional fill material from off the site as may be required for backfill. Fill obtained from off site shall be of kind and quality as specified for backfill and the source approved by the Engineer and shall be brought to the site by the Contractor requiring the fill.
- 4.9 If not specified or indicated elsewhere in the Contract Documents to be performed by Others, the Contractor shall lay new sod over their excavation work for existing disturbed grassy areas. Level, with adjacent surface, compact and water in accord with sound sodding practice.
- 4.10 Control soil compaction during construction providing minimum percentage of density specified for each area classification indicated in the following two paragraphs.
- 4.11 At a minimum, fill in grass areas shall be compacted to 90% Standard Proctor Density, ASTM D-698, at moisture content between 2 percent below to a 3 percent above the optimum moisture content or as specified in Specification Division EARTHWORK; whichever is most stringent.
- 4.12 At a minimum, fill in concrete or asphalt area shall compact to 98% Standard Proctor Density, ASTM D-698, at moisture content between 2 percent below to a 3 percent above the optimum moisture content or as specified in Specification Division EARTHWORK; whichever is most stringent.
- 4.13 Place backfill and fill materials evenly adjacent to structures, piping, or conduit to required elevations. Take care to prevent wedging action of backfill against structures or displacement of piping or conduit by carrying material uniformly around structure, piping, or conduit by carrying material uniformly around structure, piping, or conduit to approximately same elevation in each lift.
- 4.14 All materials used for backfill around structures shall be of a quality acceptable to the Engineer and shall be free from large or frozen lumps, large rocks, wood, and other extraneous material. All spaces excavated and not occupied by footings, foundations, walls, or other permanent work shall be refilled with earth up to the surface of the surrounding ground, unless otherwise specified, with sufficient allowance for settlement.
- 4.15 In making the fills and terraces around the structures, the fill shall be placed in layers not exceeding 8 inches in depth and shall be kept smooth as the work progresses. Each layer of the fill shall be compacted. Sections of the fill immediately adjacent to buildings or structures shall be thoroughly compacted by means of mechanical tamping or hand tamping as may be required by the conditions encountered. All fills shall be placed so as to load structure symmetrically.
- 4.16 Rough grading shall be held below finished grade and then the topsoil which has been stockpiled shall be evenly spread over the surface. The grading shall be brought to the levels as specified. Final dressing shall be accomplished by hand work or machine work, or a combination of these methods as may be necessary to produce a uniform and smooth finish to all parts of the regrade. The surface shall be free from clods

greater than one inch in diameter. Excavated rock (1" and smaller) may be placed in the fills, but is shall be thoroughly covered. Rock placed in fills shall not be closer than 24 inches from finished grade. Refer to Specification Division EARTHWORK.

- 4.17 Maintenance Settling: Where settling is measurable or observable at excavated areas during Project Warranty Period, remove surface (pavement, concrete or any other surface or finish), add backfill material, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work and eliminate evidence of restoration.
- 4.18 Disposal of Excess Non-organic Soil and Rock: Any excess excavated waste material shall become the property of the Contractor and shall be disposed of by the Contractor off site at no additional cost to the Owner.
- 4.19 Unless otherwise directed by the Owner during construction, excess topsoil, and subsoil suitable for fill shall be disposed of by the Contractor off site at no additional cost to the Owner.

PART 5 - MINIMUM DEPTHS OF BURY TO TOP OF PIPE:

In the absence of other indication, the following shall be the minimum depth of bury to top of pipe of exterior utility lines. Check drawings for variations.

5.1.1 Geothermal Lines
5.1.2 Domestic Water Lines
5.1.3 Sanitary Lines
48 inches below final grade.
36 inches below final grade.
36 inches below final grade.

5.1.4 All Other Lines Not Listed 36 inches below final grade.

SECTION 20 1300 - PIPE, PIPE FITTINGS AND PIPE SUPPORT

PART 1 – GENERAL:

- 1.1 The Contractor's attention is directed to the General and Special Conditions, GENERAL PROVISIONS MECHANICAL and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section, and which are hereby made a part of the work specified in this section.
- 1.2 Each Contractor's attention is also directed to Specification Section HANGERS, CLAMPS, ATTACHMENTS, ETC.
- 1.3 Unless otherwise indicated, all materials shall be new and of the best grade and quality for the type specified. Materials shall comply with the "Buy American Act".
- 1.4 Where piping is not indicated on the plans, but is obviously or apparently required, contact the Engineer prior to submission of the bid.
- 1.5 All piping shall be capped or plugged during erection as required to keep clean and debris and moisture free.
- The piping indicated shall be installed complete and shall be of the size indicated. When a pipe size is not indicated, the Contractor shall request the pipe size from the Engineer. Where a section of piping is not indicated but is obviously required for completion of the system, the Contractor shall provide same at no additional cost to the project.
- 1.7 All piping shall be installed straight and true, parallel, or perpendicular to the building construction. Piping shall be installed so as to allow for expansion without damage to the building finishes, structure, pipe, equipment, etc., use offsets, U-bends or expansion joints as required. No mitered joints or field fabricated pipe bends shall be accepted. Pipe shall clear all windows, doors, louvers, and other building openings.
- 1.8 All pipes shall be supported in a neat and workmanlike manner and wherever possible, parallel runs of horizontal piping shall be grouped together on hangers. Vertical risers shall be supported at each floor line with approved steel pipe riser clamps. Spacing of pipe supports shall not exceed eight (8) foot intervals for pipes 3" and smaller and ten (10) foot intervals on all other piping. Small vertical pipes (1" and less) shall be bracketed to walls, structural members, etc. at four (4) foot intervals so as to prevent vibration or damage by occupants.
- 1.9 Insulated piping shall be supported on a rigid insulation block at each hanger so as to prevent crushing of insulation by hangers. Hangers shall pass completely around the insulation jacket and a steel protective saddle shall be applied to prevent compression of the insulation. Refer to Specification Section INSULATION MECHANICAL.
- 1.10 The use of wire or perforated metal to support pipes will not be permitted. Hanging pipes from other pipes shall not be permitted.

- 1.11 Where piping rests directly on a hanger, clip, bracket or other means of support, the support element shall be of the same material as the pipe, (e.g., copper to copper, ferrous to ferrous, etc.) or shall be electrically isolated one from the other so as to prevent pipe damage by electrolysis. Pay particular attention and do not allow copper pipe to rest on ferrous structural members, equipment, etc. without electrolytic isolation. This includes temporary support required during Construction.
- 1.12 In general, piping shall be installed concealed except in mechanical rooms, etc. unless otherwise indicated, and shall be installed underground or beneath concrete slabs only where indicated. All lines at ceilings shall be held as high as possible and shall run so as to avoid conflicts with other trades, and to facilitate the Owner's use and maintenance. Location of pipe in interior partitions shall be carefully coordinated with whoever will construct the partitions after the piping is in place. Where exposed risers occur, they shall be kept as close to walls as possible.
- 1.13 Pipe shall be cut accurately to measurements established at the building by the Contractor and worked into place without springing or forcing. All pipes shall be reamed to full pipe diameter before joining and before assembling. All lengths of pipe shall be set vertically and tapped with a hammer to remove scale and dust and inspected to ensure that no foreign matter is lodged therein.
- 1.14 All hot and cold water piping shall be kept a sufficient distance apart so as to prevent heat transfer between them. Cold water piping shall also be kept apart from refrigerant hot gas lines.
- 1.15 Piping carrying water or other fluids subject to freezing shall not be installed in locations subject to freezing. If in doubt, consult Engineer.
- 1.16 Pay particular attention to conflict of piping with other work. Do not install until conflict is resolved. If in doubt, consult Engineer.
- 1.17 Piping materials in each system shall, to the extent practicable, be of the same material. Frequent changes of material (for example, from copper to steel) shall be avoided and in no case shall be accomplished without use of insulating unions and permission of the Engineers.
- 1.18 Dielectric couplings or through ways shall be provided at all connections of dissimilar materials.
- 1.19 Nipples shall be of the same material, composition, and weight classification as pipe with which installed.
- 1.20 Apply approved pipe dope for service intended to all male threaded joints. The dope shall be listed for intended use.
- 1.21 Eccentric reducers shall be used where required to permit proper drainage and venting of pipelines; bushings shall not be permitted.
- 1.22 High points of closed loop geothermal systems shall have manual air vents as required unless automatic air vents are specifically indicated. Pipe to suitable drainage point.
- 1.23 Installation of pipe shall be in such a manner as to provide complete drainage of the system, whether detailed or not on plans. Drain valves shall be provided at all drainage points on pipes. Drain valves shall be ½" size ball valves with 3/4" hose thread end and vacuum breaker. Label each drain valve.
- 1.24 Where plastic piping penetrates a fire rated assembly, it shall be replaced with a threaded metal adapter

- and metal pipe or whatever means necessary to maintain the separation rating in accordance with local plumbing and fire codes.
- 1.25 Plastic piping or any material with a flame and smoke spread rating not approved for plenum use shall not be permitted in supply, return, relief, or exhaust plenums.
- 1.26 All increases in vent size at roof shall be by means of service weight cast iron increasers.
- 1.27 Non-metallic piping shall be installed in strict accordance with the manufacturer's instructions. If no such instructions are available, consult Engineer.
- 1.28 When running any type of pipe below a footing, perpendicular to the footing, the area underneath the footing and in the zone of influence shall be backfilled with concrete. The zone of influence is the area within a 45 degree angle projecting down from the top edge of footing on all sides of the footing.
- 1.29 When running any type of pipe below a footing, parallel to the footing, the area underneath the zone of influence shall be backfilled with 4" of crushed stone or sand bedding under the pipe. Each pipe section shall be anchored into unexcavated earth on both ends with deadman anchor system. The remainder of the trench in the zone of influence shall be backfilled with cementitious flowable fill. The zone of influence is the area within a 45 degree angle projecting down from the top edge of the footing on all sides of the footing.
- 1.30 Piping for all drainage systems shall be installed to permit flow, trapping, and venting in accord with current codes and best practice.
- 1.31 The entire domestic hot, cold, and recirculating hot water piping system shall be sterilized in strict accord with requirements of the Department of Health Codes, Rules, and Regulations for the State in which the work is being accomplished.
- 1.32 Site water piping utilized for domestic service shall be filled, cleaned, and disinfected. Disinfection shall utilize chlorine per the local water company standards or approved equal. Hyper-chlorinated water shall be discharged and diluted at the end of the pipeline into the sanitary sewers per local utility regulations.
- 1.33 The entire sanitary waste and vent piping system within the building shall be airtight. If any sewer gases are present within the building, it shall be the Contractor's responsibility to locate and correct any leaks and retest as required. Any sewer odor issues that occur during the Warranty Period shall be corrected by the Contractor.

PART 2 – UNIONS, FLANGES AND WELDED TEES:

- 2.1 Screwed unions, soldered unions or bolted flanges shall be provided as required to permit removal of equipment, valves, and piping accessories from the piping system. Keep adequate clearances for coil removal, rodding, tube replacement, motor lubrication, filter replacement, etc. Flanged joints shall be assembled with appropriate flanges, gaskets, and bolting. The clearance between flange faces shall be such that the connections can be gasketed and bolted tight without imposing undue strain on the piping system.
- 2.2 Dielectric insulating couplings or though ways shall be used wherever the adjoining materials being connected are of dissimilar metals such as connections between copper and steel pipe.

2.3 Tee connections for welded pipe shall be assembled with welding fittings. Where the size of the side outlet is such that a different connection technique than on the run is required, a weldolet, sockolet, or threadolet type fitting may be used for the branch in place of reducing tees only where the branch is 2/3 the run size or smaller. Weld-o-let and thread-o-let branch connections are acceptable.

PART 3 – SPECIFICATIONS STANDARDS:

- 3.1 All piping and material shall be new, comply with the "Buy American Act" and shall conform to the following minimum applicable standards:
 - Steel pipe; Schedule 40; ASTM A-53.
 - Copper tube; Type K, L, M; ASTM B88-62; Type DWV ASTM B306-62.
 - Cast iron soil pipe; ASA A-40. I and CS 188-59.
 - Cast iron drainage fittings; ASA B16.12.
 - Cast iron screwed fittings; ASA B16.4.
 - Welding fittings; ASA B16.9.
 - Cast brass and wrought copper fittings; ASA B16.18.
 - Cast brass drainage fittings; ASA B16.23.
 - PVC pipe; Schedule 40; ASTM D-1785.
 - PVC pipe; Schedule 40; ASTM D2665 and D1784. Piping must be installed in compliance to the manufacturer's recommendations which shall be made available to the plumbing inspector.

PART 4 – PIPE TESTING AND CLEANING:

- 4.1 Piping shall be tested before being insulated or concealed in any manner. Where leaks or defects develop, required corrections shall be made and tests repeated until systems are proven satisfactory.
- 4.2 Water piping systems shall be subjected to a hydrostatic test of 150 psi. The system shall be proven tight after a twenty-four (24) hour test.
- 4.3 The house drain line, interior storm sewers, interior rainwater conductors, and all soil, waste and vent piping shall be subjected to a hydrostatic test of not less than a 10-foot head or an air test of not less than 5 psi and shall hold for 15 minutes.
- 4.4 Exterior sewer lines to the termination point outside the building shall be subject to a ten-foot hydrostatic test or an approved smoke test. These lines shall be subjected to a second test after 2 feet of backfill has been properly installed.
- 4.5 After fixtures have been installed, the entire plumbing system, exclusive of the house sewer, shall be subjected to an air pressure test equivalent to one inch water column and proven tight. The Contractor responsible shall furnish and install all of the test tees required, including those for isolating any portion of the system for tests.
- 4.6 The Contractor shall perform all additional tests that may be required by the Department of Health or other governing agency.
- 4.7 Any leaks or imperfections found shall be corrected and a new test run until satisfactory results are obtained. The cost of repair or restoration of surfaces damaged by leaks in any system shall be borne by the Contractor.

4.8 Contractor shall notify TAB Agency in writing that the domestic water system has been flushed, cleaned and ready for sterilization or sanitizing. No chemicals are to be added to this system until all balancing has been completed for risk of contamination. The TAB firm is to properly notify all parties in writing when they have completed this portion of testing. If not properly coordinated, then the system will require additional sterilization and sanitizing at the Contractor's expense. Refer to TESTING, BALANCING, LUBRICATION AND ADJUSTMENTS Specification Section.

PART 5 – PITCH OF PIPING:

- All piping systems shall be installed so as to drain to a low point. Certain minimum pitches shall be required for this drainage. For proper flow and/or for proper operation, the following pitches shall be required:
- 5.2 INTERIOR SOIL, WASTE AND VENT PIPING: 1/4" per foot in direction of flow where possible but in no case less than 1/8" per foot.
- 5.3 CONDENSATE DRAIN LINES FROM COOLING EQUIPMENT: Not less than 1/4" per foot in direction of flow.
- 5.4 ALL OTHER LINES: Provide ample pitch to a low point to allow 100 percent drainage of the system.

PART 6 - EXTERIOR APPLICATIONS (SITE WORK):

- 6.1 SITE DOMESTIC WATER PIPING (PIPE SIZE 3" AND LESS): SDR 21 PVC pressure-rated conforming to ASTM D1784 and ASTM D2241 with a cell classification of 12454 (specific gravity 1.4, tensile strength 7,000 psi, tensile modulus 400,000 psi, 1ZOD impact strength 0.65 lb./in.), with integral bell to utilize gasketing system for sealing and meeting specification defined in ASTM F477. Pipe shall be rated for 200 psi and shall be NSF listed. Diamond Plastics Corporation Pressure Rated PVC Pipe or equal.
- 6.2 SITE SANITARY SEWER: Refer to the Civil Plans and Specifications.
- 6.3 SITE STORM SEWER: Refer to the Civil Plans and Specifications.
- 6.4 SITE FIRE PROTECTION: Refer to the Civil Plans and Specifications.

PART 7 – PLUMBING PIPING APPLICATIONS:

- 7.1 SOIL, WASTE AND VENT PIPING (BELOW SLAB):
- 7.1.1 Schedule 40 PVC pipe with drainage pattern fittings and solvent cement joints made in accordance with the Plumbing Code (ASTM D2665 & D1784). PVC pipe shall not be installed where wastewater applications exceed 140 deg F.
- 7.1.2 Piping below slab shall be a minimum of 2" in size.
- 7.2 SOIL, WASTE AND VENT PIPING (ABOVE SLAB):
- 7.2.1 Service weight hubless cast iron pipe with manufacturer's approved bands. No-hub cast-iron and fittings shall be produced and labeled ASTM 888 or CISPI 301. No-hub couplings shall be produced and labeled

- as ASTM C1277, C1563, or CISPI 310.
- 7.2.2 Service weight cast iron hub and spigot piping with compression gasket joints. Service-weight cast-iron pipe and fittings shall be produced and labeled as ASTMA74 and C1563.
- 7.3 DOMESTIC COLD, HOT AND RECIRCULATING HOT WATER PIPING (ABOVE SLAB):
- 7.3.1 Type "L" hard copper tubing with wrought copper fittings with lead free solder equivalent in performance to 95/5. (Maximum lead content of solder and flux is 2%).
- 7.4 DOMESTIC COLD, HOT AND RECIRCULATING HOT WATER PIPING (BELOW SLAB): Type "K" hard or soft copper tubing with wrought copper fittings and brazed joints. There shall be no joints beneath slabs.
- 7.5 WATER HEATER RELIEF LINE: Type "M" copper tubing with sweat fittings and 95/5 solder.
- 7.6 FIRE PROTECTION: Refer to Specification Section FIRE PROTECTION.

PART 8 – HVAC PIPING APPLICATIONS

- 8.1 HVAC HYDRONIC PIPING:
- 8.1.1 System Types:
 - Geothermal Heat Pump Water
- 8.1.2 2" and Smaller: Schedule 40 black steel pipe with screwed fittings or Type "L" hard copper tubing with wrought copper fittings and 95/5 solder.
- 8.1.3 Schedule 40 Victaulic 107/W07 or approved mechanical grooved pipe couplings and fittings with a minimum 125# rating. Install gaskets as recommended by the manufacturer. Piping system shall be rated for minimum of 250 degrees F water temperature. Mechanical grooved piping may not be used if system water temperature exceeds 250°F. All grooved components must be of one manufacturer.
- 8.2 GEOTHERMAL/HEAT PUMP LOOP PIPING:
- 8.2.1 Mains and branches Piping shall be virgin polyethylene with a PE 3408 piping formulation and 345464C or greater cell classification. Pipe shall be SDR 15.5, minimum pressure rating of 110 psi at 73.4°F.
- 8.2.2 Individual Heat Pump Runouts Type "L" hard copper tubing with wrought copper fittings and 95/5 solder.
- 8.2.3 Special Note: Takeoffs and branch piping to individual coils or heat pumps shall not be connected to the top of hydronic mains. Connection to mains shall be at the side of the main. Also refer to details on the drawings.
- 8.2.4 Transitions from HDPE to Copper Factory Manufactured Transition required with brass or stainless steel threads. No metal threads shall be inserted into polyethylene piping, and no polyethylene threads shall be inserted into metal piping.
- 8.2.5 The only acceptable method for joining pipe is by a heat fusion process. Pipe shall be butt or socket fused

in accordance with pipe manufacturer's procedures. All piping work shall be performed in accordance with Specification Section – GEOTHERMAL LOOP SYSTEM. Victaulic style 905/908 couplings may be utilized on above ground HDPE applications.

- 8.3 EXTERIOR GEOTHERMAL PIPING: Refer to Specification Section GEOTHERMAL LOOP SYSTEM.
- 8.4 AIR VENT DISCHARGE LINES: Type "L" soft copper; wrought copper fittings, 95/5 solder. Pipe to a suitable drainage location.
- 8.5 CONDENSATE DRAIN LINES: Schedule 40 PVC with solvent welded fittings.

PART 9 - ABOVE CEILING PIPING RELOCATION:

- 9.1 Include in this project, the relocation of the following piping systems:
 - Offset (4), 1" domestic water pipes, with (4) elbows, insulated and 20 feet total length.
 - Offset (4), 1-1/2" domestic pipes, with (4) elbows, insulated and 20 feet total length.
 - Offset (4), 2" sanitary pipes, with (4) elbows and 20 feet total length.
 - Offset (4), 4" sanitary pipes, with (4) elbows and 20 feet total length.
 - Offset (4), 1-1/4" hydronic hot water pipes, with (4) elbows, insulated and 20 feet total length.
 - Offset (4), 2" hydronic hot water pipes, with (4) elbows, insulated and 20 feet total length.
- 9.2 During Construction, the Contract Sum shall be increased OR decreased based on Contract unit prices for each of the above.

SECTION 20 1305 - GEOTHERMAL LOOP SYSTEM

PART 1 – GENERAL:

1.1 The Contractor's attention is directed to the General and Special Conditions, GENERAL PROVISIONS - MECHANICAL and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section, and which are hereby made a part of the work specified in this section.

PART 2 - CONTRACTOR QUALIFICATIONS:

- 2.1 The loop installer/contractor shall been in business for a minimum of 5-years. Previous employment at a different business does not apply. The contractor shall have installed two well fields of similar size.
- 2.2 Ground heat exchanger fabricators shall have completed a heat fusion school in which each participant has performed a heat fusion procedure under direct supervision of a IGSHPA Certified Heat Fusion Technician. The Fusion Technician shall be thoroughly familiar with heat fusion procedures and have had formal training at a heat fusion school under direct supervision of an IGSHPA certified instructor.
- 2.3 Local and state laws, ordinances, and regulations as they pertain to buried pipe systems shall be strictly followed.

PART 3 – SUBMITTALS:

- 3.1 Reference Specification Section REQUIRED SHOP DRAWINGS, ETC. for additional requirements.
- 3.2 Submit the following items before construction activities:
 - Manufacturer's specification sheets and installation instruction for each component of the system, showing manufacturer, pipe or tube weight, pressure rating, fitting type, and joint type for each piping system.
 - Manufacturer's data for geothermal vault and components.
 - Manufacturer's data for the grout mixture. Submit details on grouting procedures, methods, and equipment.
 - Written flushing, purging, pressure, and flow testing plan. Include purge cart cut sheets.
- 3.3 Submit the following items after construction activities:
 - Geothermal loop water treatment test results.
 - Grout testing results for 5% of vertical bores.
 - Written results of flushing, purging, pressure, and flow testing.
 - Schedule dates for warranty period flushing, purging, etc.
 - Survey/Record Drawings with dimensions from fixed benchmarks, depths, and sizes.
 - Written tracer wire test results.
 - Submission of the completed items above is a condition of acceptance and closeout for the Project.

PART 4 – WARRANTY:

4.1 The entire ground loop system and backfill from a point 5'-0" outside the building foot print and shall be warranted for five years from date of substantial completion against any leakage or failure. Any work / expense required to access a leak will be the responsibility of the geothermal contractor.

PART 5 – PIPING MATERIALS:

- Acceptable pipe materials for the underground buried portion of the ground heat exchanger are polyethylene as specified in this Section. Piping shall be listed for closed-loop ground source geothermal application. The pipe and fittings of the buried system shall be warranted by the manufacturer for ground source heat pump service.
- 5.2 ACCEPTABLE MANUFACTURERS: GSC Energy Pro, Driscoplex 5300 Climate Guard, Centennial Plastics, Charter Plastics, Flying W Plastics, Lamson Vylon Pipe, PolyPipe, Inc.
- 5.3 Manufacturer shall supply a written warranty of 50 years or greater, specifying material replacement and labor allowance.
- All pipe and heat fused materials shall be manufactured from a virgin polyethylene extrusion compound material in accordance with ASTM D-3350, Sections 4.1 and 4.2. Pipe shall be manufactured to outside diameters, wall thickness, and respective tolerances as specified in ASTM D-3035 or D-2447. Fittings shall be manufactured to diameters, wall thicknesses, and respective tolerances as specified in ASTM D-2683 for socket fittings and ASTM F-1055 for electrofusion fittings.
- The pipe material shall maintain a 1600 psi hydrostatic design basis at 73.4 degrees F per ASTM D-2837 and shall be listed in PPI TR4 as a PE4710 piping formulation. The material shall be high density, polyethylene extrusion compound having a cell classification of PE445574C as specified in ASTM D-3350 except this material shall exhibit zero failures (F0) when tested for 192 or more hours under ASTM D-1693, condition C, as required in ASTM D-3350.
- 5.6 Pipe shall be manufactured in accordance with ASTM D-3035 and sized as follows:
 - Pipe sizes 1¼" or less: DR 11 AND rated @ 200 psi.
 - Pipe sizes $1\frac{1}{2}$ " 2": DR 15.5
 - Pipe sizes 3" and larger: DR 17
- 5.7 Sufficient information shall be permanently marked on the length of the pipe as defined by the appropriate ASTM pipe standard. Piping shall also have permanent factory length markings.
- 5.8 Electric Conduit: Provide Schedule 40 PVC piping and fittings with solvent welded joints.

PART 6 – PIPE JOINING METHODS:

- 6.1 The only acceptable method for joining buried pipe systems is by a heat fusion process.
- 6.2 Polyethylene pipe shall be butt or socket fused in accordance with pipe manufacturer's procedures.
- 6.3 "U" bends fittings shall be used at bottom of the vertical bores and installed by the bore loop manufacturer.

"U" bend fitting shall be manufactured by manufacturer of piping materials.

PART 7 – FLUSHING, PURGING, PRESSURE AND FLOW TESTING:

- 7.1 Refer to Specification Section PIPE FILLING, CLEANING, FLUSHING, PURGING AND CHEMICAL TREATMENT for additional information and coordination requirements.
- 7.2 Flushing and pressure testing to be witnessed by the commissioning agent, and report submitted to the Engineer.
- 7.3 Successful flushing and purging is critical and shall be accomplished and documented. Notify Engineer prior to flushing and purging. Submit flushing and purging plan to engineer two (2) months prior to commencing this work.
- 7.4 Vertical loops shall be pressure tested before installation, and all horizontal components of the ground heat exchanger will be flushed, pressure and flow tested prior to backfilling. All fusion joints and loop lengths shall be checked to verify that no leaks have occurred due to fusion joining or shipping damage. Heat exchangers shall be tested hydrostatically at 100 psi. No leaks shall occur within a 120 minute period.
- 7.5 The type of purging cart/equipment is critical to successful flushing and purging. The purge cart shall be sterilized before each use. The purge cart shall include a pump that minimally develops 350 gpm of flow at 130 feet of head pressure developed. It shall include a large purge return tank, interconnection piping, inlet/outlet pressure gauges, water flow readout display reversing valve and 4" flexible hose connection. Coordinate so that the vault purge ports match purge cart couplings. The first circuit purged after hose connection shall be purged minimally one hour to remove extra air introduced from the hoses. Once the first circuit is purged, minimally purge other circuits for 30 minutes. Once all well circuits are purged, close all circuit valves and purge piping between vaults and building heat exchanger using building purge ports.
- 7.6 Flow rates shall be compared to calculated values to assure that there is no blockage or kinking of any pipe. Submit written verification of compliance.
- 7.7 A minimum velocity of 3 ft/sec in each piping section must be maintained until all air is removed. The system shall also be forward and reversed to remove all debris. Purging of one wellfield row shall be witnessed by the Engineer, Owner, Construction Manager and the Commissioning Agent. The Commissioning Agent shall confirm the minimum velocities are obtained during the purging process and shall also measure supply and return pressures. The Contractor shall provide all means and methods necessary to ensure minimum velocities are obtained. After one test is confirmed, the other wellfield rows shall be tested utilizing the same procedure. The Commissioning Agent shall confirm all minimum circuit, flow rates are obtained for all wellfield piping.

PART 8 – HORIZONTAL PIPING SYSTEMS:

- 8.1 Refer to Section EXCAVATION, BACKFILLING AND TRENCHING AND GRADING for additional requirements.
- 8.2 Sharp bending of pipe around trench corners shall be prevented by using a shovel to round corners, or by installing an appropriate elbow fitting. Manufacturer's procedures shall be followed.
- 8.3 Backfilling procedure will include prevention of any sharp-edged rocks from coming into contact with the pipe by removal of the rocks before backfilling, backfill with #8 rock. Provide a minimum of 6" cover over

pipe with back filled material. Clods resulting from use of a backhoe shall be broken so as not to form air pockets around the pipe which will reduce heat conduction between the earth and the pipe. The flow of backfill soil must be controlled to prevent bridging and the formation of air pockets. Several slow passes with an angled backfill blade are required. Flooding is required to assure removal or air pockets. Minimum bury depth of piping shall be 36" to top of pipe.

- 8.4 Horizontal return bends must be backfilled by hand to properly support the pipes and prevent kinking.
- 8.5 Install continuous tracer wires on each wellfield circuit in and out of the geothermal vault and the building. Provide an additional 36" of coiled tracer wire on each end and attach in vault at each circuit. Provide an additional 36" of coiled tracer wire on each end and attach in building at each circuit riser. Perform tracer wire testing for all tracer wires in conjunction with the Owner/Engineer this is a condition of acceptance and closeout.
- 8.6 Install continuous tracer wires on each wellfield circuit in and out of the building. Provide an additional 36" of coiled tracer wire on each end and attach in building at each circuit riser. Perform tracer wire testing for all tracer wires in conjunction with the Owner/Engineer this is a condition of acceptance and closeout.

PART 9 – BORE HOLE AND GROUTING:

- 9.1 The Contractor shall accept the site as-is and is responsible for all required steel casings. If an area of voids is encountered, the Contractor shall either fill or re-drill wells in an approved area and extend piping to them. No night drilling will be allowed.
- 9.2 The Contractor shall bore wells of a sufficient diameter to allow installation of the piping and U-bend and a 1-1/4" (minimum) HDPE tremie pipe for grout installation but shall be no less than 4 ½".
- 9.3 Bore holes shall be grouted to ensure good heat transfer. Local and state laws and regulations for grouting and backfilling shall be followed. See IGSHPA Grouting Procedures Manual for detailed grouting procedures.
- 9.4 Vertical bores shall be drilled to sufficient depths to ensure that the entire length of U-tube is inserted. This may require the bore to be drilled several feet deeper than the U-tube length.
- 9.5 All U-tube joints shall be visually inspected for integrity as specified by the pipe manufacturer (alignment of joints, proper bead roll-back) before insertion into the bore hole.
- 9.6 The bore hole annulus shall be completely grouted to ensure there are no air voids and to ensure there is consistent contact between the vertical piping and the bore hole formation. This will require the bore annulus to be filled with grout from the bottom to the top with a "tremie" tube.
- 9.7 The entire bore shall be grouted with a thermally enhanced grout mixture with a thermal conductivity of 1.00 Btu/hr-ft-°F. Grout shall be GeoPro Thermal Grout Lite 100 bentonite mixture or approved equal. Mixture shall be field mixed in strict accordance with manufacturer's recommendations. Grout mixture shall be mechanically pumped with a positive displacement pump into bore hole from bottom to top utilizing a tremie tube.
- 9.8 Through the course of the project, sample grout specimens shall be randomly (chosen by Engineer or Owner's Testing Agent) taken of the mixed grouting material by this Contractor for 5% of the vertical bores. An analysis shall be performed by the grout manufacturer to verify proper thermal performance and grout

mixture. This Contractor shall submit these reports to the Owner, Architect and Engineer to verify compliance with the installation specifications.

PART 10 – HEAT TRANSFER FLUID:

- 10.1 ACCEPTABLE MANUFACTURERS: Environol, DuPont, Dow, Union Carbide.
- The heat transfer fluid shall be an ethanol based solution non-toxic antifreeze heat transfer fluid formulated specifically for use in geothermal heat pump systems.
- 10.3 Provide and install sufficient heat transfer fluid to obtain a minimum of 20°F freezing point. The Contractor shall test the final solution and provide written confirmation that the freeze point is obtained and appropriate backup data and literature. Provide a sample of the final solution to the Owner to leave in the mechanical room.
- The heat transfer fluid shall be a denatured alcohol based solution containing ethyl alcohol, DI water, sodium metal bisulfite, pine oil, denatonium benzoate, isoprophyl alcohol, methylene blue with the following characteristics before dilution (1) Boil Point-173 degrees F, (2) Freezing Point-150 degrees F, (3) Vapor Pressure-44.6mm Hg at 68 degrees F, (4) Specific Gravity-0.80 at 60 degrees F, (5) Vapor Density (AIR-1)-1.59, (6) Solubility in Water-Substantially.
- 10.5 The heat transfer fluid shall include corrosion inhibitors.
- The fluid shall not exceed the following National Fire Protection Association (NFPA) Hazardous Material Rating Codes (1) Health-0, (2) Flammability-3. (3) Reactivity-0.
- The heat transfer fluid shall be handled in strict accordance with US Department of Transportation Regulations, NFPA Standards, and all local and state codes and regulations.
- All scale, rust, sediment, pipe dope, etc., must be removed from the system. The piping system must be thoroughly cleaned before introducing the heat transfer fluid into the system.
- 10.9 The heat transfer fluid shall be used to charge the hydronic system.

PART 11 - ADDITIONAL INSTALLATION REQUIREMENTS:

- 11.1 Underground land survey of the entire geothermal wellfield system per GENERAL PROVISIONS MECHANICAL. This shall include all horizontal piping, vaults, vertical bore locations and dimension from above grade fixed benchmarks. The underground survey shall be included in the closeout documentation.
- 11.2 DUST CONTROL: The Contractor shall be responsible for and shall provide dust control. Dust shall not be allowed to leave the construction site boundaries, and furthermore, shall not be allowed to enter the building or accumulate on the building exterior. When needed to meet these requirements, the Contractor shall provide and operate a mechanical dust collection system to control dust at the source. Mechanical dust collection system shall consist of collection hood at the source ducted to a dust collector which separates dust from the airstream. Dust shall be collected into sealed containers for disposal by the Contractor. Water spraying may be used but shall not be considered a substitute for mechanical dust collection at the source when required.
- 11.3 SURFACE WATER / MUD / SLURRY CONTROL: The Contractor shall be responsible for and shall provide

PROJECT NO. 24-179.000 Harrison REMC - Addition and Renovation Harrison REMC Geothermal 20 1305 - 6 04/24/2025

control of all ground flowing fluids resulting from drilling operations. The Contractor shall erect silt fences or other structures as required to contain drill cuttings, mud, slurry, etc. within the construction site boundaries. In the event this requirement is not met, the Contractor shall provide all remediation measures as required by all authorities having jurisdiction over such events.

SECTION 20 1310 - PIPE FILLING, CLEANING, FLUSHING, PURGING AND CHEMICAL TREATMENT

PART 1 – GENERAL:

- 1.1 The Contractor's attention is directed to the General and Special Conditions, GENERAL PROVISIONS MECHANICAL and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section, and which are hereby made a part of the work specified in this section.
- 1.2 Review the Specification Section REQUIRED SHOP DRAWINGS, ETC., and provide all documentations called for therein.
- 1.3 Through coordination with other Contractors, Vendors and Suppliers associated with this Project, this Contractor shall ensure a complete, 100% functional, tested, inspected, and approved systems. Claims for additional cost or change orders will immediately be rejected.
- 1.4 Maintain a water treatment program for the closed loop piping systems. It is the Contractor's responsibility to contact the engineer 2 weeks in advance to any treatments performed on the systems. It is the Engineer's discretion whether or not this process should be monitored after notification.
- 1.5 A pre-installation meeting shall be held with the Owner, Architect, Engineer, General Contractor, Mechanical Contractor, Pipe Fitter Foreman, Geothermal Contractor, and Chemical Treatment Contractor to discuss goals and expectations for cleaning, flushing, purging and chemical treatment.
- 1.6 Chemicals, equipment, testing services, and chemical application shall be supplied by a single water treatment company for undivided responsibility. The water treatment company shall be a recognized specialist, active in the field of commercial/industrial water treatment for at least 5 years. The water treatment company shall have regional water analysis laboratories, service department, and full time representatives located within the area of the job site or facility.
- 1.7 Prior to any construction, the Contractor shall sample the existing closed loop chemicals and provide chemical treatment water quality analysis. Provide levels for all items noted in paragraph "Water Quality Minimum Performance Requirements for Closed Loops". Provide a report to the Engineer.
- 1.8 Be advised the existing loop contains an anti-freeze mixture. Prior to any construction, the Contractor shall sample the existing closed loop and provide anti-freeze mixture data.
- 1.9 Furnish initial supply of the closed loop chemicals for each system. This contractor shall retest the systems after 3, 6, 9 and 12 months upon substantial completion to verify the proper dosage is in each system. Provide all closed loop chemicals and anti-freeze for the first year. The Contractor shall determine the appropriate chemical volumes for each system. Each system's water shall be tested for proper chemical parameters, clarity, and biological activity. If needed, provide chemical addition, including anti-freeze. Provide any laboratory and technical assistance required to achieve a successful program.
- 1.10 As a condition of acceptance and project closeout, a summary of water quality and treatment shall be provided in writing to the Owner and/or Engineer after the water treatment services have been successfully completed. The closeout documentation shall include dates for warranty testing.

- 1.11 Water quality for HVAC systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of HVAC equipment without creating a hazard to operating personnel or the environment. Base HVAC water treatment on quality of water available at Project site, HVAC system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.
- 1.12 WATER QUALITY MINIMUM PERFORMANCE REQUIREMENTS FOR CLOSED LOOPS:
 - Closed hydronic systems shall maintain a pH value within 9 10.5 pH for iron and copper piping loops.
 - Total Anaerobic Plate Count Maintain a maximum value of 100 organisms/ml.
 - Nitrate Reducers (Denitrifying Bacteria) Maintain below a maximum value of 10,000 organisms/ml.
 - Sulfate Reducers Maintain below a maximum value of 200 organisms/ml.
 - Iron Bacteria Maintain below a maximum value of 100 organisms/ml.
 - Slime Bacteria Maintain below a maximum value of 1,000 organisms/ml.

PART 2 – CLEANING AND FLUSHING OF HYDRONIC PIPING:

- 2.1 This project consists of the following Hydronic Piping Loops:
 - Geothermal Heat Pump Water
- 2.2 There are several precautions which must be observed during piping installation. This contractor is advised to read all of the manufacturer's instructions prior to commencing the installation. This cleaning and flushing of the systems must be accomplished. Refer to Specification Section GEOTHERMAL LOOP SYSTEM for geothermal system requirements.
- 2.3 All water circulating systems for the project shall be thoroughly cleaned before placing in operation to rid the system of dirt, piping compound, mill scale, oil and any and all other material foreign to the water. During construction, extreme care shall be exercised to prevent all dirt and other foreign matter from entering the pipe or other parts of the system. Pipe stored on the project shall have the open ends capped and equipment shall have all openings fully protected. Before erection, each piece of pipe, fitting or valve shall be visually examined, and all dirt removed.
- 2.4 After the piping is complete:
- 2.4.1 The Contractor shall first fill the piping loops and all runouts with clear water. The loop water shall be circulated for one hour with make-up water open and boiler drain open to accomplish initial flushing of the system.
- 2.4.2 After initial flushing, all strainers shall be cleaned, and the individual terminal devices and coils shall be connected permanently to the supply and return runouts conditions and then add trisodium phosphate in an aqueous solution to the system at the proportion of one pound per fifty gallons of water in the system.
- 2.4.3 After the system is filled with this solution, the loop shall be allowed to circulate for 24 hours.
- 2.4.4 The Chemical Treatment Contractor shall be given notice by the Contractor of scheduling this cleaning and, if the Engineer's representative deems it necessary, the operation shall be repeated.
- 2.4.5 After the system has been completely cleaned as specified herein, it shall be tested by litmus paper or other

dependable method and shall be left on the slightly alkaline side.

- 2.4.6 If the system is found to be still on the acid side, the cleaning by use of Trisodium Phosphate shall be repeated.
- 2.4.7 After the cleaning including all strainers and flushing is complete, and approved by CMTA, the Contractor shall provide the proper water treatment for the system.
- 2.5 After the heat pump loop is complete:
- 2.5.1 The Contractor shall first close the WSHP isolation valves and open the WSHP bypass valves.
- 2.5.2 Fill the piping loops and all runouts with clear water. The loop water shall be circulated for one hour with make-up water open and boiler drain open to accomplish initial flushing of the system.
- 2.5.3 After initial flushing, all strainers shall be cleaned, and the Contractor shall open the WSHP isolation valves and close the WSHP bypass valves and then add trisodium phosphate in an aqueous solution to the system at the proportion of one pound per fifty gallons of water in the system.
- 2.5.4 After the system is filled with this solution, the loop shall be allowed to circulate for 24 hours.
- 2.5.5 The Chemical Treatment Contractor shall be given notice by the Contractor of scheduling this cleaning and, if the Engineer's representative deems it necessary, the operation shall be repeated.
- 2.5.6 After the system has been completely cleaned as specified herein, it shall be tested by litmus paper or other dependable method and shall be left on the slightly alkaline side.
- 2.5.7 If the system is found to be still on the acid side, the cleaning by use of Trisodium Phosphate shall be repeated.
- 2.5.8 After the cleaning, including all strainers and flushing is complete, and approved by CMTA, the Contractor shall provide the proper water treatment for the system.

SECTION 20 2100 - VALVES

PART 1 – GENERAL:

- 1.1 The Contractor's attention is directed to the General and Special Conditions, GENERAL PROVISIONS MECHANICAL and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section, and which are hereby made a part of the work specified in this section.
- 1.2 Each Contractor shall provide all valves required to control, maintain, and direct flow of all fluid systems indicated or specified. This shall include but may not be limited to all valves of all types including balancing valves, air vents, drain valves, check valves, special valves for special systems, etc., for all Mechanical Systems.
- 1.3 ACCEPTABLE MANUFACTURERS: Lunkenheimer, Powell, Nibco, Crane, Jenkins, T & S Brass, Walworth, Milwaukee, DeZurik, Consolidated Valve Industries, Inc., Bell & Gossett, Apollo.
- 1.4 The following type valves shall not be acceptable: Zinc, plastic, fiber or non-metallic.
- 1.5 Each type of valve shall be of one manufacturer, i.e., ball valves, one manufacturer, butterfly valves, one manufacturer, etc.
- 1.6 All valves shall comply with current Federal, State and Local Codes. All valves shall be new and of first quality. All valves shall be designed and rated for the service to which they are applied. Zinc, plastic, fiber, or non-metallic valves shall not be acceptable.
- 1.7 Contractor shall provide colored tape on ceiling tile where valves are located above ceiling. Provide access panels where valves are located above hard ceiling.

PART 2 - SITE WATER APPLICATIONS:

2.1 REFER TO CIVIL PLANS

PART 3 – DOMESTIC WATER APPLICATIONS:

- 3.1 GLOBE VALVES (2" AND UNDER): Globe Valves shall have bronze body, bonnet, and disc holder. Globe valve shall have union bonnet, integral seat, teflon or stainless steel renewable disc and be rated for 150 psi working pressure. Globe valve shall be Nibco T-235 for threaded ends or Nibco S-235 for solder ends.
- 3.2 CHECK VALVE (2" AND UNDER): Check valve shall have bronze body, disc, and hinge. check valve shall be Y-pattern type, horizontal swing, renewable disc and rated for 150 psi working pressure. Check valve shall be Nibco T-413 for threaded ends or Nibco S-413 for solder ends.
- 3.3 THREE PIECE BALL VALVE (2" AND UNDER): Ball valve shall have bronze body, ball, and reinforced, watertight seat. Valve shall be three piece, swing-out, construction to facilitate inspection and repair. Valve shall be "full-port" type. Valve handle shall only require quarter turn to go from full open to full close. The handle shall be removable with vinyl grip. Valve shall be rated for 180 degrees F water temperature and 150 psi working pressure. Ball valve shall be Nibco T-595 for threaded ends and Nibco S-595 for solder ends.

- 3.4 STRAINERS (2" AND UNDER): Watts 77S Series "Y" type strainer with cast iron body and threaded ends. Screen shall be 20 mesh stainless steel. Strainer shall be provided with cleanout plug and be rated for 200 psi working pressure.
- 3.5 PRESSURE REDUCING VALVES: Watts #U5B water pressure reading valve with bronze body, bolted bonnet, integral stainless steel strainer and outlet water pressure gauge. Internal disc, diaphragm and stainless steel seat shall all be removable. Valve shall be rated for inlet water pressures up to 300 psi. Water pressure reducing valves shall be provided for all equipment where water pressure exceeds the equipment manufacturer's ratings.
- 3.6 VACUUM BREAKERS: Watts #288A atmospheric type vacuum breaker with brass body. Vacuum breaker shall be rated for 210 degrees F and 125 psi working pressure and shall meet ASSE Standard 1001.
- 3.7 DOUBLE CHECK VALVE: Double check valve shall have bronze body construction and be provided with inlet strainer, two (2) gate valves for isolation and three (3) test ports. Assembly shall be rated for 110 degrees F water temperature and 175 psi water pressure. Assembly must meet requirements of AWWA Standard C506. For sizes 2" and less, provide Watts #900 (or equal) with threaded ends. For sizes 2½" and larger, provide Watts #709 (or equal) with flange ends.
- 3.8 REDUCED PRESSURE BACKFLOW PREVENTERS: Reduced pressure backflow preventers shall be provided with inlet strainer, two (2) gate valves/ball valves for isolation, three (3) test ports and air gap fitting. Assembly shall be rated for 110 degrees F water temperature and 175 psi water pressure. RPBP shall be UL listed and meet AWWA C511 standards. Watts #LF909 or equal by Wilkins or Conbraco. All valves 3" and less in size shall bronze body lead-free construction, over 3" in size shall have epoxy coated cast iron bodies. Assemblies 2" and under in size shall have threaded ends, over 2" in size shall have flange ends. Perform backflow preventer test and provide results with closeout documentation. All reduced pressure backflow preventers shall be mounted a maximum of 48" above the finished floor, unless noted otherwise.
- 3.9 BALANCING VALVE: Furnish and install balancing valves as indicated on the plans. The balancing valve shall be self-contained and fully automatic without additional piping or control mechanisms. Balancing valve shall be CircuitSolver as manufactured by ThermOmegaTech, Inc. or equal.

PART 4 – HVAC APPLICATIONS:

- 4.1 GATE VALVE (2" AND UNDER): Use ball valves as specified.
- 4.2 GATE VALVE (2" AND SMALLER): Gate valve shall have bronze body, union bonnet, non-rising stem solid wedge and handwheel. Gate valve shall be rated for 200 psi working pressure. Gate valve shall be Nibco T-136 for threaded ends and Nibco S-136 for solder ends.
- 4.3 GATE VALVE (2½" AND LARGER): Gate valve shall have cast iron body with cast iron bolted bonnet, non-rising stem, solid cast iron wedge and handwheel. Gate valve shall be rated for 200 psi working pressure. Gate valve shall be Nibco F-619 for flanged ends and Nibco T-619 for threaded ends. Threaded end valve allowed for sizes 3" or less only.
- 4.4 GLOBE VALVE (2" AND UNDER): Globe valve shall have bronze body, bonnet, and disc holder. Globe valve shall have union bonnet, integral seat, teflon or stainless steel renewable disc and be rated for 200 psi working pressure. Globe valve shall be Nibco T-235 for threaded ends or Nibco S-235 for solder ends.

- 4.5 GLOBE VALVES (2½" AND OVER): Globe valve shall have cast iron body, bolted bonnet, bronze disc, renewable seat and have outside screw and yoke. Handwheel to be cast iron. Globe vale to be rated for 200 psi working pressure. Globe valve shall be Nibco F-718 for flanged ends of Nibco T-718 for threaded ends. Threaded ends valve allowed for sizes 3" and less only.
- 4.6 CHECK VALVES (2" AND LESS): Check valve shall have bronze body, disc, and hinge. Check valve shall be Y-pattern type horizontal swing, renewable disc and rated for 200 psi working pressure. Check valve shall be Nibco T-413 for threaded ends or Nibco S-413 for solder ends.
- 4.7 CHECK VALVES (2½" AND LARGER): Check valve shall have cast iron body and cast iron bolted bonnet the disc and seat ring shall be bronze. Check valve shall be horizontal swing with renewable seat and disc. Valve shall be rated for 200 psi working pressure. Check valve shall be Nibco F-918 for flanged ends and Nibco T-918 for threaded ends. Threaded ends valve allowed for sizes 3" and less only. **Delete following if grooved system not approved.** Victaulic 716/W716 are acceptable with grooved piping systems.
- 4.8 THREE PIECE BALL VALVES (2" AND UNDER): Ball valve shall have bronze body, ball, and reinforced, watertight seat. Valve shall be the piece, swing-out, construction to facilitate inspections and repair. Valve shall be "full port" type. Valve handle shall only require quarter turn to go from full open to full close. The handle shall be removable with vinyl grip. Valve shall be rated for 250 degrees F water temperature and 200 psi working pressure. Ball valve shall be Nibco T-595 for threaded ends and Nibco S-595 for solder ends.
- 4.9 STRAINERS (2" AND UNDER): Watts 77S Series "Y" type strainer with cast iron body and threaded ends. Screen shall be 20 mesh stainless steel. Strainer shall be provided with cleanout plug and be rated for 200 psi working pressure.
- 4.10 STRAINERS (2½" AND LARGER): Watts 77F Series "Y" type strainer with semi-steel body and flanged ends. Screen shall be 20 mesh stainless steel. Strainer shall be provided with bolted cleanout and be rated for 200 psi working pressure.
- 4.11 BALANCING VALVE (4" AND LESS): Balancing valve shall have bronze or cast iron body. Valves to have differential pressure readout ports across valve seat area with integral check valves. Valve shall be equipped with memory stop. Valves to have threaded ends for sizes 3" and less, flanged ends for larger sizes. Valve to be provided with performed molded insulation casing. Design working pressure and temperature to be 200 psi at 250 degrees F balancing valve shall be similar to Bell & Gossett Model CB or Nexus UltraMB Model MBF. Provide with balancing valves, one (1) water gpm readout kit to be turned over to Owner which shall include a differential pressure meter with full scale overrange protection, hoses, readout probes, filters, carry and calculator.
- 4.12 FLEXIBLE CONNECTION: Pumpsaver SMP or equal braided stainless steel pump connector(s). Construction to be of annular corrugated stainless steel close-pitch hose with stainless steel overbraid. The corrugated metal hose, braid(s), and a stainless steel ring-ferrule/band (material gauge not less than .048") must be integrally seal-welded using a 100% circumferential, full-penetration TIG weld. End fittings shall be flat-face plate steel flanges with 150# ANSI drilling and outside diameter. Fittings must be attached using a 100% circumferential TIG weld. Braided stainless steel pump connector(s) must be suitable for operating temperatures up to 850 degrees F. The rated working pressure of the braided metal hose must have a minimum 4:1 safety factor. Each braided stainless steel pump connector shall be individually leak tested by the manufacturer using air-under-water or hydrostatic pressure. Flanged pump connectors shall be prepared for shipment using cut-to-length spacers, securely positioned between the flanges to prevent axial compression damage and maintain the manufactured length. Spacers must be removed prior to system

start up.

- 4.13 AUTOMATIC AIR VENT: Bell & Gossett Model 107A high capacity float actuated automatic air vent with cast iron body and bonnet. Vent to be rated for 150 psi working pressure and 240 degrees F working temperature. Pipe discharge to nearest floor drain unless noted otherwise.
- 4.14 MANUAL AIR VENT: Bell & Gossett Model 78 manual air vent with cast brass body and built-in check valve. Vent to be rated for 150 psi working pressure and 240 degrees F working temperature. Install with 12" length of 1/4" soft copper discharge piping unless noted otherwise.

SECTION 20 2200 - INSULATION - MECHANICAL

PART 1 – GENERAL:

- 1.1 The Contractor's attention is directed to the General and Special Conditions, GENERAL PROVISIONS MECHANICAL and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section, and which are hereby made a part of the work specified in this section.
- 1.2 Work under this section shall include all labor, equipment, accessories, materials, and services required to furnish and install all insulation, fittings and finishes for all mechanical systems specified herein and/or as indicated.
- 1.3 Application of insulation materials shall be performed in accordance with manufacturer's written recommendations. Where thickness of insulation is not specified, use applicable thickness recommended by manufacturer for specific use.
- 1.4 Insulation thicknesses shall comply with the latest version of ASHRAE 90.1 and IECC at a minimum.
- 1.5 All insulation materials shall be installed per the latest edition of the National Commercial and Industrial Insulation Standards.
- 1.6 Insulation shall be installed by a company regularly engaged in the application of insulation and any work deemed unacceptable by the Engineer shall be removed and properly installed at the expense of the Contractor.
- 1.7 The Contractor shall photograph any installations prior to concealment. This includes duct risers in chases and at rooftop equipment.

PART 2 – ACCEPTABLE MANUFACTURERS:

2.1 Johns Manville, Knauf, Owens-Corning.

PART 3 – FIRE RATINGS AND STANDARDS:

- 3.1 Insulations, jackets, facings, adhesives, mastics, tapes, fitting materials, etc. shall have composite fire and smoke hazard ratings as tested by ASTM E-84, NFPA 255 and UL 723 procedures not exceeding Flame Spread 25, Smoke Developed 50 and Fuel Contributed 50.
- 3.2 All products and their packaging shall bear a label indicating above requirements are not exceeded.
- 3.3 Fiber glass duct wrap shall meet the requirements of Scientific Certification Systems Certification or Greenguard Validation of Formaldehyde Free.
- 3.4 Fiber glass mechanical board shall meet the requirement of the Greenguard Standards for Low-Emitting Products.
- 3.5 Fiber glass pipe insulation shall meet the requirement of the Greenguard Gold level standard.

PART 4 - GENERAL APPLICATION REQUIREMENTS:

- "Concealed", where used herein, shall mean hidden from sight as in trenches, chases, furred spaces, pipe shafts, or above hung finished ceilings. "Exposed" shall mean that piping or equipment is not "concealed" as defined above. Piping and equipment in service tunnels, mechanical equipment rooms, storage areas, or unfinished rooms is to be considered "exposed".
- 4.2 Insulation shall be applied on clean, dry surfaces in a neat and workmanlike manner reflecting the best current practices in the trade. Insulation shall not be applied to piping, ductwork or equipment until tested, inspected and released for insulation.
- 4.3 Where more than one thickness of insulation is required, joints (both longitudinal and transverse) shall be staggered.
- All insulation shall be continuous through walls, ceiling openings and sleeves. However, insulation shall be broken through fire walls. All covered pipe and ductwork is to be located a sufficient distance from walls, other pipe, ductwork and other obstacles to permit the application of the full thickness of insulation specified. If necessary, extra fittings and pipe are to be used. No noticeable deformation of insulation or discontinuity of vapor seal, where required, will be accepted. Coordinate work with plumbers, pipe fitters, etc. to assure hanger locations agree with location of insulation inserts.
- 4.5 Existing and/or new insulation removed and/or damaged during course of construction shall be repaired or replaced by the Contractor at their expense.
- 4.6 Vapor barrier jackets shall be applied with a continuous unbroken vapor seal. Do not use staples through the jacket. NO EXCEPTIONS!
- 4.7 All insulation shall be installed with joints butted firmly together.
- 4.8 The Contractor shall ensure that all insulation (piping, ductwork, equipment, etc.) is completely continuous along all conduits, equipment, connection routes, etc. carrying cold fluids (air, water, other) and that condensation can, in no way, collect in or on the insulation, equipment, conduits, etc. Any such occurrence of condensation collection and/or damage therefrom shall be repaired solely at the expense of the Contractor.
- 4.9 Unless otherwise specified or allowed, closed cell type insulation shall not be acceptable.
- 4.10 Piping and ductwork supports, including hangers, straps, uni-strut and all-thread rods, for insulated piping and ductwork shall be insulated and vapor sealed a minimum of 18" minimum beyond the piping and ductwork to prevent condensing. Coordinate with Sheetmetal Contractor.

PART 5 – PIPING SYSTEMS:

- 5.1 Seal insulation and jacket at all points where insulation terminates at unions, flanges, valves, and equipment. This applies to hot water lines only as cold water lines require continuous insulation and vapor barrier.
- 5.2 Pipe insulation shall extend around valve bodies to above drain pans in hydronic equipment over pumps,

etc. to ensure no condensation drip or collection.

- Valves, flanges, and unions shall only be insulated when installed on cold fluid piping whose surface temperature will be at or below the dew point temperature of the ambient air.
- Insulation shall not extend through fire and smoke walls. Pack sleeve at fire and smoke wall with approved fire retardant packing similar to mineral wool and seal with approved sealant.
- 5.5 Metal insulation shields and inserts are required at all pipe hangers where the piping is insulated. Metal shields shall be constructed of galvanized steel, formed to a 180 degree arc. Insulation shields shall be the following size:

Pipe	Shield	Shield
Size	Gauge	Length
2" and less	20	12"
2 ½"- 4"	18	12"
5"- 10"	16	18"
Over 10"	14	24"

- Insulated pipes 2" in diameter and larger shall be additionally supported with wood inserts of sufficient compressive strength to carry the weight of the pipe and fluid. Inserts shall extend beyond extend beyond the hanger and shall be at least 6" in length.
- Provide premolded PVC insulated fitting covers on all pipe fittings, flanges, valves, and pipe terminations. Fittings shall be insulated by applying the proper factory precut insulation insert to the pipe fitting. The ends of the insulation insert shall be tucked snugly into the throat of the fitting and the edges adjacent to the pipe insulation tufted and tucked in, fully insulating the pipe fitting. The proper thickness of insulation must be applied to keep the jacket temperature less than 150°F. An approved vapor retarder mastic compatible with the PVC shall be applied around the edges of the adjoining pipe insulation and on the fitting cover throat overlap seam. The PVC fitting cover shall then be applied and secured with pressure sensitive tape along the circumferential edges. The tape shall extend over the adjacent pipe insulation and have an overlap on itself at least 2" on the downward side. On fittings where the operating temperature is below 50°F, two or more layers of the insulation inserts shall be applied with the first layer being secured with a few wrappings of fiber glass yarn to eliminate voids. One additional insert shall be used for each additional 1" of pipe insulation above 1-1/2". All joints shall be fully sealed.
- PIPE INSULATION MATERIAL: Insulation shall be Knauf "Earthwool 1000" Pipe Insulation ASJ+/SSL+" or approved equivalent fiberglass pipe insulation with an all service jacket. The insulation shall be a heavy density, pipe insulation with a K factor not exceeding 0.27 Btu per inch/h.ft² "F at 75" F mean temperature. The insulation shall be wrapped with a vapor barrier jacket. The jacket shall have an inside foil surface with self sealing lap and a water vapor permeability of 0.02 perm/inch. All circumferential joints shall be vapor sealed with butt strips. All insulation shall be installed in strict accordance with the manufacturer's recommendations. The following pipes shall be insulated with the minimum thickness of insulation as noted.

5.8.1 Domestic Cold Water: 1" thick insulation

5.8.2 HVAC Fill Lines: 1" thick insulation

- 5.8.3 Domestic Hot Water & Return Lines:
 - Piping 1-1/4" and less:1" thick insulation

• Piping 1-1/2"" and greater: 1-1/2" thick insulation

5.8.4 Hydronic Hot Water:

Piping 1-1/4" and less
Piping 2" and greater
1-1/2" thick insulation
2" thick insulation

5.8.5 Geothermal Heat Pump Piping: 1" thick

5.8.6 Condensate Drain Lines: 1/2" thick

5.9 EXPOSED, INTERIOR (MECHANICAL ROOMS, INTERIOR FINISHED ROOMS, STORAGE ROOMS, ETC.) PIPING JACKETS: All insulated piping installed in the above areas shall have a 6 oz. canvas jacket with fire retardant lagging apply to the insulation specified for the piping.

PART 6 – DUCTWORK SYSTEMS:

- Duct sizes indicated are the net free area inside clear dimensions; where ducts are internally lined, overall dimensions shall be increased accordingly.
- 6.2 Duct insulation shall extend completely to all registers, grilles, diffusers, and louver outlets, etc., to ensure no condensation drip or collection.
- 6.3 EXTERNAL INSULATION FOR SUPPLY, RETUN & OUTSIDE AIR DUCTWORK: Knauf "Friendly Feel" faced, Duct Wrap, 0.75 PCF density, 2.2" thick or approved equivalent. Wrap shall be factory laminated to a reinforced foil kraft vapor barrier facing (FRK) with a 2" stapling flange at one edge. The installed R value shall be a minimum of 6.0. Flame spread 25, smoke developed 50, vapor barrier performance 0.02 perms per inch.
- EXPOSED EXTERNAL INSULATION SUPPLY, RETURN AND OUTSIDE AIR DUCTWORK: Knauf "Insulation Board" or approved equivalent industrial insulation. Use 1½" rigid fiberglass industrial board with foil scrim kraft vapor barrier facing, 6.0 PCF density, K=0.22 Btu in/hr.ft² °F @ 75°F. Use 1/2" thick, 1.6 PCF insulation board for round ducts. The installed R-value shall be a minimum of 6.0. Flame spread 25, smoke developed 50, vapor barrier performance 0.02 perms per inch. Provide 6oz. canvas jacket with fire retardant lagging and provide a metal corner bead at all duct corners (on the exterior of the insulation) for protection. The corner bead shall be taped in place with foil scrim tape. Paint duct per architectural requirements.

PART 7 - MECHANICAL EQUIPMENT:

7.1 AIR SEPARATOR: Knauf "Elevated Temperature Blanket 1000°F" or approved equivalent. Insulation shall be constructed of non-combustible, inorganic glass mineral wool. Insulation shall be 2" thick. K = 0.28 Btu in/hr.fr² °F @ 100°F. Insulation shall be attached in strict accordance with the manufacturer's recommendations. All insulation shall be jacketed with 6 oz. canvas with fire retardant lagging.

END OF SECTION 20 2200

SECTION 20 2300 - THERMOMETERS, PRESSURE GAUGES AND OTHER MONITORING INSTRUMENTS

PART 1 – GENERAL:

- 1.1 The Contractor's attention is directed to the General and Special Conditions, GENERAL PROVISIONS MECHANICAL and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section, and which are hereby made a part of the work specified in this section.
- 1.2 The Contractor shall include all thermometers, pressure gauges and/or compound gauges at the locations indicated. All pressure gauges and/or compound gauges shall be provided with ¼ turn ball valves to allow the gauge to be removed and replaced without shutting down system.

PART 2 - THERMOMETERS AND PRESSURE GAUGES:

- 2.1 Gauges and thermometers shall be Miljoco, Marsh, Trerice, or Weksler.
- 2.2 All thermometers and pressure gauges shall be readable from a standing position on the floor. Mount thermometers in approved wells. Use sensing elements of appropriate length for pipe size. Do not make direct contact of base with fluid in pipe. Pressure gauges and thermometers subject to vibration shall be mounted remotely away from vibrating pipe surface, etc. with flexible tubing.
- 2.3 Digital thermometers shall be solar powered industrial thermometer. The range shall be -50°F/300°F with an accuracy of 1% or 1°, whichever is greater. The display shall be a 3/8" LCD digit. Use where specifically indicated on the drawings.
- 2.4 Water thermometers shall be blue-reading spirit liquid-in-glass type with 9" scale, powder coated cast aluminum case and stem socket of length as required by system. Accuracy to be plus or minus 1 scale division. Lens to be plastic. Hot water thermometer shall have a 30°F to 240°F range and chilled water and geothermal water thermometer shall have a 0°F to 120°F range.
- 2.5 Pressure gauges shall be Bourdon Type, circular, 4-1/2" face, black letters on white face graduated in 2 PSI or less and shall be manufactured for service intended. Provide with pig tail connectors and gauge cocks. Accuracy to be plus or minus 1%. Water pressure and low pressure steam gauges shall have 0 to 100 PSI range and medium/high pressure steam gauges shall have 0 to 200 PSI range.
- 2.6 Provide direct mount Bimetal dial thermometers in HVAC ductwork. Thermometer shall be 3" diameter, with polycarbonote plastic lens and stainless steel case. Air temperature range shall be 25°F to 125°F.

PART 3 – PRESSURE/TEMPERATURE PORT (PETE'S PLUG – P/T PLUG):

3.1 Provide 1/4" NPT fitting to receive either a temperature or pressure probe, 1/8" OD. Fitting shall be solid brass with two valve cores. Valve core material to be neoprene for temperatures up to 200°F and Nordel for temperatures up to 275°F. Pete's Plugs to have 3" length when installed on insulated pipes and 1-1/2" length for uninsulated pipes. Pete's Plug to be fitted with a cap and gasket and shall be rated at 1000 PSIG at 140°F.

END OF SECTION 20 2300

SECTION 20 2400 - IDENTIFICATIONS, TAGS, CHARTS, ETC.

PART 1 – GENERAL:

1.1 The Contractor's attention is directed to the General and Special Conditions, GENERAL PROVISIONS - MECHANICAL and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section, and which are hereby made a part of the work specified in this section.

PART 2 – TAGS AND CHARTS:

- 2.1 Provide and install on each valve 1" in size or greater for all mechanical systems a 1.5" diameter circular bronze or baked phenolic tag fitted to each valve so that it cannot be removed. Each tag shall be embossed consecutively with sequential number identifiers. Number identifiers shall be determined by the Contractor sequentially.
- 2.2 Provide typewritten valve charts indicating each valve identifier, the valves service, normal position, and its location. Also furnish one electronic copy on CD in "*.xls" format. One (1) copy of this chart shall be mounted in suitable frame(s) with clear plastic covers in a conspicuous location in each of the major mechanical rooms. Repeat only main valves which are to be operated in conjunction with operations of more than single mechanical room.
- 2.3 All emergency shutoff valves shall be identified with a permanent engraved tag hung from the valve with 1-inch high lettering. Emergency shutoff valves shall be identified as any valve whose closure could create an emergency condition in the facility (i.e., natural gas, water, domestic hot water, main HVAC valves, etc.).
- 2.4 Label all control panels and disconnect switches with service and equipment served.

PART 3 – PIPING AND DUCTWORK IDENTIFICATION:

- 3.1 All piping and ductwork installed shall be identified according to the charts hereinafter specified. Provide stenciled markers and arrows indicating direction of flow on all piping and ductwork installed under this contract. Markers and arrows shall be painted on the piping and ductwork using machine cut stencils. All letters shall be sprayed using fast drying lacquer paint. All markers and arrows shall be properly oriented so that descriptive name may be easily read from the floor. Piping and ductwork shall be identified on twelve (12) foot centers. All piping and ductwork shall be minimally identified once above all room ceilings and where it passes thru walls or floors. At the Contractor's option, Setmark or equivalent manufactured marking system may be substituted for field marking.
- 3.2 The following table describes the size of the color field and size of the identification letters which shall be used for pipes of different outside pipe diameters.

Outside	Label	Letter
Diameter	Length	Size
³ / ₄ " – 1 ¹ / ₄ "	8"	1/2"
1 ½" – 2"	8"	3/4"
2 ½" – 6"	12"	1 1/4"
8" – 10"	24"	2 ½"
Over 10"	24"	3 ½"

3.3 The following chart describes the pipe service and label identification which shall be used for various pipes.

PIPE ABBREVIATION

Geothermal Supply G.S.
Geothermal Return G.R.
Domestic Cold Water D.C.W.
Domestic Hot Water D.H.W.
Recirculated Hot Water R.H.W.
Sanitary Sewer Piping SAN
Sanitary Vent Piping VENT

Fire Protection SPRINKLER

PART 4 - EQUIPMENT IDENTIFICATION:

- 4.1 Unless otherwise specified, all equipment shall be identified. The titles shall be short and concise, and abbreviations may be used as long as the meaning is clear. In finished rooms and mechanical rooms, equipment shall be identified neatly and conspicuously with engraved black lamacoid plates (or equivalent) with 1" high white letters on the front of each piece of equipment.
- 4.2 All mechanical equipment and associated starters/disconnects shall have the electrical panel number and circuit number identified on a lamacoid plate. Coordinate with the Electrical Contractor.

PART 5 – DUCTWORK IDENTIFICATION:

All ductwork shall be identified as to the service of the duct and direction of flow. Include equipment designator on SA & RA ductwork. The letters shall be at least two inches high, and the flow arrow shall be at least six inches long. The letters and flow arrow shall be made by precut stencils and black oil base paint with aerosol can. Concealed ducts also need to be identified.

5.2 DUCTWORK ABBREVIATION

Supply Air Ductwork

Return Air Ductwork

Exhaust Air Ductwork

Outside Air Ductwork

SA + Equipment Identifier

RA + Equipment Identifier

OA + Equipment Identifier

PART 6 – ACCESS THROUGH LAY-IN CEILINGS:

6.1 Mark each lay-in ceiling panel which is nearest access to equipment, valves, dampers, filters, duct heaters, etc., with colored tape labels located on the ceiling grid.

END OF SECTION 20 2400

SECTION 20 2500 - HANGERS, CLAMPS, ATTACHMENTS, ETC.

PART 1 - GENERAL:

- 1.1 The Contractor's attention is directed to the General and Special Conditions, GENERAL PROVISIONS MECHANICAL and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section, and which are hereby made a part of the work specified in this section.
- 1.2 Each Contractor's attention is also directed to Specification Section PIPE, PIPE FITTINGS AND SUPPORT.
- 1.3 This section includes, but is not limited to, furnishing, and installing supports, anchors, and accessories for piping, ductwork, equipment, etc. Furnishing and installing shall be by each trade for the completion of their work as directed in this Section.

PART 2 – MATERIALS AND EQUIPMENT:

- 2.1 HANGERS, CLAMPS, ATTACHMENTS SCHEDULE:
 - ACCEPTABLE MANUFACTURERS: Grinnell, Elcen, Fee & Mason.
 - All hangers, clamps and attachments shall be manufactured products.
 - Pipe Rings (2" pipe and smaller) adjustable swivel split ring or split pipe ring.
 - Pipe Clevis (2.5" pipe and larger) adjustable wrought clevis type.
 - Pipe Clevis (All pipe sizes) steel clevis for insulated pipe.
 - Riser Clamps (All pipe sizes) extension pipe or riser clamp.
 - Beam Clamps (All pipe sizes) malleable beam clamp with extension piece.
 - Brackets (All pipe sizes) medium weight steel brackets.
 - Concrete Inserts (All pipe sizes) wrought or wedge type inserts.
 - Concrete Fasteners (All pipe sizes) self-drilling concrete inserts.
 - Rod Attachments (All pipe sizes) extension piece, rod coupling, forged steel turnbuckle
 - U-bolts (All pipe sizes) standard u-bolt.
 - Welded Pipe Saddles (All pipe sizes) pipe covering protection saddle sized for thickness of insulation.
 - Pipe Roll (All pipe sizes) adjustable swivel pipe roll.
 - Protection Saddle (All pipe sizes) 180 degree coverage, sheet metal pipe protection saddle.
 - Hanger Rods (All pipe sizes) Steel, diameter of hanger threading.
 - Concrete Channel Inserts (All pipe sizes) continuous heavy duty slot inserts unistrut.
 - Adjustable Spot Inserts (All pipe sizes) continuous heavy duty spot insert unistrut.
 - Miscellaneous steel such as steel angles, rods, bars, channels, etc used in framing for supports, fabricated brackets, anchors, etc. shall confirm to ASTM-A-7.

2.2 HANGER RODS

2.2.1 Hanger rods or single rod hangers shall conform to the following:

PIPE SIZE	HANGER ROD DIAMETER		
	STEEL PIPE	COPPER, PLASTIC, HDPE	
2" and smaller	3/8"	3/8"	
2-1/2" through 3-5/8"	1/2"	1/2"	
4" and 5"	5/8"	1/"	
6"	3/4"	5/8"	
8" through 12"	7/8"	3/4"	
14"	1'	7/8"	

- 2.3 Rods for double rod hangers may be reduced on size. Minimum rod diameter is 3/8 inches.
- 2.4 Hanger rods and accessories used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-plated zinc finish.

PART 3 – INSTALLATION:

- 3.1 Supporting and hanging shall be done so that excessive load will not be placed on any one hanger so as to allow for proper pitch and expansion of piping.
- 3.2 Hangers and supports shall be placed as near as possible to joints, turns, and branches.
- For concrete construction, utilize adjustable concrete inserts for fasteners. Expansion anchors and power driven devices may be used when approved in writing by the Architect/Engineer.
- 3.4 Utilize beam clamps for fastening to steel joists and beams. Expansion anchors in masonry construction. Do not support piping or ductwork from bridging or metal decking.
- 3.5 When piping is routed in joists, piping shall be top mounted on trapeze type hangers with each pipe individually clamped to trapeze hanger. Do not support piping or ductwork from bridging angles.
- 3.6 Trapeze hangers are not allowed, unless specifically approved by the Engineer.
- 3.7 Install all miscellaneous steel other than designed building structural members as required to provide means of securing hangers, supports, etc., where piping does not pass directly below or cross structural elements.
- 3.8 Piping shall not be supported by the equipment to which it is connected. Support all piping so as to remove any load or stress from the equipment.
- 3.9 Where piping, etc., is routed vertically, approved riser clamps, brackets or other means shall be utilized at approximately 10'-0" center to center minimum. An approved adjustable base stand or fitting on concrete support base shall be utilized at the base of the vertical run.
- 3.10 Where piping is routed along walls, knee braced angle frames, etc. pipe brackets with saddles, clamps, and

rollers mounted on structural brackets fastened to walls or columns shall be used.

- 3.11 Support all ceiling hung equipment with approved vibration isolators.
- 3.12 Where copper tubing is specified, hangers shall be of copper clad type when piping is uninsulated.
- Uninsulated piping hung from above shall be supported with ring and clevis type pipe hangers. Uninsulated piping mounted on trapeze (when allowed) and wall bracket type support shall be held in place with U-bolts. U-bolts shall allow for axial movement in the piping.
- 3.14 All insulated piping shall be supported with clevis type and pipe roll hangers. Hangers shall be sized to allow the pipe insulation to pass through the hangers. Install insulation protection saddles at all hanger locations. Welded pipe saddles shall be installed at all hangers on piping 5" and larger. The pipe saddles shall be sized for the thickness of insulation used. Hangers shall fit snugly around outside of insulation saddles.
- 3.15 Under no conditions will perforated band iron or steel wire driven hangers be permitted.
- 3.16 Support steel and copper piping at a minimum of eight (8) foot intervals for piping 3" and smaller and ten (10) foot intervals for larger piping. Provide additional support at end of the branches and change of direction.
- 3.17 Support plastic pipe at intervals not to exceed four (4) feet and at the end of the branches and at the change of direction and shall be installed as to permit freedom of movement. Vertical piping shall be supported at their bases and all upward movement shall not be restricted. Hangers shall be at least one (1) inch wide and shall not compress, distort, cut or abrade the piping to allow free movement at all times.
- 3.18 Where fireproofing is dislodged/damaged from the building structure due to Contractor's installation of hangers, clamps, etc., it shall be the Contractor's responsibility to repair all dislodged/damaged fireproofing to original fireproofing rating. This shall also include all work performed by their contractors sub-contractors.
- 3.19 Ensure that all bolts and nuts are tightened.

END OF SECTION 20 2500

SECTION 20 3100 - TESTING, BALANCING, LUBRICATION AND ADJUSTMENTS

PART 1 – GENERAL:

- 1.1 The Contractor's attention is directed to the General and Special Conditions, GENERAL PROVISIONS MECHANICAL and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section, and which are hereby made a part of the work specified in this section.
- 1.2 The Engineer, or authorized representative, shall be notified by the Contractor twenty-four (24) hours in advance of any tests called for in these Specifications or required by others.
- 1.3 Only after written approval, signed by the Engineer, shall the Contractor apply insulation or paint or allow the work to be furred in. This written approval, however, does not relieve the Contractor of the responsibilities for any failure during the guarantee period. The expense of all tests shall be borne by the Contractor, along with all temporary equipment, materials, gauges, etc. required for tests.
- 1.4 Contractor shall notify TAB Agency in writing that the domestic water system has been flushed, cleaned and ready for sterilization or sanitizing. No chemicals are to be added to this system until all balancing has been completed risk of contamination. The TAB firm is to properly notify all parties in writing when they have completed this portion of testing. If not properly coordinated, then the system will require additional sterilization and sanitizing at the Contractor's expense. Refer to PIPE, PIPE FITTINGS AND PIPE SUPPORT Specification Section.

PART 2 - HEATING. VENTILATING AND AIR CONDITIONING TESTING:

- 2.1 The test and balance of this system shall be by a Contractor who employs only the services of a certified AABC or independent NEBB firm whose sole business is to perform test and balance services.
- 2.2 The test and balance contractor shall bid directly to the Mechanical Contractor.
- 2.3 Mechanical Contractor shall provide all start-up documents to Test and Balance Contractor prior to any test and balance services.
- 2.4 The Mechanical Contractor shall test all piping before being insulated or concealed in any manner. Where leaks or defects develop, required corrections shall be made and tests repeated until systems are proven satisfactory. Water piping systems shall be subjected to a hydrostatic test as specified and shall be proven tight after a twenty-four (24) hour test.
- 2.5 All motors, bearings, etc. shall be checked and lubricated as required during start-up procedures. All automatic, pressure regulating, and control valves shall be adjusted. Excessive noise or vibration shall be eliminated.
- 2.6 System balancing, where required, shall be performed only by persons skilled in this work. The system shall be balanced as often as necessary to obtain desired system operation and results.
- 2.7 All fan belts shall be adjusted for proper operation of fans.

- 2.8 Testing shall occur after completion of the ceiling systems installation.
- 2.9 All deficiencies observed by the Test and Balance Contractor shall be reported immediately to the Engineer and Mechanical Contractor.
- 2.10 Refer to Specification Section GEOTHERMAL LOOP SYSTEM and Specification Section CONTROLS for additional requirements.
- 2.11 Refer to Specification Section CONTROLS DIRECT DIGITAL for additional requirements.
- 2.12 Refer to Specification Section GENERAL PROVISIONS MECHANICAL for startup requirements.
- 2.13 Provide a preliminary test report to the Engineer immediately after the system is air balanced, or any initial phases are balanced. This report may be handwritten. Any systems that are not found to operate within the design tolerances by the Test and Balance Contractor shall immediately be reported to the Engineer via telephone call to attempt to determine a resolution while the Test and Balance Contractor is still on site. Additional compensation will not be accepted for additional trips.
- 2.14 Anticipate visiting the site again after the Engineer has reviewed the report. The Engineer may request up to two (2) additional site visits for onsite troubleshooting where additional measurements may be required.
- 2.15 For the purpose of placing the Heating, Ventilating and Air Conditioning systems in operation according to design conditions and certifying same, final testing and balancing shall be performed in complete accordance with AABC Standards for Total System Balance, 7th edition for air and hydronic systems as published by the Associated Air Balance Council.
- 2.16 THE FOLLOWING SYSTEMS SHALL BE TESTED AND BALANCED:
 - The outside and exhaust air duct systems associated with all OA units and heat pumps. Provide static pressure profiles thru each system.
 - Heat pump total air flow, discharge, and inlet pressures.
 - Balance heat pump water-to-water loop, circulating pumps and associated coil water flows.
 - Verify calibrations of the water pressure sensors for all systems.
 - Balance each geothermal wellfield row.
 - Balance each heat pump unit and adjust ECM motor to design airflow. Record inlet and outlet static
 pressure, including filters. Measure outside air flow at each heat pump.
 - Balance all supply, return and exhaust air grilles to within 10% of design air flow rate.
- 2.17 Balance all units rated for 2,000 cfm unit such that the total air volume delivered does not exceed 2,000 cfm, otherwise the Contractor shall furnish and install a code compliant duct smoke detection system integrated into the building's system.
- 2.18 The flushing and purging of the geothermal system shall be witnessed and approved. Refer to Specification Section GEOTHERMAL LOOP SYSTEM and Specification Section PIPE FILLING, CLEANING, FLUSHING, PURGING AND CHEMICAL TREATMENT for additional requirements.
- 2.19 Balance the water flow rate of each domestic hot water recirculating pump. Set the flow rate for each

- balancing valve in the recirculating hot water system. If flow rates are not indicated, contact the engineer for each balance valve GPM.
- 2.20 Instruments used for testing and balancing of air and hydronic systems shall have been calibrated within a period of six months prior to balancing. All final test analysis reports shall include a letter of certification listing instrumentation used and last date of calibration.
- 2.21 Test and Balance agency shall provide sizing of fan or motor sheaves required for proper balance. The Mechanical Contractor shall purchase and install all sheaves and belts as required. This includes new and existing equipment.
- 2.22 Three (3) copies of the complete test reports shall be submitted to the Consulting Engineer prior to final acceptance of the project. Preliminary test reports shall be submitted when requested.
- 2.23 The Contractor shall provide and coordinate work to provide sufficient time before final completion date so that tests and balancing can be accomplished and provide immediate labor and tools to make corrections when required without undue delay.
- 2.24 The Contractor shall put all heating, ventilating and air conditioning systems and equipment and rangehood system into full operation and shall continue the operation of same during each working day of testing and balancing.
- 2.25 The Test and Balance Contractor shall be present during the Engineer's final inspection of the building, or a separate project review date. The Engineer may request confirmation of the air balance report by asking for new measurements to be taken at that time. Any information in the test and balance report may be asked to be reconfirmed.

END OF SECTION 20 3100

SECTION 21 0100 - FIRE PROTECTION SYSTEM

PART 1 – GENERAL:

- 1.1 The Contractor's attention is directed to the General and Special Conditions, GENERAL PROVISIONS MECHANICAL and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section, and which are hereby made a part of the work specified in this section.
- 1.2 No Contractor, other than those regularly engaged in the installation of approved and franchised automatic sprinkler systems will be considered or approved for the work under this Specification Section. The Contractor shall have not less than five (5) years experience in the fabrication and erection of fire protection systems as specified. The Contractor shall have completed five (5) installations similar and equivalent in scope to the systems specified.
- 1.3 Before submitting bid, examine the Contract Documents, visit the site (if necessary) and become acquainted with all conditions that may, in any way whatsoever, affect the execution of this work. The Contractor shall take their own measurements and be responsible for exact size and location of all openings required for installation of this work. Figured dimensions where indicated are reasonably accurate and should govern in setting out work. Detailed method of installation is not indicated. Where variations exist between described work and approved practice, the Engineer shall be consulted for directive.
- 1.4 It is the intent of the Plans and Specifications to provide a general layout only and locate major equipment, components, piping, etc. Variations in head locations, pipe routing, etc., shall be anticipated by the Contractor and shall be coordinated with all other trades and indicated on the drawings and descriptive literature called for hereinafter. It shall be the express responsibility of the Contractor to provide all required design, materials and equipment and perform all work required to install a complete and approved installation.
- All materials and methods shall be in accordance with applicable codes, regulations and/or ordinances and meet approval of local inspection authority and the State Fire Marshal. Also, all work shall comply with the latest editions of the National Board of Fire Underwriters, National Fire Protection Association, OHSA Regulations, the International Building Code, the Life Safety Code, International Mechanical Code and governing building codes. All materials and equipment installed as a part of this work shall be listed by the Underwriters Laboratories, Inc. as approved for fire protection installations.
- 1.6 Where flow and pressure data are available, they are indicated on the project drawings. The Contractor shall independently verify all such information and notify the Engineer of any discrepancies discovered prior to beginning the work. Where no flow information is indicated on the project drawings, the Contractor shall obtain the data and indicate it on the shop drawing submittal. All flow information obtained shall be less than six (6) months old. Piping systems shall be hydraulically sized based on the most conservative flow information obtained. No adjustments in the contract amount will be allowed for failure of the Contractor to obtain adequate flow information.
- 1.7 All sprinkler piping (new & existing) shall be concealed above ceilings. Contractor shall be responsible for modifying the elevation of the existing sprinkler piping as necessary to conceal piping above the ceiling. Coordinate all ceiling related work with the architectural reflected ceiling plans. This includes but is not limited to the following: ceiling height changes, soffits, headers, lights, diffusers, grilles, speakers, cameras, fire alarm devices, etc. Refer to the architectural, electrical, and mechanical drawings for additional

information.

- 1.8 The Owner's local insuring agency may review plans prepared and submitted by the Contractor but shall have no authority to make changes once work has begun. Coordinate with the Owner prior to construction.
- 1.9 All work performed under this section shall be accomplished in close harmony with all other trades. All work not so coordinated shall be removed and reinstalled at the expense of the Contractor.
- 1.10 The Contractor shall list the following cost breakdowns, material, and labor, on the official project schedule of values:
 - Fire Protection Shop Drawings and Approvals
 - Fire Protection Materials & Labor
 - Fire Protection Record Drawings & Acceptance
 - Fire Pump and Controllers
- 1.11 Unless otherwise indicated, all materials shall be new and of the best grade and quality for type specified. Materials shall comply with the "Buy American Act".
- 1.12 Where piping is not indicated on the plans, but is obviously or apparently required, contact Engineer prior to submission of the bid.
- 1.13 All piping shall be capped or plugged during erection as required to keep clean and debris moisture free.
- 1.14 All piping shall be installed straight and true, parallel, or perpendicular to the building construction. Piping shall be installed to allow for expansion without damage to the building finishes, structure, pipe, equipment, etc., use offsets, U-bends or expansion joints as required. No mitered joints or field fabricated pipe bends shall be accepted. Pipe shall clear all windows, doors, louvers, and other building openings.
- 1.15 All pipes shall be supported in a neat and workmanlike manner and wherever possible, parallel runs of horizontal piping shall be grouped together on hangers. Vertical risers shall be supported as each floor line with approved steel pipe riser clamps. Spacing of pipe supports shall not exceed eight (8) foot intervals for pipes 3" and smaller and ten (10) foot intervals on all other piping. Small vertical pipes (1" and less) shall be bracketed to walls, structure members, etc. at four (4) foot intervals to prevent vibration or damage by occupants.
- 1.16 The use of wire or perforated metal to support pipes will not be permitted. Hanging pipes from other pipes shall not be permitted.
- 1.17 Support piping with standard pipe hangers with C-clamp connection to main structural members, use angle steel cross pieces between main structural members where required to provide rigid support.
- 1.18 Where piping rests directly on a hanger, clip, bracket, or other means of support, the xxx element shall be of the same material as the pipe, (e.g., copper to copper, ferrous to ferrous, etc.) or shall be electrically isolated one from the other so as to prevent pipe damage by electrolysis. Pay particular attention and do not allow copper pipe on ferrous structural members, equipment, etc. without electrolytic isolation. This includes temporary support require Construction.
- 1.19 In general, piping shall be installed concealed except in mechanical rooms, etc. unless otherwise indicated,

and shall be installed underground or beneath concrete slabs only where indicated. All lines at ceiling shall be held as high as possible and shall run to avoid conflicts with other trades, and to facilitate the Owner's use and maintenance. Location of pipe in interior partitions shall be carefully coordinated with whoever will construct the partitions after the piping is in place. Where exposed risers occur, they shall be kept as close to walls as possible.

- 1.20 Pipe shall be cut accurately to measurements established at the building by the Contractor and worked into place without springing or forcing. All pipes shall be reamed to full pipe diameter before joining and before assembling. All lengths of pipe shall be set vertically and taped with a hammer to remove scale and dust and inspected to ensure that no foreign matter is logged therein.
- 1.21 Piping carrying water or other fluids subject to freezing shall not be installed in locations subject to freezing. If in doubt, consult Engineer.
- 1.22 Pay particular attention to conflict of piping with other work. Do not install until conflict is resolved. If in doubt, consult Engineer.
- 1.23 Piping materials in each system shall, to the extent practicable, be of the same material. Frequent changes of material (for example, from copper to steel) shall be avoided and in no case shall be accomplished with use of insulated unions and permission of the Engineer.

PART 2 – SCOPE OF WORK:

- 2.1 Furnish all material, labor, tools, equipment, and supervision required for installation of a complete and new fire protection system as indicated on the project drawings and within these specifications. Include all necessary piping, sprinkler heads, test connections, valves, drains, etc.
- 2.2 The Contractor shall provide flushing and sterilization of all water lines in accordance with current Codes, Rules and Regulations and shall make connection to domestic water mains in accord with current rules and regulations of the State Department of Sanitary Engineering and Division of Water.
- 2.3 The Contractor shall obtain and pay for all necessary state, municipal, county, city and other permits and fees and pay all State taxes which are applicable.
- 2.4 All workmanship, equipment and material shall be guaranteed in writing against defects from any cause, other than misuse, for a period of one year from substantial completion.
- 2.5 Upon completion, the Contractor shall submit to the Engineer, a properly completed "Sprinkler Contractor's Certificate Covering Materials and Tests" form.
- Upon completion of this work all debris, material, and equipment shall be removed from the building and premises; all piping shall be cleaned ready for finish painting. Do not remove rust inhibitive primer specified hereinafter.

PART 3 – SHOP DRAWINGS:

- 3.1 The Contractor shall prepare and submit to the Engineer, shop drawings including design calculations, detailed catalog cutsheets and layout drawings indicating the proposed automatic sprinkler system. All layouts and drawings shall be closely coordinated by the Contractor with the work of ALL other trades. The shop drawings shall indicate the following items:
 - Name and address of Owner, Architect and Engineer.
 - Sprinkler heads including temperature rating.
 - Fire department connection.
 - Post indicator valve.
 - Detector check valves.
 - Water motor gong.
 - Retard chamber/surge tanks.
 - Wet pipe alarm valves and wet system specialties.
 - Flanged gate and check valves.
 - Pipe hangers.
 - Supervised O.S & Y valve.
 - Fire valve cabinets.
 - Fire pump, starter/controller, and electrical characteristics.
 - Make and type of jockey pump and electrical characteristics.
 - The pressure sensing switch.
 - The post indicator supervisory switch (coordinated with the Fire Alarm Contractor).
 - The main gate valve supervisory switch (coordinated with the Fire Alarm Contractor).
 - The flow switch (coordinated with the Fire Alarm Contractor).
- 3.2 On a set of drawings to the same scale as the drawings accompanying these specifications, indicate:
 - Each head location coordinated with lights, diffusers, and other ceiling mounted device.
 - Location of all risers, mains, runout lines, etc.
 - Size of all risers, mains, runout lines, etc.
 - Location and type of pipe hangers.
 - All other information required by the Authority Having Jurisdiction providing approval.
- 3.3 The Contractor shall submit these shop drawings to the Engineer through the General Contractor and Architect for their review and approval. The Contractor shall submit the reviewed drawings to the Authority Having Jurisdiction for their review and approval. The Contractor shall incorporate all review comments from the Engineer and the Authority Having Jurisdiction. No work shall be performed onsite until all review processes are complete and updated drawings are on the job site.

PART 4 – EQUIPMENT AND MATERIALS:

- 4.1 POST INDICATOR VALVE: Furnish and install a post indicator valve as required by the local authority. It shall be listed and approved by Underwriters Laboratories and Associated Factory Mutual Laboratories; Marked SV-FM; vertical; non-adjustable; with electric supervisory switch, handle, view window, brass padlock with two (2) keys; gate valve to meet gate valve specifications, except to have non-rising stem and mechanical joint ends; equivalent to Mueller, Scott or Lunkenheimer.
- 4.2 DETECTOR CHECK VALVE: Furnish and install detector check valve as required by the local authority. It shall be listed and approved by Underwriter Laboratories and Associated Factory Mutual Laboratories; 175# working pressure; IBBM; flanged; with tapped bosses each side for by-pass meter trimming; equivalent to

Victaulic, Badger or Grinnell.

- 4.3 The Contractor shall contact the servicing water company and ascertain their policy pertaining to the bypass water meter. If not furnished by water company, the Contractor shall furnish and install the bypass meter and trimming as detailed on the drawings.
- 4.4 FIRE DEPARTMENT CONNECTION: Furnish and install a fire department connections with threads as approved by the local fire department; cast brass polished and chromium plated; with connection sizes and lettering as directed by the local authority having jurisdiction; Viking, Automatic Sprinkler Corporation, or approved equivalent.
- 4.4.1 At the low point near each fire department connection, install a 90-degree elbow with drain connection to allow for localized system drainage to prevent freezing. Basis of Design: Victaulic #10-DR.
- 4.5 WET ALARM VALVES: All alarm valves must be UL and FM approved. Alarm valve shall have a grooved seat design with retarding chamber. Valve shall be rated for 225 PSI working pressure. Valve shall be provided with external bypass line and drain valve. Valve internal components shall be replaceable without removal of valve from installed position. Basis of Design: Victaulic Series 751. Engineer approved equal Reliable, Gem, Grinnell, Star, Viking.
- 4.6 FLOW INDICATOR SWITCHES: Furnish and install flow indicator switches as required by NFPA 13. All flow indicator switches shall be UL approved. Coordinate with Fire Alarm System supplier/installer.
- 4.7 TAMPER SWITCHES FOR WATER SHUT-OFF VALVES: Furnish and install tamper switches where required by NFPA 13. All tamper switches shall be UL approved. Coordinate with Fire Alarm System supplier/installer. All tamper switches located in fire protection pits shall be waterproof, capable of operating beneath water and be NFPA approved.
- 4.8 BUTTERFLY VALVES: 2" AND OVER; listed and approved by UL and FM; 300-psi working pressure, grooved ends, ASTM A536, Grade 65-45-12, ductile iron body, electroless-nickel plated ductile iron disc, pressure-responsive elastomer seat and stainless steel stem. (Stem offset from the disc centerline to provide complete 360-degree circumferential seating.) Valve complete with weatherproof actuator housing with handwheel and supervisory switches. Basis of Design: Victaulic Series 705.
- 4.9 GATE VALVES: 2½" and over; listed and approved by UL and FM; marked SV-FM; 175# working pressure; 1 BBM; OS&Y; flanged or grooved ends; cast iron discs; bronze seat rings; four point wedging mechanism; Basis of Design: Victaulic Series 771, or engineer approved equivalent to Mueller, Scott or Lunkenheimer. 2" and under; 150# working pressure; bronze; rising stem; screwed; bronze discs; bronze seat rings; two point wedging mechanism; equivalent to Jenkins, Scott or Lunkenheimer.
- 4.10 CHECK VALVES: 2½" and over; listed and approved by UL and FM; marked SV-FM; 250 psi working pressure with grooved ends or 175# working pressure; 1 BBM; flanged; Basis of Design: Victaulic Series 717, or engineered approved equivalent to Mueller, Scott, or Lunkenheimer. 2" and under; 150# working pressure; bronze; screwed; equivalent to Jenkins, Scott, or Lunkenheimer.
- 4.11 INTERIOR PIPE & FITTINGS: Up to 2" Schedule 40 ASTM A-53 black steel; 125# cast iron screwed fittings or Schedule 10, ASTM A-135 black steel with victaulic or similar type approved fittings. 2½" and larger: Schedule 40 black steel with flanged, welded or victaulic (or similar) type approved fittings or Schedule 10, ASTM A-135 black steel with victaulic or similar type approved fittings.

- 4.11.1 Grooved joint couplings consisting of two ductile iron housing segments to ASTM A536, grade 65-45-12; pressure responsive elastomer gasket; and ASTM A449 compliant bolts and nuts.
 - Rigid Type: Housings cast with offsetting, angle-pattern, bolt pads to provide system rigidity and support and hanging in accordance with NFPA-13, fully installed at visual pad-to-pad offset contact. (Couplings that require exact gapping at specific torque ratings are not permitted.) Installation-Ready for complete installation without field disassembly. Basis of Design: Victaulic Style 107N and 009-EZ.
 - Flexible Type: For use in locations where vibration attenuation and stress relief are required: Basis of Design: Victaulic Installation-Ready Style 177 or Style 77.
- 4.12 Do not route sprinkler piping (including drops) directly above any light fixtures. Do not route sprinkler piping near ceiling; hold tight to structure. Where large volumes occur above ceiling route pipe at least 36" above ceiling. The Sprinkler Contractor shall coordinate during design of sprinkler systems to ensure these requirements are met.
- 4.13 SPRINKLER HEADS: Victaulic, Gem, Grinnell, Star, Viking, Reliable, Tyco: All sprinkler heads shall be fed in a return bend arrangement. All return bend connections must be taken off the top of the connecting pipe. Sprinkler head degree ratings shall be determined by the area serviced in accord with current Codes and Standard Practices.
- 4.14 Sprinkler head degree ratings shall be determined by the area serviced in accord with current Codes and Standard Practices.
- 4.14.1 Sprinklers shall be glass bulb type, with hex shaped wrench boss integrally cast into the sprinkler body to reduce the risk of damage during installation.
- 4.14.2 Wrenches shall be provided by the sprinkler manufacturer that directly engage the hex-shaped wrench boss integrally cast in the sprinkler body.
- 4.14.3 Contractor shall be responsible to match sprinkler type within existing compartments as needed. Standard response and quick response sprinklers shall not be installed in the same compartment as defined by NFPA 13.
- 4.14.4 Types of sprinkler heads shall be as follows:
 - Semi-Recessed, Quick Response Reliable (or equal) Model F1FR-300 or Victaulic Model V27 semi-recessed automatic sprinkler head. Escutcheon and head shall be white.
 - Upright, Quick Response Reliable (or equal) Model F1FR or Victaulic Model V27 Vertical Upright automatic sprinkler head.
 - Sidewall, Quick Response Reliable (or equal) Model GFR or Victaulic Model V27, horizontal sidewall automatic sprinkler head.
 - Concealed, Quick Response Reliable (or equal) Model G4A or Victaulic Model V38, Concealed automatic sprinkler head. Cover shall be white.
 - Caged, Pendent, Quick Response Reliable (or equal) Model F1FR or Victaulic Model V27
 Vertical Upright automatic sprinkler head with D1 cage.
- 4.15 At the Contractor's option, extended coverage sprinkler heads may be used where appropriate.
- 4.16 At the Contractor's option, code approved flexible sprinkler heads may be used where appropriate and in compliance with the installation requirements of these specifications.

- 4.16.1 In lieu of rigid pipe offsets or return bends for sprinkler drops, the Victaulic VicFlex™ Multiple-Use Flexible Stainless Steel Sprinkler Drop System [with captured coupling Style 108] may be used to locate sprinklers as required by final finished ceiling tiles and walls. The drop system shall consist of a braided type 304 stainless steel flexible tube, zinc plated steel Male threaded nipple or Victaulic FireLock IGS Groove Style 108 coupling for connection to branch-line piping, and a zinc plated steel reducer with a female thread for connection to the sprinkler head. All connections to rigid system must be off of the top of the connection pipe in a true return bend fashion.
- 4.16.2 The drop shall include a UL approved Series AH1 with 3" bend radius; AH2 or AH2-CC braided hose with a bend radius to 2" to allow for proper installation in confined spaces.
- 4.16.3 Union joints shall be provided for ease of installation.
- 4.16.4 The flexible drop shall attach to the ceiling grid using a one-piece open gate Series AB1 or AB2 bracket. The bracket shall allow installation before the ceiling tile is in place.
- 4.16.5 The braided drop system is UL listed for sprinkler services to 175 psi (1206 kPa) and FM Approved to 200 psi (1380 kPa).
- 4.17 Where sprinkler heads are installed in a tile ceiling, they shall be installed in the middle of the tiles, at half or quarter points along the length of the tiles.
- 4.18 CLAMPS AND ANCHORS: Furnish and install approved clamps, as required, at all (45 degree) I/8 bends, (90 degree) 1/4 bends and flange and spigot pieces to the straight pipe to ensure permanent anchorage of all fire lines. Fittings, clamps, clamp rods, nuts, washers, and glands shall be factory zinc-coated.
- 4.19 HANGERS: All piping shall be adequately and permanently supported in an approved manner on approved hangers. Minimally support piping on 8 foot intervals for pipe 3" and smaller; 10 foot intervals for larger piping. Also support within 24" of changes in direction and end of runs. Reference Specification Section 20 2500 for additional information.
- 4.20 SLEEVES AND ESCUTCHEON PLATES: Furnish and install sleeves for pipes where piping penetrates masonry walls; exterior wall sleeves to be watertight. Fire and smoke stop all penetrations through fire and smoke walls and coordinate with General Contractor for locations. Furnish and install cast brass chrome plated split ring type escutcheons where piping penetrates walls, ceilings, and floors, whether in finished areas or not.
- 4.21 INSPECTION TEST CONNECTIONS & PRESSURE GAUGES: A 1" inspection test connection as required by the Building Code. Discharge shall run to open air. Control valve for test connection shall be installed not over 7' above the floor. A pressure gauge at the inspection. Test connection at each location indicated on the Plans. Pressure gauges shall be 2½" diameter and readable from the floor.
- 4.22 SIGNS: Appropriate code approved and required signs shall be installed on all control valves, drains, inspector's test, etc., indicating the function, installation, etc. Signs shall be neatly affixed with rust inhibitive screws, rivets or where hung from piping; with stainless steel No. 14 AWG wire.
- 4.23 SPRINKLER HEAD CABINET: Furnish and install a cabinet, clearly labeled, (where the quantity of sprinklers is less than 300 provide six (6) of each type complete with required wrenches. If the quantity of

sprinklers exceeds 300 – provide twelve (12) of each type). Locate as directed by Engineer. Label "Sprinkler Heads".

PART 5 – SYSTEM DRAINAGE:

- The entire System except that part which is below grade and will not freeze shall be installed so as to allow 100% drainage.
- 5.2 All sprinkler branch piping shall be installed so as to drain back to the main riser.
- 5.3 Approved 2" drawoff piping shall be provided on sprinkler risers with discharge piping running to nearest floor drain or open air.
- 5.4 Where sprinkler piping is trapped, an approved auxiliary draw-off shall be provided and neatly installed.
- 5.5 All draw-offs shall have a metal tag labeled "Sprinkler Drain".

PART 6 – INSPECTIONS AND TESTS:

- Furnish all labor, equipment and conduct all required tests in the presence of the Owner and Engineer or designated representative if requested. Coordinate with Owner and Engineer prior to testing.
- All interior and exterior piping and devices comprising the fire protection system shall be tested under hydrostatic pressure of not less than 200 PSI and maintained for not less than two (2) hours. Any leaks or cracks developing as a result of these tests shall be repaired to the satisfaction of the Owner.
- Upon completion of their work, the Contractor shall submit a written and signed certificate to the Engineer indicating that they performed the above prescribed tests and rectified all malfunctions arising therefrom.

PART 7 - FIRE PUMP. JOCKEY PUMP AND CONTROLS:

- 7.1 APPROVED MANUFACTURERS: Aurora, Peerless, ITT A-C,
- 7.2 The pump furnished for fire protection service shall be supplied with the specified electric motor, controls, and pump accessory items by the pump manufacturer. The pump, motor and control shall be UL listed and FM approved for fire protection service. The pumping equipment shall be installed as recommended in the National Fire Protection Association (NFPA) Standard 20, Standard for the Installation of Centrifugal Fire Pumps. The fire pump shall also be capable of delivering not less than 150% of rated flow at not less than 65% rated head. The pump shall be furnished with drive, controls and accessories as indicated. Pump manufacturer shall have unit responsibility for the proper operation of the complete unit assembly as indicated by field acceptance tests.
- 7.3 Each individual pump shall be hydrostatically tested and run tested at the factory prior to shipment. The pump shall be hydrostatically tested at a pressure of not less than one and one-half times the no flow (shut off) head of the pump's maximum diameter impeller plus the maximum allowable suction head but in no case less than 250 PSIG.
- 7.4 A field acceptance performance test shall be conducted upon completion of pump installation. The test shall be made by flowing water through calibrated nozzles, approved flow meters or other such accurate devices

as may be selected by the authority having jurisdiction. The test shall be conducted as recommended in NFPA Standard 20 by the installing contractor in the presence of the authority having jurisdiction and with that authority's final approval and acceptance. Failure to submit documentation of factory and field tests will be just cause for equipment rejection.

- 7.5 HORIZONTAL CENTRIFUGAL PUMP: The fire pump shall be of horizontal centrifugal single stage construction specifically labeled for fire service. The pump shall be connected to the fire standpipe and fire protection (sprinkler) system. The suction supply for the fire pump shall be from a public service water main. The pump casing shall be cast iron with 125 pound rating suction and 250 PSI pound rating discharge flanges. The flanges shall be machined to American National Standards Institute (ANSI) dimensions.
- 7.6 FITTINGS: The pump manufacturer shall furnish piping accessory items for the pump installation which will adapt the pump connections to the fire protection system and test connection as follows. Fittings subjected to pump discharge pressure shall be ANSI 250 pound rating. The following fittings subjected to suction pressure shall be ANSI 125 pound rating.
 - Eccentric tapered suction reducer.
 - Concentric tapered discharge increaser.
 - Hose valve test head.
 - Hose valves with caps and chains.
 - Pump casing relief valve.
 - Automatic air release valve.
 - Ball drip valve.
 - Suction and discharge pressure gauges.
 - Low suction control valve.
- 7.7 ELECTRIC MOTORS: The pump driver shall be horizontal foot mounted ball bearing induction motor. The size of the motor is scheduled on the drawings. The motor locked rotor current shall not exceed the values stated in NFPA Pamphlet 20. The motor shall be mounted on a steel base common to the pump and shall be connected to the pump with a flexible coupling protected by a suitable guard. The fire pump manufacturer shall accurately align the pump and motor shaft prior to shipment. After field installation but prior to grouting the base, a millwright or similarly qualified person shall check and verify or correct the shaft alignment. The fire pump shall be provided with a Wye-delta starter.
- 7.8 ELECTRIC MOTOR CONTROLLERS: The automatic electric motor controller shall be UL listed and FM approved specifically for fire pump service. Provide fire pump controller with integral open transition type transfer switch to comply with NFPA-20 & NFPA 70. Provide with integral over-current protection and disconnecting means for normal and emergency power feeds to transfer switch. Over-current protection shall be sized per NFPA-20 & NFPA-70. Controller and all components shall be service entrance rated. Controller shall have second utility option for emergency power feed.
- 7.9 JOCKEY PUMP: The jockey pump shall have a capacity as scheduled on the drawings. The motor enclosure shall be built to NEMA 56 frame standards. The pump shall have a cast iron frame and adapter fits to maintain axial alignment. The pump shall have threaded suction and discharge connection. The pump shall have mechanical seals. The pump shall be provided with a casing relief per NFPA 20.
- 7.10 FIRE PUMP TEST CONNECTION: Crocker 6800 Series with pipe size/number of inlets to match the fire pump capacity. Each outlet shall have a cast brass gate valve with cap and chain. Unit body shall be cast brass. Entire unit shall have a polish chrome finish.

PROJECT NO. 24-179.000 Harrison REMC - Addition and Renovation Harrison REMC

Fire Protection 21 0100 - 10 04/24/2025

END OF SECTION 21 0100

SECTION 22 0100 - PLUMBING SPECIALTIES

PART 1 – GENERAL:

- 1.1 The Contractor's attention is directed to the General and Special Conditions, GENERAL PROVISIONS MECHANICAL and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section, and which are hereby made a part of the work specified in this section.
- 1.2 The Contractor shall provide all equipment and specialties complete with trim required and connect in a manner conforming to the State Plumbing Code.
- 1.3 The Contractor shall obtain exact centerline rough-in dimensions between partitions, walls, etc. as required for lay-out of the rough-in work. All work shall be roughed-in so that all exposed piping will be straight and true without bends or offsets.
- 1.4 All equipment and specialties shall be new. All equipment and specialties shall be installed as recommended by the manufacturer.
- 1.5 Prior to final inspection, test by operation at least twice, all equipment. Also, remove all stick-on labels, dirt, grease, other removable stampings, lettering, etc. from equipment and specialties and thoroughly clean same.
- 1.6 All equipment and specialties shall be installed in a neat and workmanlike manner. Unacceptable workmanship shall be removed and replaced at the installing Contractor's cost.
- 1.7 Provide all drainage specialties indicated, specified and/or required to provide complete and acceptable removal of all storm, sanitary, waste, laboratory waste, etc. from the building and into approved receptors. Drainage specialties shall be on non-electrolytic conduction to the material to which they are connected. Drainage specialties shall be installed in a manner so as to ensure no leakage of toxic or odorous gases or liquids and shall have traps and/or backflow preventers where required. Nor shall they allow backflow into other or existing systems.

PART 2 - CLEANOUTS:

- 2.1 CLEANOUTS: In addition to cleanouts indicated on the drawings, provide cleanouts in soil and waste piping and storm drainage at the following minimum locations:
 - At base of each stack.
 - At fifty (50) foot maximum intervals in horizontal lines.
 - At each change of direction of a horizontal line.
 - As required to permit rodding of entire system.
 - As required by current State Plumbing/Building Codes.
- 2.2 Water closets, mop sinks/basins and other fixtures with fixed traps shall not be accepted as cleanouts.

- 2.3 Cleanouts and/or test tees concealed in inaccessible pipe spaces, walls and other locations shall have an eight (8) inch by eight (8) inch (minimum) access panel or cover plates shall be set flush with finished floors and walls and shall be key or screwdriver operable.
- 2.4 Access panels for cleanouts shall be of the Zurn 1460 series or equivalent by Josam or Wade. Where they are not to receive paint, they shall be polished bronze unless otherwise indicated where they are to receive paint or other finishes.
- 2.5 Cleanouts and access panels shall be sized so as to permit the entry of a full sized rodding head capable of one hundred percent circumferential coverage of the line served.
- 2.6 Provide a non-hardening mixture of graphite and grease on threads of all screwed cleanouts during installation.
- 2.7 Do not install cleanouts against walls, partitions, etc. where rodding will be difficult or impossible. Extend past the obstruction.
- 2.8 In finished walls, floors, etc., ensure that cleanouts are installed flush with finished surfaces and, where required, grout or otherwise finish in a neat and workmanlike manner.
- 2.9 EXTERIOR CLEANOUTS (ECO): Provide exterior cleanouts where indicated for all sanitary and storm lines leaving the building within 5'-0" of building perimeter. Permanently locate all exterior cleanouts with 12"x12"x12" solid finished concrete marker slightly above grade in grass areas or flush in concrete or pavement areas. Label "CO". Zurn Z-1400-HD cleanout with tractor cover for exterior locations. Provide concrete supporting pad crowned to shed water.
- 2.10 Cleanouts shall be as manufactured by Zurn, Josam, Wade, Ancon, Jay R. Smith, similar to the following:
 - Zurn Z-1440 or Z-1445 cleanout tee at base of exposed stack and at change in direction of exposed lines.
 - Zurn Z-1440 cleanout or Z-1445-1 cleanout tee where stacks are concealed in finished walls.
 - Zurn ZN-1400-T cleanout with scoriated top in finished concrete and masonry tile floors.
 - Zurn ZN-1400-Tx cleanout with square recessed top for VCT and linoleum finished floors.
 - Zurn ZN-1400-Z cleanout with round recessed top for poured floors.
 - Mueller D-731 or D-714, Nibco, Flage or equivalent for cleanouts in copper waste with cover plates and/or access panels listed for other cleanouts.
 - Threaded hex head type cleanouts of same materials as pipe for piping 2" and smaller.
 - Zurn cleanout with round top with adjustable retainer for carpet area. Install flush with carpet.

PART 3 – FLOOR DRAINS:

- 3.1 FLOOR DRAINS: Provide floor drains at locations indicated and/or as required by State Plumbing/Building Codes. Install in a neat and workmanlike manner. Install floor drains in strict accordance with manufacturer's recommendations and the State Plumbing and Building Codes. Coordinate locations with General Contractor to ensure floor pitch to drain where required. Refer to trap primer detail(s) for where floor drains require trap primer connections. All detail indicated floor drains shall have trap primers by means of trap primer connections to the drain body, drain trap, or trap primer adapter, in accordance to the plumbing code.
- 3.2 Ensure by coordination with the General Contractor that spaces served with floor drains on all floors above

the lowest level have a water seal extending at least three (3) inches from the floor. Also, for these locations, provide a 36"x36", four (4) pound sheet lead flashing sheet and clamping collar or a 30 mil chlorinated polyethylene shower pan liner. Lead pans shall be given a heavy coat of asphaltum on bottom and sides before installation and a heavy coat on any exposed surfaces. After installation, provide one ply of fifteen (15) pound roofing felt beneath each pan.

- 3.3 The floor drains shall be Zurn, Josam, Smith, Wade, Watts Drainage, Ancon, similar to the following:
 - FD-1 Zurn, FD2210 Adjustable Floor Drain designed for finished floor areas and foot traffic. Complete with ABS body, adjustable nickel bronze head and secured grate. Provide with 3" outlet and chrome plated top.
 - FD-2 Zurn, ZN-511 floor drain with 9"dia. nickel bronze strainer, dura-coated cast iron deep sump with 4" bottom outlet, seepage pan and sediment bucket.

PART 4 – FREEZEPROOF HYDRANTS:

- 4.1 FREEZEPROOF WALL HYDRANTS: Provide code approved wall hydrants at each location indicated in a neat and workmanlike manner. Affix tight to walls and ensure that the feed piping is on the heated side of the building insulation blanket. Provide all water supply specialties indicated, specified and/or required for the complete installation. Install in accordance with the manufacturer's recommendations and the Building Code. Where required by the State Plumbing Code, install code approved vacuum breakers in each water supply specialty.
- 4.1.1 Wall hydrants shall be Zurn 1320 or equivalent, 3/4", with half-turn ceramic cartridge, encased, flush, non-freeze, anti-siphon, automatic draining wall hydrant with key lock and combination backflow preventer/vacuum breaker.
- 4.1.2 Mount all wall hydrants at least twenty (20) inches above finished exterior grade. Where this is not possible or practical, contact Engineer for direction.
- 4.1.3 Turn over for each hydrant, an operator key in an envelope labeled "Exterior Wall Hydrants" to Owner upon completion of the project. Where hydrants have lockable boxes, turn over an operator key for each in an envelope labeled "Exterior Wall Hydrant Locks" to Owner upon completion of project.
- FREEZEPROOF YARD HYDRANTS: Z1396 Exposed, non-freeze yard hydrant complete with Dura-Coated cast iron head and lift handle with locking capability, bronze interior parts, galvanized steel casing, bronze valve housing, and 3/4" female IP inlet connection. Hydrant is equipped with a tapped 1/8" drain port in the valve housing, and 3/4" male hose connection.

PART 5 – INTERIOR HOSE BIBBS AND DRAIN VALVES:

- HOSE BIBBS AND DRAIN VALVES: Provide code approved hose bibbs and drain valves at each location indicated in a neat and workmanlike manner. Affix hose bibs tight to walls. Provide all water supply specialties indicated, specified and/or required for the complete installation. Install in accordance with the manufacturer's recommendations and the Building Code. Where required by the State Plumbing Code, install code approved vacuum breakers in each water supply specialty.
- 5.2 HOSE BIBBS (HB): Provide code approved hose bibbs with vacuum breakers and male threaded spouts at each location indicated on the drawings. The hose bibbs shall be Woodford Model 24 (or equal) with loose

key handle polished chrome finish, brass construction. Hose bibbs shall be mounted at eighteen (18) inches above finished floor. Do not install hose bibbs in spaces which do not have floor drains. Provide recessed hose bibbs in toilet rooms with floor drains. Woodford Model B75. Locate adjacent to ADA water closet.

- 5.3 DRAIN VALVES: Install 3/4 inch bronze body drains, similar and equivalent to Nibco, No. 72 or 73, as indicated and at the following locations:
 - At the low point and isolatable section of the plumbing system.
 - At each low point and isolatable section of the hydronic system.
 - At each isolatable pipe section.
 - At each water heater.
 - At each storage tank.
 - At each boiler.
 - At each heat pump.
 - At each water-to-water unit.
 - At each chiller.
 - At each pump suction.
 - Install a code approved vacuum breaker where installation on to domestic water system.

PART 6 – WATER HAMMER ARRESTORS (WHA):

- WATER HAMMER ARRESTORS (WHA): Provide water hammer arrestors at each location indicated and/or as required to eliminate hydrostatic on the domestic water system. Install in an accessible location and in a neat and workmanlike manner. Provide all water supply specialties indicated, specified and/or required for the complete installation. Install in accordance with the manufacturer's recommendations and the Building Code. Where required by the State Plumbing Code, install code approved vacuum breakers in each water supply specialty.
- Water hammer arrestors shall be Zurn, Z-1700, Shoktrol, Smith, Josam, Wade or equivalent. Water hammer arrestors shall be stainless steel, bellows type. Field fabricated capped cylinders shall not be acceptable. Provide insulating unions where arrestors are of dissimilar material from the piping served (unless piping is non-conducting, such as ABS or PVC).
- 6.3 MULTIPLE FIXTURES BRANCH LINE LESS THAN 20' LONG: The preferred location for a Zurn Shoktrol is at the end of the branch line between the last two fixtures served when the branch lines do not exceed 20' in length, from the start of the horizontal branch line to the last fixture supply on this line.
- 6.4 MULTIPLE FIXTURES BRANCH LINE MORE THAN 20' LONG: On branch lines over 20' in length, use two Shoktrols whose capacities total the requirement of the branch. Locate one unit between the last and next to last fixture and the other unit approximately midway between the fixtures.
- 6.5 Provide at least one water hammer arrestor at all guick acting valve locations including:
 - Mop Basins, downstream of check valves Type "A"
 - Flush valve fixtures Type "B", each toilet room with 1-3 flush valve fixtures shall have its own Type "B" water hammer arrestor.
- 6.6 ARRESTOR SCHEDULE:

Zurn Model Fixture P.D.I.
Mark Z-1700 Units Size

Type "A"	#100	1-11	Α
Type "B"	#200	12-32	В
Type "C"	#300	33-60	С
Type "D"	#400	61-113	D

PART 7 - OTHER SPECIALTIES:

- 7.1 VACUUM BREAKERS AND BACK FLOW PREVENTERS: Where required by the Building Code, whether indicated or not, provide approved vacuum breakers or backflow preventers at the following locations.
 - Where domestic water system connects to a limited area fire protection system.
 - Where domestic water system connects to hydronic system.
 - At any threaded hose tap on the domestic water system.
 - At all mop basins, provide check valves to the hot and cold water supply upstream of the faucet.

END OF SECTION 22 0100

SECTION 22 0200 - PLUMBING FIXTURES, FITTINGS AND TRIM

PART 1 – GENERAL:

- 1.1 The Contractor's attention is directed to the General and Special Conditions, GENERAL PROVISIONS MECHANICAL and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section, and which are hereby made a part of the work specified in this section.
- 1.2 The Contractor shall provide all fixtures complete with trim required and connect in a manner conforming to the State Plumbing Code.
- 1.3 The Contractor shall obtain exact centerline rough-in dimensions between partitions, walls, etc. as required for lay-out of the rough-in work. All work shall be roughed-in so that all exposed piping will be straight and true without bends or offsets.
- 1.4 All fixtures and trim shall be new. All fixtures and trim shall be installed as recommended by the manufacturer. All fixtures shall be set level and true and shall be caulked into finished walls, floors, etc. in a neat and workmanlike manner with an approved waterproof non-yellowing caulk for such service. All fixtures and trim hall be installed in a neat and workmanlike manner. Unacceptable workmanship shall be removed and replaced at the installing Contractor's cost. Pay particular attention to flush valves and bracket concealed portion to building structure during rough-in. Loose, shaky flush valves, lavatories, etc. shall not be acceptable.
- 1.5 Handicapped accessible fixtures shall be mounted as recommended by the Building Code and ADA. Special Note for Handicap Grab Rails: Coordinate top of shower valves, flush valves, flush tank, etc., with location of grab rails as shown on the architectural plans. The Contractor shall install all items to allow for installation, removal, and service without removal of the grab bar.
- 1.6 Fixture seats shall be Church model 2155CTJ, elongated open front less cover w/ JUST-LIFT, STA-TITE check hinge and DuraGuard Antimicrobial Agent, or approved equal.
- 1.7 All exposed piping, stops, traps, tailpieces, etc. shall be code approved chrome plated brass unless otherwise indicated or specified. Where acid resistant piping is indicated on the drawing or the specifications, all piping and ancillary components from the sink/lavatory to dilution basin shall be acid resistant as specified and required by code.
- 1.8 Water supplies shall connect through walls with stops and chrome plated escutcheons with set screws. In general, furnish drinking fountains, wall-hung lavatories, and hose bibbs with manual loose key stop valves. For all other fixtures, furnish with manual permanent-key stop valves (i.e., sinks in casework, etc.). When in doubt, contact Engineer prior to installation.
- 1.9 Coordinate all stainless steel sinks with architectural casework shop drawings for appropriate fit. Do not order sinks until this has been coordinated. Change Orders will be immediately rejected for lack of coordination during construction.
- 1.10 Test for appropriate operation at least twice, ALL fixtures and trim including hands-free trim. Open all faucets and allow to run for fifteen (15) minutes, then remove all faucet aerators and thoroughly clean until smooth flow is obtained. Test by operation at least twice, adequate flow of water at flush valves including

- appropriate adjustment of hands-free devices, faucets including appropriate adjustment of hands-free devices, hose bibbs, fixture drains, shower heads, etc.
- 1.11 Remove all stick-on labels, dirt, grease, other removable stampings, lettering, etc. from plumbing fixtures and thoroughly clean same.
- 1.12 ACCEPTABLE MANUFACTURERS: Subject to compliance with requirement's manufacturers offering plumbing fixtures and trim which may be incorporated in the work include only the following:
- 1.12.1 Plumbing Fixtures: American Standard, Kohler, Zurn, Sloan
- 1.12.2 Plumbing Trim: American Standard, Chicago Faucet, Kohler, Delta Commercial, T&S Brass, Just, Speakman, Zurn Aqua-Spec, Moen Commercial, Symmons
- 1.12.3 Flush Valves: Sloan, Zurn, Delany
- 1.12.4 Stainless Steel Sinks: Elkay, Just, Moen Commercial, Sterling
- 1.12.5 Mop Basins and Laundry Tubs: American Standard, Elder, Fiat, Kohler, Mustee, Acorn, Zurn
- 1.12.6 Appliance Connection Boxes: Guy Gray, Oatley, Wolverine
- 1.12.7 Fixture Seats: Bemis, Church, Olsonite
- 1.12.8 Fixture Carriers: Josam, Kohler, Tyler Pipe, Zurn, Wade, Smith, Watts
- 1.12.9 Lavatory, Sink, Mop Basin and Laundry Tub Strainers: American Standard, Elkay, Kohler, McGuire., Sloan, Zurn.
- 1.12.10 P-traps, Tailpieces, and Escutcheons: American Standard, Elkay, Kohler, McGuire, Moen Commercial, Sloan, Zurn.
- 1.12.11 P-trap Insulation covering for ADA Fixtures: IPS Corp., McGuire, Plumberex.
- 1.12.12 Water supplies and stops: American Standard, Elkay, Kohler, McGuire, Moen Commercial, Nibco, Sloan, Watts, Zurn,

PART 2 – PLUMBING FIXTURE SPECIFICATIONS:

- P-1 WATER CLOSET FLUSH TANK STANDARD HEIGHT

 Zurn model Z5575, 1.6 GPF, pressure assist, vitreous china, close coupled, two-piece, water closet with elongated bowl and white open front plastic seat with check hinge and bolt caps.
- P-1A WATER CLOSET FLUSH TANK ADA HEIGHT

 Zurn model Z5560, 1.6 GPF, pressure assist, vitreous china, close coupled, two-piece, water closet with elongated bowl and white open front plastic seat with check hinge and bolt caps. Mount seat at 18" A.F.F.
- P-1B WATER CLOSET FLUSH VALVE, FLOOR MOUNTED STANDARD HEIGHT

Zurn model Z5655-BWL, vitreous china, 15" high siphon jet, elongated bowl, china bolt caps and white open front plastic seat with check hinge. Water closet flush valve shall be manual flush valve shall be Zurn model Z6000-WS1.

P-1C WATER CLOSET – FLUSH VALVE, FLOOR MOUNTED – ADA HEIGHT

Zurn model Z5660, vitreous china, 18" high, siphon jet, 1-1/2" top spud, elongated bowl, china bolt caps and white open front plastic seat with check hinge. Install flush valve on "open" side of water closet. Water closet flush valve shall be manual ADA flush valve shall be Zurn model Z6000-WS1. Top of flush valve handle shall be a maximum of 31-1/4" A.F.F.

P-2 URINAL – WALL-HUNG – ADA HEIGHT

Zurn model Z5750 vitreous china, wall-hung, 1.0 GPF urinal with 3/4" top spud and concealed wall hanger brackets. Mounting height shall be per ADA. Urinal flush valve shall be manual ADA flush valve shall be Zurn model Z6003-WS1. Install per ADA requirements.

P-3 LAVATORY – UNDERMOUNT – ADA COMPLIANT

Kohler Iron Plains K-5400 18-1/2" rectangular undermount bathroom sink. Provide with overflow drain. Sink is to be ADA complant, ensure drain fits for slopped access panel. Color to maktch casework. Sink is made of enameled cast iron. Sink dimensions:

- Length: 17-1/2" (445 mm)
- Width: 14-3/4" (375 mm)
- Bowl depth: 4-9/16" (116 mm)
- Water depth: 2-15/16" (74 mm)

Provide lavatory drain with integral perforated strainer, 3/8" angle rigid supplies with stops and P-trap. Lavatory trim shall be as follows:

• Single handle faucet shall be Zurn model Z81000-3M with polished chrome-plated cast brass faucet body on 4" centers with single lever control. Furnish with 0.5 GPM vandal-resistant aerator.

P-4 STAINLESS STEEL UNDERMOUNT SINK WITH HOSE SPRAYER

Elkay Crosstown® 18 Gauge Stainless Steel 18-1/2" x 18-1/2" x 9" Single Bowl Undermount Sink Model ECTRU17179T. Sink is handmade/fabricated from 18 gauge 304 Stainless Steel with a Polished Satin finish, Rear Center drain placement, and Full spray sides and bottom with Sides and Bottom pads. Provide with grid strainer, chrome supply stops, tailpiece, 17 gauge P-trap, drain and escutcheon. Sink trim to be:

- 3-1/2" Drain Fitting Type 304 Stainless Steel Body Strainer Basket and Tailpiece.
- Elkay Everyday Single Hole Deck Mount Kitchen Faucet with Pull-down Spray Forward Only Lever Handle

P-4A STAINLESS STEEL UNDERMOUNT SINK WITH HOSE SPRAYER – ADA COMPLIANT

Elkay Lustertone® Classic Stainless Steel 14-1/2" x 14-1/2" x 5-1/2" Single Bowl Undermount ADA Sink w/Perfect Drain® Model(s) ELUHAD121255PD. Sink is manufactured from 18 gauge 304 Stainless Steel with a Lustrous Satin finish, Center drain placement, and Bottom only pads.. Provide with grid strainer, chrome supply stops, tailpiece, 17 gauge P-trap, drain and escutcheon. Sink trim to be:

- Perfect Drain® Chrome Plated Brass Body Strainer and LKADOS Tailpiece.
- Elkay Everyday Single Hole Deck Mount Kitchen Faucet with Pull-down Spray Forward Only Lever Handle

P-5 SURFACE-MOUNTED SHOWER UNIT - ADA

Provide an Acorn Apex, Type 5 Surface Mounted (453-ADA-A-W-SC) barrier free, ADA Compliant Wall

Shower with Slide Rail, and Safti-Therm thermostatic mixing valve. Shower panel shall be fabricated from heavy gage, type 304 stainless steel and shall have a satin finish. Exposed trim shall be chrome-plated brass. Fixture shall be furnished with an ADA compliant control valve with lever handle or pushbutton 60" hose hand shower with vacuum breaker and flow control, 24" slide rail, recessed soap dish. Mount diverter valve 48" AFF. Provide cover extension (SC) to ceiling. Provide with Zurn ZS880 Type 304 Fabricated Stainless Steel Linear Shower Drain. Complete with vertically adjustable anchoring support legs, anti-ponding V-shaped channel with 2" No-Hub center outlet, adjustable secured leveling frame with built-in tile edge, integral membrane flange for glue on waterproofing membrane, and secured, light-duty, slotted heel-proof grate. Drain is designed for installation in a minimum 2" concrete pour and can be adjusted to accommodate 1/4" and 3/8" finished tile thicknesses.

P-6 DOUBLE COMPARTMENT SINK – 29"X18"

Elkay Lustertone® Classic Stainless Steel 30-3/4" x 18-1/2" x 4-3/8" Equal Double Bowl Undermount ADA Sink Model ELUHAD311845. Provide with grid strainer, chrome supply stops, offset tailpiece, 17 gauge P-trap, drain and escutcheons. Sink trim shall be as follows:

- Elkay Gourmet Single Hole Kitchen Faucet Pull-out Spray and Lever Handle with Hi and Midrise Base Options. Faucet has a flow rate of 1.75 GPM, and is made of Brass material, with a Ceramic Disc valve. Faucet requires 1 faucet holes.
- Garbage Disposer shall be Badger 1 1/3 H.P.

P-7 ELECTRIC WATER COOLER (BI-LEVEL) WITH BOTTLE FILLER - ADA

Elkay Enhanced ezH2O® Bottle Filling Station, & Versatile Bi-Level ADA Cooler, Filtered 8 GPH Stainless. Chilling Capacity of 8.0 GPH of 50°F drinking water, based on 80°F inlet water and 90°F ambient, per ASHRAE 18 testing. Features shall include Hands Free, Visual Filter Monitor, Automatic Filter Status Reset, Filtered, Energy Savings, Green Ticker™, Laminar Flow, Antimicrobial, Real Drain. Furnished with Flexi-Guard ® Safety Bubbler. Electronic Bottle Filler Sensor With Electronic Front And Side Bubbler Pushbar activation. Product shall be Wall Mount, for Indoor applications, serving 2 station(s). Unit shall be certified to UL 399 and CAN/CSA C22.2 No. 120. Unit shall be lead-free design which is certified to NSF/ANSI 61 & 372 and meets Federal and State low-lead requirements.

P-8 MOP BASIN

Fiat MSB-24 24, 24" x 24" 10" high molded stone mop service basin in #231 white drift color and #874, 3" drain, Provide Chicago Faucet model 897-CP faucet, #832-AA hose and hose bracket, #889-CC mop hanger and #E-77-AA vinyl bumperguard. Provide with MSG stainless steel wall guards. Provide check valves on the hot and cold water supplies to the faucet. Provide Guardian G1819-DC-TMW, Wall mounted eye wash, less bowl, with stainless steel dust covers and thermostatic mixing valve. Install eye wash over mop basin.

P-6 ICE MAKER CONNECTION BOX

IPS Corporation Water-Tite mini round ice maker outlet box with integral water hammer arrestor and preloaded nails. Connect cold water supply line to water supply at adjacent sink. Field paint exposed portions of box to match adjacent wall surfaces.

END OF SECTION 22 0200

SECTION 23 0100 - PUMPS

PART 1 – GENERAL:

- 1.1 The Contractor's attention is directed to the General and Special Conditions, GENERAL PROVISIONS MECHANICAL and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section, and which are hereby made a part of the work specified in this section.
- 1.2 Electric motors shall be furnished with the pumps and shall be of the size and type scheduled or otherwise specified. All motors shall be UL labeled and shall comply with applicable NEMA standard. Motors to be high efficiency type. Refer to Specification Section ELECTRIC MOTORS, ETC.
- 1.3 Shop drawings shall be submitted as required and shall include complete pump specifications, installation and start-up instructions, current and accurate pump performance curves with the selection points clearly indicated, maintenance data and spare parts lists.
- 1.4 Pumps shall be factory tested, cleaned, and painted prior to shipment. Size, type, capacity, and electrical characteristics are listed in the pump schedule.
- 1.5 Insofar as possible, all pumps shall be by the same manufacturer.

PART 2 – CLOSED COUPLED INLINE PUMPS:

- 2.1 Closed Coupled Inline Pump shall be Series 90 as manufactured by Bell & Gossett or equal by Taco, Armstrong, Patterson.
- 2.2 The pumps shall be of a vertical or horizontal installation type specifically designed for quiet operation. Suitable for 225° F operation at 175 PSIG working pressure. The pump shall be single stage, vertical split case design, all bronze construction. The pump internals shall be capable of being serviced without disturbing piping connections.
- 2.3 The pumps shall have a solid SAE1045 steel shaft that is integral to the motor. A non-ferrous shaft sleeve shall be employed to completely cover the wetted area under the seal.
- 2.4 The motor bearings shall support the shaft via heavy-duty grease lubricated ball bearings.
- 2.5 Pump shall be equipped with a mechanical seal assembly. Seal assembly shall have a brass housing, BUNA bellows and seat gasket, stainless steel spring, and be of a carbon ceramic design with the carbon face rotating against a stationary ceramic face.
- Pump shaft shall connect to a brass impeller. Impeller shall be hydraulically and dynamically balanced, keyed to the shaft and secured by a locking capscrew or nut.
- 2.7 Pump should be designed to allow for true back pull-out access to the pump's working components for ease of maintenance.

- 2.8 Pump volute shall be of cast iron design for heating systems or cast brass for domestic water systems. The connection style on cast iron and bronze pumps shall be flanged. Volute shall include gauge ports at nozzles.
- 2.9 Motors shall meet scheduled horsepower, speed, voltage, and enclosure design. Motors shall have heavy-duty grease lubricated ball bearings to offset the additional bearing loads associated with the closed coupled pump design. Motors shall be non-overloading at any point on the pump curve and shall meet NEMA specifications.
- 2.10 Pump shall be of a maintainable design and for ease of maintenance should use machine fit parts and not press fit components.
- 2.11 Each pump shall be factory tested and name-plated before shipment.
- 2.12 Pumps shall conform to ANSI/HI 9.6.3.1 standard for Preferred Operating Region (POR).

END OF SECTION 23 0100

SECTION 23 0200 - HVAC EQUIPMENT

PART 1 – GENERAL:

- 1.1 The Contractor's attention is directed to the General and Special Conditions, GENERAL PROVISIONS MECHANICAL and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section, and which are hereby made a part of the work specified in this section.
- 1.2 The Contractor shall provide in complete working order the heating, ventilation and air conditioning equipment located as indicated and installed, connected, and placed in operation in strict accordance with the manufacturer's recommendations. All equipment shall be factory painted and, where applicable, factory insulated and shall, where such standards exist, bear the label of the Underwriters Laboratory.
- All Contractors and Vendors providing a bid for this project shall review the Plans and Specifications and determine any modifications and/or adjustments necessary relative to the proposed equipment and materials with specific manufacturer's installation requirements. Include in the bid any necessary installation methods, features, options, accessories, etc. necessary to install the proposed equipment and materials, regardless of whether used as basis of design or being offered as a substitution in accordance with the specific manufacturer's installation requirements whether specifically detailed or not within the Plans and Specifications.
- 1.4 All equipment, material and labor warranties shall be furnished by the equipment supplier/vendor. All warranties begin on the date of Substantial Completion. Refer to Specification Section GENERAL PROVISIONS MECHANICAL for special warranty requirements.
- 1.5 Refer to Specification Section GENERAL PROVISIONS MECHANICAL for minimum required Schedule of Values breakdown.
- 1.6 Review the Specification Section REQUIRED SHOP DRAWINGS, ETC., and provide all documentations called for therein.
- 1.7 Each subcontractor shall be responsible for their own completion of System Verification Checklists/Manufacturer's Checklists. Refer to Specification Section GENERAL PROVISIONS MECHANICAL for additional requirements. Factory startup is required for all HVAC equipment. In general, as part of the verification process, equipment suppliers shall perform start-up by their factory authorized technicians and shall complete and submit start-up reports/checklists. This shall include the following:
 - Heat Pumps
 - Outside Air Units
 - Variable Frequency Drives
 - Water Flow Meters/BTUH Meters
- 1.8 All HVAC equipment shall comply with the latest provisions of ASHRAE Standard 90.1 and all provisions of the International Energy Conservation Code.
- 1.9 Ensure that the equipment that is proposed to be furnish may be installed, connected, placed in operation, and easily maintained at the location and in the space allocated for it.

- 1.10 The contractor and vendor shall confirm connection sides for each piece of equipment specific to this project.
- 1.11 Determine from the Bid Documents the date of completion of this project and ensure that equipment delivery schedules can be met so as to allow this completion date to be met.
- 1.12 Through coordination with other Contractors, Vendors and Suppliers associated with this Project, this Contractor shall ensure a complete, 100% functional, tested, inspected, and approved systems. Claims for additional cost or change orders will immediately be rejected. Refer to Specification Section ELECTRIC MOTORS, ETC. for additional requirements. All equipment shall be furnished for a single point electrical connection unless specifically excluded as a requirement.
- 1.13 Review the Specification Section CONTROLS to determine controls, including variable frequency drives, to be furnished. Where manufacturer's temperature controls are specified, they shall be in full compliance with NFPA 90A including automatic smoke shut down provisions.
- 1.14 Review the Specification Section TESTING, BALANCING, LUBRICATION AND ADJUSTMENTS. For all belt driven equipment, provide final fan and motor sheaves as determined by the air balance contractor during project balancing phase. The mechanical contractor shall install any new sheaves and belts as required for balancing.
- 1.15 Refer to schedules for additional information. All units not basis of design will need approval prior to bidding.

PART 2 – GEOTHERMAL HEAT PUMPS:

- 2.1 A 100% complete mockup installation shall be required for a typical unit. This mockup shall be inspected/reviewed by the Engineer prior to installation of other units.
- Any mechanical closet dimension modifications or access requirements due to the manufacturer specifics shall be the burden of the approved manufacturer.
- 2.3 Equipment shall be specifically designed for applications within conditioned interior areas. Capacities shall be rated in accordance with ARI for geothermal applications. Equipment shall be ETL or CSA approved. All equipment shall have decals and labels to aid in servicing and indicate caution areas.
- 2.4 Equipment shall be completely factory assembled and tested, piped, internally wired and fully charged with Refrigerant R-410A. Threaded female water inlet and outlet connections, threaded female condensate connection, duct collars and all safety controls shall be furnished and factory installed.
- A terminal block with screw terminals shall be provided for control wiring. A condensate overflow device shall be factory installed to stop compressor operation if drain pan overflow is imminent. An energy management relay to allow unit control by an external source shall be factory installed.
- 2.6 Refer to Specification Section GENERAL PROVISIONS MECHANICAL for special warranty requirements.
- 2.7 CASING AND CABINET: The cabinet shall be constructed of galvanized steel and factory painted with ½" fiberglass on interior, discharge duct collar and return collar. Lift-out removable access panels shall be provided for access to the compressor and blower assembly compartments.
- 2.8 DRAIN PAN: The drain pan shall be constructed of stainless steel and insulated to prevent sweating. The

bottom of the drain pan shall be sloped on two planes which will direct the condensate to the drain connection. When the unit is installed per the manufacturer's instructions, the drain pan shall be tested as follows: (1) Temporarily plug the drain pan, (2) fill the drain pan with 2" of water or the maximum allowed by the drain pan depth, whichever is smaller, (3) remove the temporary plug and verify the drain pan removes the water within 3 minutes.

- 2.9 COMPRESSOR: The compressor or compressors shall be high-efficiency, hermetically sealed scroll type with internal vibration isolation. Compressors motors shall be equipped with overload protection. Refer to the drawing schedules as multiple compressor types shall be utilized.
- 2.10 AIR-TO-REFRIGERANT HEAT EXCHANGER: The air-to-refrigerant heat exchanger shall be constructed of staggered copper tubes with die formed corrugated aluminum fins mechanically bonded to the tubes. The air-to-refrigerant heat exchanger shall have a working pressure rating of 400 PSIG. Multiple compressor equipment shall provide a single air-to-refrigerant heat exchanger for each compressor.
- 2.11 WATER-TO-REFRIGERANT HEAT EXCHANGER: The water-to-refrigerant heat exchanger shall be of a high quality co-axial coil for maximum heat transfer and insulated to prevent condensation at low temperatures. The copper coil shall be fluted to enhance heat transfer and minimize fouling and scaling. The coil shall have a working pressure of 600 psig on the refrigerant side and 400 psig on the water side.
- 2.12 REVERSING VALVE: The reversing valve shall be a pilot operated sliding piston type with replaceable encapsulated magnetic coil. The reversing valve shall be energized in the cooling cycle.
- 2.13 REFRIGERANT TUBING: Refrigerant tubing shall be constructed of copper. All low temperature refrigerant lines shall be insulated with an elastomeric insulation that has a 3/8" thick wall, flame spread rating of less than 25 and smoke density rating of less than 50, as tested in accordance with ASTM-84. The elastomeric insulation shall have a UL 94V-5 rating.
- 2.14 REFRIGERANT METERING: The equipment shall be provided with a thermal expansion valve. This device shall allow operation of the equipment in the range of 25 to 110° F entering fluid temperatures and 40 to 95° F entering air temperatures. The equipment shall only operate with one variable (enter water temperature, entering air temperature, cfm or gpm) at an extreme condition. All other variables must be within the nominal range of operation.
- 2.15 REFRIGERANT SYSTEM SERVICE ACCESS: The equipment shall be provided with factory supplied high and low pressure Schrader ports for easy refrigerant pressure or temperature testing.
- BLOWER AND MOTOR ASSEMBLY: See Schedules for motor type. The motor shall have permanently lubricated and sealed bearings. All motors shall have internal thermal overload protection. The fan assembly shall be arranged for back, left, or right discharge. The discharge must also be capable of being changed in the field. Removal of the motor and fan wheel shall be made with the assistance of a factory provided orifice ring assembly. This assembly shall attach the wheel and motor to the fan housing providing single service access. Where available, provide one hand-held motor programming module to the Owner to utilize for startup and test and balance.
- 2.17 UNIT CONTROLS SAFETIES: A factory tested and installed control box shall contain all necessary devices to allow heating and cooling operation of the equipment to occur. These devices shall be as

follows: (1) 24 Vac, energy limiting class II transformer. (2) Blower motor controller shall be a 24 Vac relay. (3) Compressor controller shall be a 24 Vac contactor. All three-phase operated equipment shall have a contactor that interrupts all three-phases providing power to the compressor. (4) Electrically operated safety lockout relay. This device shall prevent operation and anti-short cycling of the compressor during adverse conditions of operation. This device may be reset by either a remote thermostat or momentary interruption of power. (5) High pressure switch shall protect the compressor against operation at refrigerant system pressures in excess of 395 PSIG. (6) Low pressure switch shall prevent compressor operation underneath low charge or catastrophic loss of charge situations.

2.18 FACTORY-MOUNTED DDC CONTROLLER

- 2.18.1 All units shall have factory mounted DDC controller. This shall include transformer, power wiring to controller, installation and wiring of discharge air temperature sensor, installation and wiring of filter differential pressure switch, factory wiring of all outputs/inputs with the exception of the space sensor or thermostat.
- 2.18.2 Space thermostat/sensor shall to be provided by the heat pump manufacturer. All thermostat/sensors shall be provided with digital display and occupancy override button. Doors shall not be allowed on sensors.
- 2.18.3 The factory installed controller shall be a direct digital controller that communicates via BACnet MS/TP or LON protocol. The controller shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135 on the controller network. The controller shall be BACnet Testing Labs (BTL) certified and carry the BTL Label. The controller shall be tested and certified as a BACnet Application Specific Controller (B-ASC).
- 2.18.4 Provide protocol implementation conformance statement (PICS) for factory installed controllers. Submittals shall include point name, BACnet name, BACnet object ID and description. The controller shall be factory programmed with a minimum of the following points:

2.18.5 Inputs

- Space temperature
- Space setpoint adjust
- Occupancy Override
- Safety shutdown alarm codes
- Discharge air temperature
- Filter Status

2.18.6 Outputs

- Unit Fan Control
- Isolation Control Valve
- Reversing valve
- Compressor stage 1
- Compressor stage 2 (where provided)
- 2.18.7 A minimum of the following BACnet MS/TP points must be available to the third party building automation system
 - Occupancy Command

- Space temperature
- Room Occupied/ Unoccupied cooling setpoint
- Room Occupied/ Unoccupied heating setpoint
- Fan Status
- Discharge Air Temperature
- Low temperature sensor/ freeze alarm
- Low pressure sensor alarm
- High pressure alarm
- Condensate overflow alarm
- High/ Low voltage alarm
- Occupied Deadband
- 2.18.8 The DDC controller is to be factory programmed with the following sequence of operation:
 - Each unit shall be placed into the occupied/unoccupied mode based upon the user adjustable schedule at a third party building automation system.
 - If communication is lost between the building automation system and the heat pump controller, then the heat pump controller shall be placed into the occupied mode until communication is restored.
 - During the occupied mode, the heat pump shall cycle as required to satisfy space thermostat/sensor setpoint. The units shall automatically change from heating to cooling. To prevent short cycling a minimum of 1 minute delay when transitioning between heat and cool modes.
 - When space temperature is satisfied, fan and compressor shall be off and the auxiliary in-line pump shall be off.
 - During the unoccupied mode, the heat pump shall not operate unless the space temperature falls below unoccupied heating setpoint (adj. from BAS) or rises above unoccupied cooling setpoint (adj. from BAS).
- AIR FILTER SYSTEM: The Contractor shall completely assemble an Air Filter System for each unit and install ready to use. Heat pumps 5 tons and smaller require one 24" X 24" air filter system (one 24 X 24 filter). Heat pumps 6 tons through 10 tons require one 48" X 24" air filter system (two 24 X 24 filters). Heat pumps larger than 10 tons require one 72" x 48" air filter system (Six 24 X 24 filters). See plans for sizes and quantities. Refer to Specification Section GENERAL PROVISIONS MECHANICAL for Temporary Use of Equipment Requirements and filter quantities.
- 2.19.1 Side Access Filter Housing: Housings shall accommodate required quantity of 24" X 24" X 2" deep flat filters as noted above. Housings shall be factory assembled, have one hinged access door with quick access latches (operable without special tools), and be constructed on 18 gauge aluminized steel minimum.
- 2.19.2 Filters shall be 30% efficient Merv 8, pleated and disposable. Provide Flanders/FFI Pre Pleat 40, 24" x 24" x 2" thick or approved equal. The filter pressure drop shall be 0.28" at 500 fpm face velocity. Each filter shall consist of a non-woven cotton and synthetic fabric media, media support grid and enclosing frame. The filter shall be listed by Underwriters' Laboratories as Class 2.
- 2.20 HOSE KIT & PIPING PACKAGE: Hose kits and piping package shall be as scheduled on the drawings. Single piece hose kits shall be provided for hose kits that are 1-1/2" or less in size. Two piece hose kits shall be provided for hose kits that are 2" and larger in size. Hose kits shall be the pipe runout size, not heat pump connection sizes. No exceptions!

- 2.20.1 Provide a factory-assembled hose kit/piping package for supply and return connections for each heat pump. Kits may be mounted in any direction and shall not require straight sections of pipe either upstream or downstream for proper operation. All hoses shall be equipped with end connections at terminal unit and shall be 24" long. All end connections shall be either permanently crimped swivel ends or butt welded to carbon steel end fittings to meet stated pressure ratings. Operational temperature shall be rated from fluid freezing to 200 degrees F. Minimum burst pressure shall be four times the working pressure. Furnish with field flushing connection fitting. Up to 1-1/4" shall be reinforced, fire retardant EPDM rubber, bonded to the inside wall of braiding. 1 ½" and larger shall be a corrugated type 321 stainless steel tube.
- 2.20.2 Each supply side (water inlet) hose kit/piping package shall include a single piece Y valve body for sizes up to 1-1/2" and shall be constructed of hot forged brass with threaded inlets and outlets. 2" and larger sizes shall be two-piece and constructed of ductile iron with threaded inlets and outlets. All valve bodies are suitable for a minimum of 400 PSIG working pressure. Include single pressure/temperature test ports for verifying the pressure differential and system temperature. Include full flow design ball valve with blow out stems for shut off. Strainer shall be Y-type configuration furnished with hose connector blow down valve. Strainer screen shall be stainless steel mesh and easily accessible for cleaning without disconnecting hoses. All valves shall be labeled with flow direction, manufacturer and model number, unit tagging.
- 2.20.3 Each return side (water outlet) hose kit/piping package shall include a single piece Y valve body for sizes up to 1-1/2" and shall be constructed of hot forged brass with threaded inlets and outlets. 2" and larger sizes shall be two-piece and constructed of ductile iron with threaded inlets and outlets. All valve bodies are suitable for a minimum of 400 PSIG working pressure. Include single pressure/temperature test ports for verifying the pressure differential and system temperature. Include full flow design ball valve with blow out proof stems for shut off. All valves shall be labeled with flow direction, manufacturer and model number, unit tagging.
- 2.21 EQUIPMENT START-UP: Prior to utilization of equipment, start-up service shall be performed by factory authorized representative. Utilize startup sheets included in the Specification Section GENERAL PROVISIONS MECHANICAL. Refer to Specification Section GENERAL PROVISIONS MECHANICAL for additional requirements.
- 2.22 Provide eight (8) hours of onsite training for this system. All training shall occur after building completion. Systems shall function properly and O&M staff shall be able to operate the system prior to turnover.

END OF SECTION 23 0200

SECTION 23 1100 - REGISTERS, GRILLES, DIFFUSERS & LOUVERS

PART 1 – GENERAL:

1.1 The Contractor's attention is directed to the General and Special Conditions, GENERAL PROVISIONS - MECHANICAL and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section, and which are hereby made a part of the work specified in this section.

PART 2 – REGISTERS, GRILLES, AND DIFFUSERS:

- 2.1 Acceptable R, G & D manufacturers are Krueger, Price, Anemostat, Nailor Industries, Titus, and Tuttle & Bailey. Shop drawings shall identify and list all characteristics of each device exactly as scheduled herein. Finishes for specified devices shall be selected by the Architect. Factory color samples shall be submitted with shop drawings. Devices shall be white unless noted otherwise. Aluminized steel devices are not acceptable. Steel devices are not acceptable unless specifically noted otherwise.
- 2.2 Include with the shop drawings a room-by-room schedule indicating devices installed. Also note ceiling types and installations.
- 2.3 Refer to drawings for schedule.

PART 3 – LOUVERS:

- 3.1 Acceptable louver manufacturers are Ruskin, Greenheck, United Enertech, Arrow. Shop drawings shall identify and list all characteristics of each device exactly as scheduled herein. Finishes shall be selected by the Architect. Factory color samples shall be submitted with shop drawings.
- 3.2 Refer to drawings for schedule.

END OF SECTION 23 1100

SECTION 23 1200 - SHEET METAL

PART 1 – GENERAL:

- 1.1 The Contractor's attention is directed to the General and Special Conditions, GENERAL PROVISIONS MECHANICAL and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section, and which are hereby made a part of the work specified in this section.
- 1.2 This branch of the work includes all materials, labor and accessories for the fabrication and installation of all sheet metal work as shown on the drawings and/or as specified herein. Where construction methods for various items are not indicated on the drawings or specified herein, all such work shall be fabricated and installed in accordance with the recommended methods outlined in the latest edition of SMACNA's Duct Manual and Sheet Metal Construction for Low Velocity Ventilating and Air Conditioning Systems. All equipment furnished by manufacturers shall be installed in strict accord with their recommended methods.
- 1.3 Ductwork shall be constructed and installed per the latest edition of the International Mechanical Code.
- 1.4 Ductwork shall be kept clean at all times. Ductwork stored on the job site shall be placed a minimum of 4" above the floor and shall be completely covered in plastic. Installed ductwork shall be protected with plastic. Do not install the ductwork if the building is not "dried-in". If this is required, the entire lengths of duct shall be covered in plastic to protect. The Owner/Engineer shall periodically inspect that these procedures are followed. If deemed unacceptable, the Contractor shall be required to clean the duct system utilizing a NADCA certified Contractor.
- 1.5 Prior to purchase and fabrication of ductwork (shop fabricated or manufactured), the Contractor shall coordinate installations with new and existing conditions. Notify the Engineer if there are any discrepancies for resolution.

PART 2 – LOW VELOCITY DUCTWORK:

- 2.1 Ductwork, plenums, and other appurtenances shall be constructed of one of the following: Steel sheets, zinc coated, Federal Specification 00-S-775, Type I, Class E & ASTM A93-59T with G-90 zinc coating. Aluminum alloy sheets 3003, Federal Specification AA-A-359, Temper H-14.
- 2.2 Ductwork, plenums, and other appurtenances shall be constructed of the materials of the minimum weights or gauges as required by the latest SMACNA 2" W.G. Standard or below table. When gauge thickness differs, the heavier gauge shall be selected. The below table shall serve as a minimum.

Round Diameter	Duct Gauge	Rectangular Width	Duct Gauge
3-12 Inches	26 Ga.	3-12 inches	26 Ga,
12-18 Inches	24 Ga.	13-30 inches	24 Ga.
19-28 Inches	22 Ga.	31-54 inches	22 Ga.
29-36 Inches	20 Ga.	55-84 inches	20 Ga.
37-52 Inches	18 Ga.	85 inches and up	18 Ga.

- 2.3 All ductwork connections, fittings, joints, etc., including longitudinal and transverse joints, seams and connections shall be sealed. Seal with high velocity, smooth-textured, water based duct sealant. Sealant shall be UL 181B-M listed, UL 723 classified, NFPA 90A & 90B compliant, permanently flexible, non-flammable, and rated to 15"wg. Apply per manufacturer's recommendations. Contractors shall ensure no exposed sharp edges or burrs on ductwork.
- 2.4 Duct dimensions indicated are required inside clear dimensions. Plan duct layouts for adequate insulation and fitting clearance.
- 2.5 All angular turns shall be made with the radius of the center line of the duct equivalent to 1.5 times the width of the duct.
- 2.6 Cross-break all ducts where either cross sectional dimension is 18" or larger.
- 2.7 Ducts shall be hung by angles, rods, 18 ga. minimum straps, trapezes, etc., in accordance with SMACNA's recommended practices. Duct supports shall not exceed 12 ft intervals. There shall be no less than one set of hangers for each section of ductwork. Where ductwork contains filter sections, coils, fans or other equipment or items, such equipment or items shall be hung independently of ductwork with rods or angles. Do not suspend ducts from purlins or other weak structural members where no additional weight may be applied. If in doubt, consult the Structural Engineer.
- 2.8 Double turning vanes shall be installed in square turns and/or where indicated.
- 2.9 Provide a "high efficiency" type take-off with round damper (Flexmaster STOD-B03 or approved equal) for all round duct branches from a rectangular main to a GRD. Refer to the detail on the drawings for all installation requirements.
- 2.10 Air volume dampers shall be installed in each duct branch takeoffs and/or where indicated, whichever is more stringent. All such dampers shall be accessible without damage to finishes or insulation and shall be provided where required for proper system balance.
- 2.11 Unless otherwise dimensioned on the drawings, all diffusers, registers, and grilles shall be located aesthetically and symmetrically with respect to lighting, ceiling patterns, doors, masonry bond, etc. Locate all supply, return, and exhaust diffusers and grilles in the locations shown on the architectural reflected ceiling plan.
- 2.12 The interior surface of the ductwork connecting to return/exhaust air grilles shall be painted flat black. The ductwork shall be painted a minimum of 24" starting from the grille.
- 2.13 Provide approved flexible connectors at inlet and outlet of each item of heating and cooling equipment whether indicated or not. Install so as to facilitate removal of equipment as well as for vibration and noise control.
- 2.14 All fans and other vibrating equipment shall be suspended by independent vibration isolators.
- 2.15 Miscellaneous accessories such as test openings with covers, latches, hardware, locking devices, etc., shall be installed as recommended by SMACNA and/or as indicated. Test openings shall be placed at the inlet and discharge of all centrifugal fans, VAV boxes, fan sections of air handling units, at the end and middle of all main trunk ducts and where indicated. All such openings shall be readily accessible without damage to finishes.

- 2.16 Whether indicated or not, provide code approved, full sized fire dampers at all locations where ductwork penetrates fire rated walls. Fire stop rating shall meet or exceed the rating of the wall. Provide an approved access panel at each fire damper located and sized so as to allow hand reset of each fire dampers. All such fire dampers and access panels shall be readily accessible without damage to finishes. Refer to Architectural Plans for locations of fire rated walls. All access doors shall be 16"x16" or as high as ductwork permits and 16" in length.
- 2.17 The Contractor who installs the sheet metal shall furnish to the Air Balancing Contractor, a qualified person to assist in testing and balancing the system.
- 2.18 INSULATED FLEXIBLE AIR DUCT: Thermaflex G-KM or equal. Flexible air duct shall be two (2) inch thick fiberglass insulation with CPE liner permanently bonded to a coated spring steel wire helix supporting a fiberglass scrim and fiberglass insulating blanket. Flexible air duct shall be listed under UL Standard 181 as a Class I flexible air duct complying with NFPA 90A and 90B. Maximum flame spread = 25 and maximum smoke developed = 50. Minimum insulating value is R-6.0. Flexible duct shall be used only for GRD runouts, and no section shall be more than five feet in length.
- 2.19 FLEXIBLE CONNECTORS: Duro-Dyne, Ventfabrics, Inc., U.S. Rubber or equivalent; conforming to NFPA No. 90A; neoprene coated glass fabric; 20 oz. for low velocity ducts secured with snap lock.
- 2.20 TURNING VANES: Fabricated as recommended by SMACNA: noiseless when in place without mounting projections in ducts. All turning vanes shall be double blade type.
- 2.21 ACCESS DOORS IN DUCTWORK: Flexmaster TBSM, Air Balance, Vent Products or equal. Access doors for rectangular ducts shall be 16"x16" where possible. Otherwise install as large an access door as height permits by 16" in length. Door shall be 2" thick double-wall insulated with continuous hinge and cam lock. Provide in ducts where indicated or where required for servicing equipment whether indicated or not. Provide a hinged access door in duct adjacent to all fire, smoke, and control dampers for the purpose of determining position. Access doors shall also be provided on each side of duct coils and downstream side of VAV boxes and CAV boxes.
- 2.22 ARCHITECTURAL ACCESS DOORS IN CEILINGS OR WALLS: Provide Kees D Panel, Cesco, Milcor or equal. Panels shall be 24"x24" in size and constructed with 16 gauge galvannealed steel for door and frame. Provide with primer finish to accept specified finish. Door shall include three (3) screwdriver operated cam latches and concealed continuous pivoting rod hinge. Door shall open 175 degrees. For masonry construction, furnish frames with adjustable metal masonry anchors. For fire rated units, provide manufacturer's standard insulated flush panel/doors with continuous piano hinge and self-closing mechanism. The Contractor shall include all required access doors in the bid and shall coordinate with the General Contractor prior to the bid to ensure a complete project.
- VOLUME DAMPERS (RECTANGULAR): Ruskin MD35 or Air Balance, Pottorff, rectangular volume dampers. Frames shall be 16 gauge galvanized steel. Blades shall be opposed blade 16 gauge galvanized steel with triple crimped blades on 6" centers. Linkage shall be concealed in jamb. Bearings shall be ½" nylon. Maximum single section size shall be 48" wide and 72" high. Provide with Ventfabrics 2" high elevated dial regulator to avoid damper handle from conflicting with duct insulation. Provide permanent mark on dial regulator to mark air balance point.
- 2.24 VOLUME DAMPERS (ROUND): Ruskin MDRS25 or Air Balance, Pottorff round volume dampers. Dampers shall be butterfly type consisting of circular blade mounted to axle. Frames shall be 20 gauge

PROJECT NO. 24-179.000
Harrison REMC - Addition and Renovation
Harrison REMC

Sheet.Metal 23 1200 - 4 04/24/2025

steel and 6" long. Damper blades shall be 20 gauge crimped galvanized steel. Axle shall be 3/8" square plated steel. Bearing shall be 3/8" nylon. Provide with Ventfabrics 2" high elevated dial regulator to avoid damper handle from conflicting with duct insulation. Provide permanent mark on dial regulator to mark air balance point.

END OF SECTION 23 1200

SECTION 25 0100 - ELECTRIC MOTORS AND OTHER ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENT

PART 1 – GENERAL:

- 1.1 The Contractor's attention is directed to the General and Special Conditions, GENERAL PROVISIONS MECHANICAL and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section, and which are hereby made a part of the work specified in this section.
- 1.2 Through coordination with other Contractors, Vendors and Suppliers associated with this Project, this Contractor shall ensure a complete, 100% functional, tested, inspected, and approved systems. Claims for additional cost or change orders will immediately be rejected. Refer to Specification Section HVAC EQUIPMENT for additional requirements. All equipment shall be furnished for a single point electrical connection unless specifically excluded as a requirement.
- 1.3 Review the Specification Section CONTROLS to determine controls, including variable frequency drives, to be furnished.
- 1.4 Prior to ordering any materials or rough-in of any kind, the Mechanical Contractor shall be responsible for final coordination of all electrical requirements (i.e., voltage, phase, circuit breaker, wire sizing, etc.) with the Electrical Contractor. There will be no change in the Contract Amount for any discrepancies. A final coordination meeting shall be held with the Architect, Owner, Engineer, General Contractor, Mechanical Contractor, Electrical Contractor, and their sub-contractors.

PART 2 - MOTORS:

- 2.1 The following are basic requirements for simple or common motors. For special motors, more detailed and specific requirements are specified in the individual equipment specifications and drawing schedules.
- 2.2 Torque characteristics shall be sufficient to satisfactorily accelerate the driven loads.
- 2.3 Motor sizes shall be large enough so that the driven load will not require the motor to operate in the service factor range.
- 2.4 Motors shall be capable of frequency of starts as indicated by automatic control system and not less than five (5) evenly time spaced starts per hour for manually controlled motors.
- 2.5 Motors shall have a 1.15 service factor for poly-phase motors and 1.35 service factor for single phase motors.
- 2.6 Motors shall have a temperature rating for 40 deg C ambient environment with maximum 90 deg C temperature rise for continuous duty at full load with 1.15 service factor and Class B insulation.
- 2.7 Unless otherwise noted or required by application, motors shall conform to NEMA Standard MG 1 (Table 12-10) for general purpose, continuous duty, horizontal, T-frame, single speed, design "A" or "B". Utilize design "C" motors where required for high starting torque.
- 2.8 Motor frames shall be NEMA Standard No. 48 or 56. Use driven equipment (fans, pumps, etc.) manufacturer's standards to suit specific application.
- 2.9 Provide inverter rated motors where variable frequency drives are utilized. Motor shall be premium efficiency type with Class F insulation and shall conform to NEMA MG 1 parts 30 and 31. Inverter duty rated motors shall have a temperature rating for 40 deg C ambient environment with maximum of 105 deg C temperature rise.
- 2.10 Motor bearings shall be ball or roller bearings with inner and outer shaft seals. Bearings shall be re-greasable, except

permanently sealed where motor is normally inaccessible for regular maintenance. Bearings shall be designed to resist thrust loading where belt drives or other drives produce lateral or axial thrust in motor.

- 2.11 Motor enclosure type shall be open drip-proof motors for indoor use where satisfactorily housed or remotely located during operation. Enclosures shall be guarded drip-proof type motors where exposed to contact by employees or building occupants. Enclosure shall be weather protected Type I for outdoor use or Type II where not housed.
- 2.12 Provide built-in thermal overload protection and, where required, internal sensing device suitable for signaling and stopping motor at starter.
- 2.13 Provide energy efficient motors with a minimum EPACT efficiency in accordance with NEMA MG 1, Table 12-10 for 1800 rpm, enclosed motors. If efficiency not specified, motors shall have a minimum efficiency as listed below:

1 hp - 82.5%	7.5 hp – 89.5%	30 hp – 92.4%
1.5 hp – 84.0%	10 hp – 89.5%	40 hp – 93%
2 hp – 84%	15 hp – 91%	50 hp – 93%
3 hp - 87.5%	20 hp – 91%	60 hp - 93.6%
5 hp – 87.5%	25 hp – 92.4%	75 hp – 94.1%

2.14 On the motor nameplate, indicate the full identification of manufacturer, ratings, characteristics, construction, special features and similar information.

PART 3 - MOTOR STARTERS:

- 3.1 Provide motor starters where indicated on the mechanical equipment schedules or elsewhere in the Contract Documents.
- 3.2 Motor starters shall be NEMA style. Their sizing and installation shall be coordinated with the equipment manufacturer's requirements and in accordance with the National Electrical Code.
- 3.3 All starters shall be size 0 minimum. They shall be constructed and tested in accord with latest edition of NEMA standards. All starters shall be across-the-line magnetic type, unless indicated otherwise. On motors of 20 H.P. or greater rating, the supplier shall provide starters capable of limiting inrush currents. These shall be the reduced voltage open-transition type. Do not utilize closed transition starters unless specifically indicated.
- 3.4 Magnetic starters shall be furnished with the following characteristics and accessories as a minimum. See remaining paragraphs of the Part and mechanical schedules for further requirements.
- 3.5 Contacts shall be silver-alloy, double-break type except NEMA size 8 and 9 shall be single-break type. Contacts shall be replaceable without removal of wiring or removal of starter from enclosure. Number of contacts shall be as required for service indicated. Contacts shall be gravity dropout type, positive operation.
- Coil voltage shall be 120 volts, A.C., 60 HZ or less, as required to suit control systems available voltages. Coils shall be of molded construction, except for size 8 and 9 which shall be hand wound. Provide coil clearing contact as required.
- Provide control transformer of adequate K.V.A. as required on all starters with line-to-line voltages higher than 120 volts A.C. Provide fuse block and slow-blow fuse to protect control transformer per NEMA, N.E.C. and U.L.
- 3.8 Provide hand-off-auto selector switch in face of starter, wired into hand and off switch positions. Auto position (if needed) to be field wired as indicated for automatic control.
- 3.9 Provide NEMA Class 20 resetable overload relays, accurately sized to the motor nameplate rating of the motor served and the temperature differential between motor and controller. Overloads shall be easily replaceable, and resetable without opening enclosure, via a push button or similar means. Class 10 or Class 30 overloads may be used

depending on type of motor duty encountered.

- 3.10 Provide at least one N.O. auxiliary contact (field-convertible to N.C. operation) with each starter. All starters shall have space for two additional single-pole contacts.
- 3.11 All starters shall be thru-wiring type.
- 3.12 Provide phase failure sensing relay to open starter coil circuit (on loss of one or more phases) on all three-phase starters controlling motors of 7½ H.P. or larger.

PART 4 – ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENT:

- 4.1 All mechanical equipment shall be provided for single point electrical connection unless noted otherwise.
- The equipment manufacturer shall provide internally mounted fuses with the equipment, as required, to comply with the U.L. listing on the equipment name plate. (i.e., hermetically sealed compressors or equipment with name plate data that recommends or requires fuse protection.) See also, National Electrical Code, Article 440, Part C, and other applicable sections of the N.E.C.
- 4.3 It shall be the Contractor's responsibility to assure that all mechanical equipment requiring electrical connections be provided with all required proper wiring, electrical protective devices, disconnecting means and electro-mechanical starting units to properly match the mechanical equipment requirement.
- 4.4 Each separate contractor engaged for the project shall coordinate with all other trades to ensure all necessary equipment and labor is included for fully functioning mechanical systems, installed per Code and Project requirements.
- 4.5 Refrigeration condensing units with internal compressors shall be furnished with integral starter.
- 4.6 All interlock or other control wiring, unless specifically noted otherwise, is the responsibility of this Contractor.
- 4.7 All equipment shall be suitably enclosed. All enclosures for equipment shall be rated and approved for the environment in which it operates. (i.e., NEMA 1, NEMA 3R, NEMA 7, NEMA 12, etc.) Verify the requirement with the installation condition if not indicated on the plans.
- Observe the following standards for manufacture of equipment and in selection of components: (1) Starters, control devices and assemblies NEMA (I.E.C. style not acceptable), (2) Enclosures for electrical equipment NEMA, (3) Enclosed switches NEMA, (4) All electrical work, generally NFPA 70, (5) All electrical work in industrial occupancies J.I.C. standards, (6) All electrical components and materials U.L. listing required.
- 4.9 Where scheduled on the drawings, provide disconnect switches and contactors. Disconnect switches shall be fusible type or circuit breaker type.

PART 5 – REQUIREMENTS FOR MECHANICAL EQUIPMENT 3/4 H.P. OR LESS:

- This section describes requirements for small mechanical equipment such as (but not limited to) package terminal heating/cooling units, VAV boxes, unit heaters, unit ventilators, exhaust fans, fans, fan coil units, cabinet heaters, DDC temperature control panels, etc.
- 5.2 Small equipment with motor(s) of 3/4 H.P., single phase or less are generally not required to be furnished with starter(s), unless otherwise noted. For such equipment, provide integral contactor or horsepower-rated relay where controlled by thermostat or other type of switch. Contactors or relays shall be as recommended by the manufacturer of the equipment.

- 5.3 Provide transformer within unit as required to provide low voltage A.C. for thermostat control.
- 5.4 Provide internal fusing for unit motor and other loads in fuse block or in-line fuseholder.
- Where externally mounted disconnecting means is required and would be impractical, unsightly or inappropriate in the judgment of the Engineer, disconnects shall be located within the unit. These disconnects may be fusible H.P.-rated snap switches or manual starters with overload elements, as required. Locate this and other electrical equipment within enclosure where easily accessible behind access panel or door on unit, and as acceptable to the electrical inspector or local authority having jurisdiction.

END OF SECTION 25 0100

SECTION 25 0400 - CONTROL - DIRECT DIGITAL (WEB BASED)

PART 1 – GENERAL:

- 1.1 The controls system for this project shall be a web-based digital controls system. All controllers, control interface hardware, services, installation, warranty, training, etc., shall be included as hereinafter specified. The system shall utilize a network controller and unitary" type controllers. Including such minor details not specifically mentioned or shown, as may be necessary for the complete operation of the system.
- 1.2 The Temperature Control Contractor (TCC) shall furnish all labor, materials, equipment, and service necessary for a complete and operating Building Automation System (BAS), utilizing Web Based Direct Digital Controls. All labor, materials, tools, equipment, software, software licenses, software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, samples, submittals, testing, commissioning, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, temporary protection, cleaning, cutting and patching, warranties, services, and items, even though these may not be specifically mentioned shall be included for the complete, fully functional and commissioned temperature controls system.
- 1.3 The TCC shall provide all items, articles, materials, devices, operations, or methods listed, mentioned, or scheduled on the drawings including all labor, materials, equipment, and incidentals necessary and required for their completion to provide a complete and operating temperature control system. This will include connecting to any mechanical equipment furnished with a control interface device and contacting the equipment suppliers and/or manufacturers for information for the proper interface to the equipment being furnished.
- 1.4 These apparatus' shall consist of, but not limited to, all necessary thermostats, sensing devices, valves, automatic dampers, damper motors, actuators, (except automatic dampers, valves, and damper motors furnished with HVAC equipment), and with the necessary accessories for the complete control of all equipment hereinafter specified.
- 1.5 Control sequences are specified at the end of this section. Provide all control equipment required to perform sequences described. Coordinate all dampers with the sheet metal contractor and equipment provider. It is the responsibility of the control contractor to ensure all required dampers in the sequence of operations are provided.
- 1.6 Include all power wiring and cabling for the operation of the controls system. Refer to Electrical Division Specifications for additional requirements.
- 1.7 APPROVED MANUFACTURER'S: American Auto-Matrix, Alerton, Andover, Honeywell, Invensys, Johnson Controls, Siemens, Trane. These TCCs/manufacturers have prior approval with the Owner and Engineer and are the only allowed suppliers and/or installing TCCs.
- 1.8 The TCC shall have an established working relationship with the control manufacturer of not less than five years and shall have prior approval from the Owner and Engineer and are the only allowed suppliers and/or installing contractors. The TCC shall have a local office within 100 miles of the project site and provide service and/or replacement parts within a 24 hour notification of a control failure.

- 1.9 A mandatory pre-installation meeting shall occur prior to the TCC beginning any work on site. This meeting shall be attended minimally the prime contractor, mechanical contractor superintendent, TCC superintendent, Engineer, Owner, and Architect. The purpose of the meeting is to have the controls installer communicate their understanding of the system design and how the system is intended operate to the Engineer and get the Engineer's input and agreement. The agreement between the TCC and the mechanical engineer is to be thoroughly documented by the TCC for later reference.
- 1.10 The installation shall comply with the Local Authorities and State Fire Marshal code requirements, including normal operating and smoke mode functions (where applicable). The installation shall comply with the requirements of the NEC, NFPA, UL and the Building Codes, including referenced mechanical, electrical, energy codes, etc.

1.11 ABBREVIATIONS:

• TCC – Temperature Control Contractor

PART 2 - GENERAL SYSTEM REQUIREMENTS:

- 2.1 All labeling for this system shall utilize actual final room names and numbers. The room names and numbers on the Contract Documents may not be the Owner's exact requirements. Coordinate with the Owner to ensure compliance.
- 2.2 Include in the bid for the Controls Contractor to perform additional 40 on-site hours of on-site programming, adjustments, modifications, etc. as requested by the Engineer during the warranty period after the date of substantial completion for the project.
- 2.3 All points of user interface shall be on standard PCs that do not require the purchase of any special software from the control's manufacturer for use as a building operations terminal. The primary point of interface on these PCs will be a standard Web Browser.
- 2.4 The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system integrated utilizing ANSI/ASHRAE Standard 135-2001 BACNet, LONWorks technology, OBIX TCP/IP, MODBUS, OPC, and other open and proprietary communication protocols in one open, interoperable system
- 2.5 The TCC shall connect to any mechanical and electrical (power monitoring) equipment furnished with a control interface device. The TCC shall contact the equipment suppliers and/or manufacturers for information for the proper interface to the equipment being furnished. All points not provided with the equipment control interface are the responsibility of the TCC.
- 2.6 The operating system shall be based on a distributed control system in accordance with specifications. All building controllers, application controllers and all input/output devices shall communicate via BACnet MS/TP or LonMark/LonTalk communication protocol. Network controller shall communicate via BACnet over Ethernet (IP).
- 2.7 The TCC contractor shall provide access to the system from a location determined by the Owner and from the Consulting Engineer's office (CMTA, Inc.). This shall include remote access requirements, set-up, passwords, and any software necessary to access the BAS system.

- 2.8 The TCC shall all have access to various types of WEB browsers which shall be included for access to the Direct Digital Control (DDC) system via the Owner's Wide Area Network (WAN) and/or Local Area Network (LAN).
- 2.9 The TCC shall be responsible for coordination with the Owner's IT staff to ensure that their system will perform in the Owner's environment without disruption to any of the other activities taking place on that WAN/LAN.

PART 3 – SUBMITTALS:

- 3.1 The TCC shall not start the project installation until the shop drawing submittals have been reviewed by the Engineer.
- 3.2 Submittals shall include hardware, end devices, ancillary control components, a written operating sequence, unitary control wiring, building floor plans showing communication cabling and labels as well as logic flow diagrams. All submittals shall be provided on paper and electronically in PDF format.
- 3.3 Submittals shall contain one control drawing per specified system and equipment. Drawing shall include point descriptors (DI, DO, AI, AO), addressing, and point names. Each point names shall be unique (within a system and between systems). For example, the point named for the mixed air temperature for AHU #1, AHU #2, and AHU #3 shall not be MAT but should be named AHU#1MAT, AHU#2MAT, and AHU#3MAT. The point names should be logical and consistent between systems and AHU's. The abbreviation or shorthand notation (e.g., MAT) shall be clearly defined in writing by the TCC.
- 3.4 Control diagrams shall identify: System being controlled (attach abbreviated control logic text, all digital points, analog points, virtual points, all functions (logic, math, and control) within control loop, legend for graphical icons or symbols, definition of variables or point names and detailed electric connections to all control devices and sensors.
- Points list shall include all physical input/output. Points list shall be provided in both hard copy and in electronic format and shall include Name, address, engineering units, high and low alarm values and alarm differentials for return to normal condition, default value to be used when the normal controlling value is not reporting, message and alarm reporting as specified, identification of all adjustable points and description of all points.
- 3.6 Submittals shall contain floor plans depicting DDC control devices (control units, network devices, LAN interface devices, and power transformers as well as static pressure sensor in duct and temperature sensors in rooms) in relation to mechanical rooms, HVAC equipment, and building footprint.
- 3.7 Submittals shall contain DDC system architecture diagram indicating schematic location of all control units, workstations, LAN Interface devices, gateways, etc. Indicate address and type for each control unit, Indicate protocol, baud rate, and type of LAN per control unit.
- 3.8 Electrical wiring diagrams shall include motor start, control, and safety circuits and detailed digital interface panel control point termination diagrams with all wire numbers and terminal block numbers identified. Indicate all required electrical wiring. Provide panel termination drawings on separate drawings. Clearly differentiate between portions of wiring that are existing, factory-installed and portions to be field-installed.
- 3.9 Show all electric connections of the controls system to equipment furnished by others complete to terminal points identified with manufacturer's terminal recommendations.
- 3.10 TCC shall provide one complete drawing that shows the control-wiring interface with equipment provided by

others.

- 3.11 Submittals shall include project specific graphic screens for each system including a picture of the screen with a list of the variables to be placed on the screen.
- 3.12 Submittals shall include TCC's hardware checkout sheets and test reports.
- 3.13 Submittals shall include the agenda for approval by the engineer and owner of the specified training periods. See training section for requirements.
- 3.14 Provide complete panel drawings that are:
 - Clearly labeled and schematic or drawn to scale.
 - Show the internal and external component arrangement so that the operators can identify the components by their position if the labels come off.
 - Wiring access routes shall also be identified so that Class 1 wiring is separated from Class 2 and 3 and so high voltage wiring is segregated from low voltage wiring.
 - Complete identification of all control devices (manufacturer's type, number, and function).
 - Provide details for labeling all wiring, control devices, and controllers.
 - Material and equipment descriptive material such as catalog cuts, diagrams, performance curves, and other data to demonstrate conformance with specifications shall be provided.
- 3.15 Include room schedule including a separate line for each terminal unit, heat pump, etc. indicating location and address.
- 3.16 Include control valve schedules including a separate line for each valve provided under this section and a column for each of the valve attributes: code number, configuration, fail position, pipe size, valve size, body configuration, close-off pressure, capacity, valve Cv, design pressure, and actuator type.
- 3.17 Include control damper schedule including a separate line for each damper provided under this section and a column for each of the damper attributes, including: code number, fail position, damper type, damper operator, duct size, damper size, mounting, and actuator type.

PART 4 – O&M MANUALS AND CLOSEOUT DOCUMENTS:

- 4.1 Refer to Mechanical Specification Section REQUIRED SHOP DRAWINGS, ETC. for additional requirements.
- 4.2 Operating instructions, maintenance procedures, parts and repair manuals shall be supplied. Repair manuals shall include detailed instructions in the setup, calibration, repair, and maintenance of all equipment furnished. Also supplied with these manuals will be a complete parts listing of all devices supplied which is to include part numbers and model numbers of all parts and component parts along with exploded views of devices.
- 4.3 All as built drawings (wiring diagrams, flowcharts, floor plans, etc.) shall also be supplied to the owner electronically in PDF format.
- 4.4 System specific wiring, control diagrams, sequence of operation and points lists shall be as installed in each control panel. This means as-built drawings, not design (submittal) drawings.

- 4.5 Supply all software necessary for configuration of, modification, editing or communicating to any of the unitary devices. Software shall be capable of uploading and down-loading the entire unitary data base or any part of the automated system for backup or archiving.
- 4.6 Supply one copy of the software programming manual (hard copy and PDF format). The manual shall describe all furnished software. The manual shall be oriented to programmers and shall describe calling requirements, data exchange requirements, data file requirements, and other information necessary to enable proper integration, loading, testing, and program execution.
- 4.7 Provide a Bill of Materials with each schematic drawing. List all devices/equipment and match to schematic and actual field labeling. Provide quantity, manufacturer, actual product ordering number, description, size, accuracy, operating ranges (voltage, temperature, pressure, etc.), input/output parameters, etc.
- 4.8 Maintenance manual shall include copies of signed-off acceptance test forms, commissioning reports, start-up reports, etc.
- 4.9 The TCC shall turn over to owner two (2) sets of computerized back-ups of the complete temperature control system.

PART 5 - WARRANTY & SOFTWARE LICENSES:

- 5.1 Labor and materials for the control system specified shall be warranted free from defects for a period of 12 months after substantial completion and acceptance. Control system failures during the warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to the Owner.
- The TCC shall respond to the Owner's request for warranty service within 24 hours during normal business hours. The TCC shall respond to the Owner's request for Emergency service (defined as life-threatening or creating the potential to cause property damage) during the warranty period within 4 hours.
- 5.3 The TCC shall provide technical phone support to the owner during the warranty period for warranty related issues and for two years after the warranty period. If the technical support location of the TCC is outside of the toll free calling area for the customer, the TCC shall have a toll free number or accept collect calls for the purpose of providing technical support.
- During the warranty period, standard parts for the DDC system shall arrive at the facility within 48 hours of placing an order. Non-standard parts (requiring re-manufacturing or ordering from another supplier) shall be shipped within 96 hours.
- Operator workstation software, project-specific software, graphic software, database software, and firmware updates which resolve known software deficiencies as identified by the TCC shall be provided and correctly installed at no charge during the warranty period.
- Provide licensed electronic copies of all software for each workstation, laptop, server. This includes but is not limited to: project graphic images (editing/modifying/creating), project database, trouble-shooting and debugging programs, project-specific programming code and all other software required to operate and modify the programming code (including software at system level, primary control units, secondary control units, and all communication software). Any hardware devices (cables, protection devices) required to operate the software/hardware shall also be provided.

- 5.7 All additional licensing needed for this project shall be supplied by TCC. Software license shall not expire or utilize any sort of protection hardware device for its use. In any case owner shall be free to direct the modification of any software license, regardless of supplier to allow open access to all controllers. Owner shall hold the software and firmware licensing. Software license shall not expire or utilize any sort of protection hardware device for its use.
- 5.8 System software shall be the latest version available with upgrades provided at the end of the warranty period and shall be fully licensed to the Owner for the entire system. Supply all software necessary for configuration of, modification, editing or communicating to any of the unitary devices. Software shall be capable of uploading and downloading the entire unitary data base or any part of the automated system for backup or archiving. Software shall be "IBM compatible".

PART 6 – TRAINING:

- A formal on-site "Hands On" training session shall be conducted for the owner's maintenance personnel. This session shall be a minimum of one (1) eight (8) hour days to train the staff on setup, operation, and maintenance of all system(s) and/or devices. This will be at a time and location selected by the owner. One (1) additional eight (8) hour session shall be provided as "opposite season" training generally 6 months into the warranty period. One (1) additional eight (8) hour session shall be provided at a later date. (This may be requested any time during the warranty period.) All training materials and books shall be provided. Both sessions shall be given by the manufacturers "factory" technical representative. (This is defined as someone other than the installing contractor's representative.) All expenses are to be provided by the TCC. All training sessions shall be scheduled at owner's request.
- TCC shall conduct training courses for designated personnel in operation and maintenance of system. Training shall be oriented to specific system being installed under his contract and shall be digitally recorded and submitted on DVD by the TCC.
- Training shall be a mix of, test exercises, and actual keyboard entry and screen viewing at the operator's terminal. A curriculum shall be discussed and implemented based on the level of expertise of the employees. Hands-on experience and problem solving shall be emphasized.
- 6.4 If during any training session, the trainer/owner finds more than three (3) items that need repair, the training session will be immediately terminated. The session will be rescheduled for another date. The re-scheduled training session will be carried out at no additional cost to the Owner.
- The training shall be oriented to making the owner self sufficient in the day-to-day use and operation of the DDC system.
- 6.6 Additionally, the training shall include:
 - System start-up, shutdowns, power outage and restart routines, alarms, security levels, changing setpoints, changing schedules and other parameters, overrides, freeze protection, manual operation, return to automatic operation, and resetting equipment.
 - All screens shall be discussed, allowing time for guestions.
 - Information specifically focused on showing the owner methods of troubleshooting the mechanical systems using the DDC.
 - Use of laptop and hand-held operator interface device, if applicable.
 - Creating, modifying, viewing, downloading, and reloading, trend logs.
 - Remote access to the system.

- The other training sessions shall be oriented toward answering specific questions from Owner's staff.
- The trainer must be well grounded in both DDC system operation and in mechanical systems service and shall be the programmer.
- This documentation and process shall be complete, approved and accepted by Engineer and Owner prior to acceptance. This information shall be documented as completed. A copy shall be delivered to the Engineer and Owner and included in the O&M manuals.

PART 7 - COMMISSIONING & VERIFICATION, FUNCTIONAL PERFORMANCE TESTING & CHECKLISTS:

- 7.1 100% compliance with the requirements of this section is a condition of the Owner's acceptance and start of the warranty period.
- 7.2 The TCC shall be responsible for completion of (1) their hardware checkout sheets and test reports, (2) Point-by-point confirmations of ALL points this includes visual inspection of installed components, and (3) sequence of operation confirmation.
- 7.3 This documentation and process shall be complete, approved and accepted by Engineer and Owner prior to acceptance. This information shall be documented as completed. A copy shall be delivered to the Engineer and Owner and included in the O&M manuals. Each subcontractor shall be responsible for completion of their own System Verification Checklists/Manufacturer's Checklists. Sample checklists shall be submitted to the Engineer and Testing Agent for approval.
- 7.4 Air and water balancing shall be completed (and discrepancies resolved) before the TCC's final system check and before the acceptance test to be conducted in the presence of the Engineer.
- 7.5 Refer to Mechanical Specification Section GENERAL PROVISIONS for additional information and requirements.

PART 8 – WIRE MANAGEMENT, ELECTRICAL POWER, ETC:

- 8.1 Refer to CABLING section of this specification for additional requirements.
- 8.2 Electrical work required for system interlock and installation of the temperature control system shall be included in the bid and installed per all applicable codes. Coordinate with other trades as required for installation of a complete system.
- 8.3 All wiring and cabling in mechanical and electrical rooms shall be in conduit. No wiring or conduit can be exposed to view in any other area. Conceal all wiring and cabling in conduit in wall from thermostats or other controls devices to above ceiling. Install conduit in wall from wall thermostats to above ceiling for cabling. Route wiring directly to cable tray from control points above the ceiling. Rough-in for control devices shall be in compliance with the requirements of the ELECTRICAL SPECIFICATIONS.
- Any power for controls shall be fed from dedicated circuits in emergency electrical panels, when provided for a project, and shall not be obtained from receptacles, lighting, or equipment circuits. Unitary control power may be obtained from the equipment served. If power is obtained from the equipment served, the power may not be interrupted to the electronics if the equipment is off for any reason.

- The TCC shall be responsible for the power source to any control panels, unitary controllers, etc. on any controlled equipment and all other control power requirements. This includes circuit breakers, wiring, conduit, etc. installed in strict accordance with NEC. The TCC may contract with the electrical contractor for the power wiring installation.
- Prior to installation, insure through coordination with all trades, that appropriate clearances (36" minimum) as required by the N.E.C. are maintained at all control panels, including unitary controllers for VAV terminals, heat pumps, etc.
- The TCC shall provide all CAT5 or CAT6 cabling network cabling for a complete system. This shall include cabling to the Owner's data drop. The main system data drop will be provided by others.
- 8.8 All control circuits within the electrical panels shall be marked to indicate equipment served.
- 8.9 The TCC shall perform all temperature control interlock wiring. This shall include control valves, dampers, thermostats, indoor/outdoor HVAC systems, etc. Electrical work required for system interlock and installation of the temperature control system shall be included in the bid and installed per all applicable codes. Coordinate with other trades as required for installation of a complete system.
- 8.10 The TCC shall be responsible for any power required for the unitary controls or control panels. This includes circuit breakers, wiring, conduit, etc. installed in strict accordance with NEC. The TCC may contract with the electrical contractor for the power wiring installation.
- 8.11 Provide one duplex outlet mounted inside the control panel and separately fused with a non-time delay fuse at 15 A at any panel location containing electronic control components. This receptacle may be served from the control panel 120 VAC power source.
- 8.12 All wiring shall be continuous runs. Any junctions must be made in metal enclosure.
- 8.13 Grounding terminals shall be color coded green and yellow and shall be compatible with the other specialty terminals specified above and shall mount on the same DIN rail system. Units shall be arranged so that the wiring connected to them is grounded to the enclosure via the mounting rail. These terminals shall be provided for grounding cable shields at the points where the cables enter a control panel and terminate on the control panel terminal strip. Terminals shall be Entrelec M 4/5.3A.PI or equivalent by Weidmuller, Phoenix, or Allen Bradley.
- The Department of Housing, Building and Construction's Electrical Division requires that all new lighting control panels, new Building Automation Systems control panels, and new conventional HVAC control panels be certified as being constructed and wired in accordance with NFPA 70 110.3 (a) (1) and article 409.
- 8.15 Contractor shall insure control panels have an identification label stating the "Certification Agency" such as UL, CSA, CE, etc. or a label of certification for each control panel by a Professional Engineer (P.E.) registered stating that the design of the control panel was under their direct supervisory control. Include with shop drawings.

8.16 The Electrical Advisory Council for the State requires that only an electrical contractor licensed by the State with a licensed Master Electrician and a licensed on-site electrician can install the electrical wiring for lighting controls systems or Building Automation Systems (BAS).

PART 9 – CABLING:

- 9.1 Refer to WIRE MANAGEMENT section of this specification for additional requirements.
- 9.2 ALL CONTROL WIRING SHALL BE INSTALLED IN A WIRE MANAGEMENT SYSTEM TO INCLUDE CABLE TRAYS, BRIDLE RINGS, & CONDUITS. NO EXCEPTIONS! COORDINATE WITH ELECTRICAL CONTRACTOR TO INSURE A COMPLETE WIRE MANGEMENT SYSTEM.
- 9.3 Acceptable cable manufacturers are Belden, West Penn, or Alpha.
- 9.4 A complete cabling system shall be furnished and installed, which shall adhere to the highest workmanlike standard of quality and appearance. Cabling shall be installed square with building lines and contained within a wire management system.
- 9.5 All sizing of cabling shall be according to manufacturer's recommendations but shall be a minimum of 18 AWG.
- 9.6 Furnish a floor plan of the building indicating communication cable labeling and routing as well as addresses and branch wiring from the unitary devices. All cabling shall be labeled on both ends. The type, size and label of all cabling shall be indicated on submittal floor plan drawings.
- 9.7 Wall space temperature sensor cabling (from the sensor to the unitary controller) shall have a minimum of four (4) conductors.
- 9.8 All cabling shall be stranded. "NO" solid conductors will be accepted. All cabling shall be 100% shielded with appropriate drain wire and insulation.
- 9.9 All cable connections shall be continuous run (including shield). Any junctions must be made in a metal enclosure, connections must be soldered, taped and the metal enclosure must be mechanically attached to the nearest ground. No wire nuts or crimped connections will be accepted. Note location of junction boxes on the as built floor plans. All cabling networking unitary controllers, and other networked equipment, shall be in soldered.
- 9.10 All shields must be terminated as per manufacturer's recommendation. Shield termination requirements by the manufacturer must be provided with submittals.
- 9.11 Wireless controllers are not approved unless specifically mentioned in the sequence of operations or noted on plans.

PART 10 - SYSTEM SOFTWARE:

10.1 System software will be the latest version available with upgrades provided for full warranty period and shall be fully licensed to the owner for all network controllers and servers. Refer to WARRANTY section of this specification for additional requirements.

- 10.2 The BAS shall include trend logging screens accessible from tabs on the home page for building utilities usage.
- 10.3 System software shall, at a minimum, provide:
 - Monitor and supervise all control points.
 - Add new points and edit system database.
 - Change control setpoints, timing parameters and loop tuning of PID coefficients in all control loops in all control units.
 - Enter programmed start/stop schedules.
 - View alarm and messages.
 - Modify existing control logic (or sequence of operation) in all control units.
 - Upload/Download programs, databases, control parameters, etc.
 - Modify graphic screens.
- Sequence of operation programming methodology The application software shall be user programmable. Application programming shall be (1) Line type programming that uses text programming in a language similar to BASIC or FORTRAN, or (2) graphical block programming The method of programming shall be by manipulation of graphic icon "blocks." Each block represents a subroutine containing the programming necessary to execute the function of the device that the block represents.
- 10.5 Unitary Control Unit Database Archiving The host software shall provide capability to upload sequence of operation, database, and other control parameters from each controller. Uploaded programs shall be retained on hard disk for system backup. Programs may be modified using Editor functions and downloaded to individual controllers as desired. Downloading of databases shall not interrupt other multi-tasked functions that are ongoing.
- 10.6 THIRD PARTY SOFTWARE PACKAGES: The host software shall provide the capacity to run third party software packages for word processing, spreadsheets, or database management programs. Use of third party software shall not suspend operation of background tasks of multi-tasking operating system, such as alarm logging, and report generation.

PART 11 – NETWORK CONTROLLER

- 11.1 Install the Network Controller in a surface mounted panel, NEMA type 1 enclosures, with a removable hinged door. Provide a flush mounted key lock. All control panels must be painted the same color and identified. The boxes are to be made from 16 gauge material. Panels should not be provided with knockouts.
- 11.2 Control panels shall be constructed by a UL approved panel manufacturer. The standard used shall be UL508A. All proper labels are to be attached. Panel shall meet arc flash requirements.
- 11.3 The Network Controller shall be web-based and communicate BACnet IP. It shall issue all time schedules, summer/winter commands, customized trending, holiday scheduling, alarm handling, clock, or other shared commands to all unitary controllers within the building network. If for any reason communications between the unitary(s) and the Network Controller is lost, the unitary(s) shall operate in a stand-alone manner (in day operation) until communications is restored. It shall also operate in the "summer" or "winter" mode as last commanded.
- 11.4 The Network Controller shall be integrated and interoperable with the facility infrastructure and include user access to all system data locally over the Local Area Network (LAN) / Wide Area Network (WAN) within the

building and remotely by a standard Web Browser over the Internet. Any computer connected to the network, utilizing a web browser, and having the proper password.

- 11.5 The Network Controller shall be a fully user-programmable, supervisory controller. It shall monitor the network of distributed unitary controllers, provide global strategy and direction, and communicate on a peer-to-peer basis with other Network Controllers.
- The Network Controller shall have battery back-up to allow a minimum of seven days of operation. The Network Controller shall be composed of one or more independent, stand-alone, microprocessor to manage the network strategies described in Application software section. The network controller shall have ample memory to support its operating system, database, and programming requirements. The operating system of the Network Controller shall manage the input and output communications signals to allow distributed unitary controllers to share real and virtual point information and allow central monitoring and alarms. The database and custom programming routines of the Network Controller shall be editable from a single operator station.
- 11.7 The Network Controller shall be remotely monitored via the internet. Additionally, it shall include automatic emailing and texting out alarms, gathering alarms, reports and logs, programming and downloading database.
- 11.8 The Network Controller shall continually check the status of all processor and memory circuits. If a failure is detected, the controller shall:
 - Assume a predetermined failure mode.
 - Emit an alarm.
 - Display card failure identification.
- 11.9 Under no circumstance shall more than 75% of the total number of sensor and control points be connected through a single Network Controller. Each DDC system component shall provide for the future addition of at least 20% of each type of the number of sensor and control points connected to that component including a minimum of one universal input and one universal output.

PART 12 – UNITARY CONTROLLER

- 12.1 Unless otherwise specified, each piece of equipment shall have its own Unitary Controller (i.e., heat pump, AHU, terminal unit, etc.). The Unitary Controller for each piece of equipment shall be mounted on the side of the unit. The Unitary Controller for all other equipment shall be mounted in a panel and properly labeled.
- 12.2 Unitary Controllers used in conditioned ambient shall be mounted in dust-proof enclosures, and shall be rated for operation at 32 degrees F to 120 degrees F. All Unitary Controllers shall have an RJ-11 or similar type connection for monitoring or programming access by room or local equipment level with access to any unitary within the network without modification.
- 12.3 Control panels shall be constructed by a UL approved panel manufacturer. The standard used shall be UL508A.

 All proper labels are to be attached. Panel shall meet arc flash requirements.
- 12.4 Unitary Controllers utilized in the network shall have full stand alone capability including time of day and holiday scheduling as well as all energy management functions such as optimal start/stop, duty cycling, etc. The terminal unit Unitary Controllers may be pre-programmed with the project specific sequence of operation as specified for the application. Any re-programming of the electronics shall be performed on location using a portable personal computer with appropriate software or through the Network Controller. The entire unitary data base shall have the capability of being backed up and or downloaded locally.

- All points to have a unique digital input to the BAS system. The use of digital point count expanders is not an acceptable replacement to digital inputs to the unitary controller. The conversion of a single universal input channel to accept up to multiple voltage free contacts such as relay contacts, auxiliary starter contacts, differential pressure switches, etc. IS NOT ACCEPTABLE.
- 12.6 Unitary Controllers shall communicate via BACnet MSTP or LonMark/LonTalk communication protocol. A BACnet Protocol Implementation Conformance Statement (PICS) shall be provided for each Unitary Contoller that will communicate on the BACnet MS/TP Bus.
- 12.7 All Unitary Controllers shall be fully application programmable. All control sequences within or programmed into the unitary controller shall be stored in non-volatile memory, which is not dependent upon the presence of a battery shall be retained.
- 12.8 Unitary Controllers shall have a 10% spare point capacity to be provided for all applications.
- 12.9 After a power failure, the Unitary Controller shall operate the control application using the current setpoints and configuration. Reverting to default or factory setpoints are not acceptable.

PART 13 - SENSORS AND MISCELLANEOUS DEVICES:

- 13.1 WEATHER STATION HOUSING: Provide Kele Model A21 Outdoor Aspirated Humidity/Temperature housing. NEMA 3R enclosure is painted white to reduce the effect of radiation, and the enclosure has a lockable latch for security. The outdoor air sensor will be installed on the north wall in the shade as not to be affected by sunlight, building ventilation or weather. This location shall be indicated on the control drawings. Installation in outside air ductwork or louvers is not acceptable. If not installed to provide "accurate" temperature readings, it shall be relocated (at the TCC's expense) until a suitable location is found.
- SENSOR RESOLUTION: All temperature sensors shall have a minimum resolution of 1/10th of 1 degree F. (0.1 degree F.) Sensor stability shall be 0.24 degrees over a year period. Space sensors shall be tested and accurate to within 0.75 degrees F. Outside air, water and duct sensors shall be tested and accurate to within 2.0 degrees F.

13.3 SPACE SENSORS AND THERMOSTATS:

- Refer to the drawings for proper type and location.
- All thermostat and sensors shall be provided with temperature indication, unless otherwise noted.
- Programmed set-point shall be locally adjustable limited to 2 degrees above set-point and 2 degrees below set-point for supervised areas.
- Unsupervised areas shall have non-adjustable set-point.
- Generally, thermostats/sensors shall be installed 5'-0" above the finished floor.
- Where thermostats/sensors are to be mounted next to a light switch, install at the same height as the light switch.
- Sensors in hallways, vestibules, stairways, restrooms, and locker rooms shall utilize a stainless steel
 surface mount temperature sensor installed on an interior wall or partition (2"x4" blank plate). Care must be
 taken in the installation of these sensors to ensure proper insulation from the wall temperatures in order to
 properly sense space temperature.
- If there is a question consult engineer prior to rough-in.

- 13.4 WATER SENSORS: Temperature sensors for water lines are to be the well type. Wells are to be threaded brass (same manufacturer as the temperature sensor) with the sensor coated with a heat transfer compound. Strap on sensors will not be acceptable.
- 13.5 MIXED AIR SENSORS: These sensors shall be bendable averaging, type made of copper or aluminum elements. In unit ventilators, these sensors shall be at least five (5) feet in length and installed in the discharge air of the unit. For Air Handling Units, Outside Air Units, etc. the sensors shall be at least 20 feet in length.
- 13.6 DISCHARGE AIR AND DUCT ROOM RETURN AIR SENSORS: Shall be rigid insertion type. In all applications, care shall be taken to ensure that the sensors are securely mounted as not to allow any vibration and installed in such a manner as to indicate the truest possible temperature.
- 13.7 FREEZE/LOW-LIMIT THERMOSTAT: Provide a freeze/low-limit thermostat in each Air Handling Unit, Outside Air Unit, etc with a water coil for freeze protection. These devices shall be the manual reset type. This device shall be wired by using a normally closed contact in series with the motor starting circuit and a normally open set of contacts as an input to the unitary controller. The element shall be constructed of copper and be at least 20 feet in length. It shall be installed serpentined across the air entering the coil. In some cases, it may require being installed after the coil. Each application should be closely evaluated before installation. The device shall sense the lowest temperature by any one foot section of its element.
- HUMIDITY SENSORS: These devices shall be 100% solid state, linear and temperature compensated with scaling 0-100% RH range with LED or LCD Display. Accuracy at 25°C from 10-80% RH* ±2%, operating Humidity Range 0 to 100% RH (non-condensing), Stability ±1% @ 20°C (68°F) annually, for two years, Hysteresis 1.5% typical, Temperature Effect ±0.1% RH/°C above or below 25°C (typical), 1% accuracy between 0% 90% RH, Operating Temperature Range -40° to 50°C (-40° to 122°F) +/-1%.-Do not submit products that do not meet this range. The output of the device shall utilize an analog output 4-20 mA, 2-wire, polarity insensitive, (clipped and capped), The device shall use a power supply of 24 VAC or VDC. Duct mounted sensors shall have at least 4" insertion probe with a 16 gauge steel enclosure. NIST traceable certification shall be provided to the Engineer as part of the shop drawings. For wall mounted sensors the enclosure shall be polystyrene plastic mounted next to and at the same height as the temperature sensor in that area. Both shall have the same appearance. Provide protective cages in fitness and common areas.
- COMBINATION TEMPERATURE/HUMIDITY SENSORS: All temperature sensors shall have a minimum resolution of 1/10th of 1 degree F. (0.1 degree F.) Sensor stability shall be 0.24 degrees over a year period. Space sensors shall be tested and accurate to within 0.75 degrees F. The humidity sensing device shall be 100% solid state, linear and temperature compensated with a 0-100% RH range. The response time shall be a minimum of 30 seconds for a 60% change. They shall have a minimum of 2% accuracy minimum accuracy of +/-2% RH minimum rangeability 5 to95% RH non-condensing and maximum hysteresis +/_1.5% RH.— Do not submit products that do not meet this range. The output of the device must utilize a 0-10 VDC or 4-20mA signal as required. The device must use a power supply of 24 VAC or VDC. Duct mounted sensors shall have at least 4" insertion probe with a 16 gauge steel enclosure. NIST traceable certification shall be provided to the Engineer as part of the shop drawings. For wall mounted sensors the enclosure shall be polystyrene plastic mounted next to and at the same height as the temperature sensor in that area. Both shall have the same appearance. Provide protective cages in fitness and common areas.
- 13.10 LOW PRESSURE TRANSDUCERS: These devises shall be 100% solid state, linear and temperature compensated. Accuracy shall be no less than plus or minus 1% of its full range. Linearity, repeatability, and hysteresis shall be no less that plus or minus 0.1%. All pressure sensors shall utilize output averaging/output clipping to adjust and stabilize any fluctuations in the output. The output of the device shall utilize a 0 10 VDC signal. The device shall use a power supply of 24 VAC or VDC. The enclosure 16 gauge steel. For sensing

internal static pressure of air handling ducts utilize sensors with a rage of 0 to 5 inches water column. For sensing building static pressures (building compared to atmospheric) utilize a sensor with a range of -0.25 to +0.25 inches water column.

- 13.11 RELAYS: Relays for starting and stopping fractional horsepower motors shall be rated as follows:
 - 1/4 horsepower motors or less use 15 ampere rated relays,
 - 1/3 horsepower motors use 20 ampere rated relays,
 - 1/2 horsepower motors use 30 ampere rated relays,
 - Relays used for pilot duty service shall be rated at a minimum of 10 amperes.
 - Provide auxiliary pilot duty relays on motor starters as required for control function.
 - Do not install control and status relays in packaged equipment control panel enclosures containing Class 1 starters.
- 13.12 CENTRAL STATION AIR HANDLERS: All Central Station Air Handlers, Outside Air Units, etc shall be provided with a D.A.P. (differential air pressure) switch across each the supply fan to provide fan status for each air handler.
- 13.13 SMOKE SHUTDOWN: All AHUs, OA units, Heat Pump Units, etc with fans of greater than 2,000 CFM are required to have smoke shutdown safeties as required by the Building Code. These smoke detectors shall have a set of auxiliary contracts wired to a dedicated input of the Unitary to provide status of the smoke detector. All units must be provided with a current sensor to provide fan status for each air handler. For projects with Outside Air (OA) units, any system fire alarm activation shall shutdown all OA units. Coordinate with the Fire Alarm Contractor to insure a complete, code compliant installation.
- 13.14 CURRENT SENSING DEVICES: Veris Industries model Hx08 Series and H701 or equal. All current sensors shall be capable of alarming to the BAS for belt losses, pump coupling shear or other mechanical failure on loads.
- 13.15 SINGLE DIRECTION WATER FLOW METER: Onicon Model F-1200 series dual turbine insertion flow meter. 50:1 turn down with 2% accuracy with 0.4 to 20 fps range. Install flow meter with sufficient pipe diameters as recommended by manufacturer. Provide factory authorized start-up verification of operation and calibration. Provide with remote display where indicated.
- 13.16 POTABLE WATER FLOW METER: Onicon Model F-1330/F-1130 series dual turbine insertion flow meter suitable for potable water applications. 50:1 turn down with 2% accuracy with 0.4 to 20 fps range. Install flow meter with sufficient pipe diameters as recommended by manufacturer. Provide factory authorized start-up verification of operation and calibration. Provide with remote display where indicated.
- 13.17 DIFFERENTIAL PRESSURE TRANSMITTERS: Provide Rosemount (ITT Bell & Gossett ST-102R) or Johnson Controls Setra DPT 2302-050-V field mounted differential pressure sensor transmitters as indicated on the plans. Range shall be 0-25 psig. Accuracy shall be .025% full span.
- 13.18 CARBON DIOXIDE SENSORS: This sensor shall have a range of 0-2000 ppm +/-5% and +/- 50 ppm. Analog output of 0-10 or 2-10 VDC. Power shall be 24VAC. Calibration interval rated for 5 years. Sensor shall not be provided with a digital display. Honeywell Model C7232 or equal. A replacement CO2 sensor shall be installed annually for 5 years after substantial completion by the control's contractor. Provide with LED display.

PART 14 - VALVES, DAMPERS AND ACTUATORS:

- 14.1 Unless otherwise specified, valves shall be furnished and sized by the TCC. The valves are to provide the required capacity and the close off rating shall be in excess of the system pressures encountered (minimum 40 psi differential). Proportioning-type valve bodies shall be packed type with throttling type inner valve (quick close plug shall not be acceptable). Proportional type valves to be rated at 125 psi static pressure. Modulating control valves shall be selected within a 3-5 psig pressure drop range. Two position control valves (open/close) shall be line size.
- Dampers for various units requiring field mounting shall be tight closing, "ultra low leakage", opposed blade with side and edge seals. They shall be sized and furnished under this section. Installation of dampers shall be by the sheet metal contractor, coordinated by the TCC. Frames shall be no less than 16 gauge galvanized steel and furnished with mounting holes for duct mounting. Damper blades shall be no less than 14 gauge galvanized steel with maximum blade width of 8 inches. Blades shall be secured to 1/2 inch zinc plated axles and hardware with nylon bearings. Provide thrust bearings at the end of each blade. All dampers shall have end switches to positively prove damper position. No Exceptions!
- 14.3 All damper and valve actuators shall be fail safe spring return type with sufficient force to operate the dampers or valves under all normal operating conditions. They shall return to the normally open position upon a loss of power. Exceptions to the spring return applications are (1) face and bypass actuators, (2) boiler 3-way loop mixing valves, (2) boiler room seasonal changeover valves. Actuators for fan coil units, terminal units, etc. shall fail in the last position.
- "ALL" Actuators shall be of the same manufacturer and have internal feedback circuitry to provide a positive action to insure proper positioning of the damper or valve through the entire sequence. Actuators shall have an adjustable starting point to accurately set the range of travel to the output of the controller. All actuators shall also utilize the same input signal (6-9 VDC, 0-010V, 2-10 VDC, 4-20 MA) in order to maintain some consistency in the control application. Analog actuation is 6-9 VDC, 0-010V, 2-10 VDC or 4-20 MA, floating point control with 2 digital outputs is NOT approved as analog actuation.
- Actuators may be factory installed. If not factory installed, they shall be installed as per instructions by the terminal equipment manufacturer.
- 14.6 Locations mounted above ceiling shall be marked on ceiling grid.
- 14.7 Install damper motors on the outside of the duct in warm areas where possible, not in air stream or locations exposed to outdoor conditions.

PART 15 - VARIABLE FREQUENCY DRIVES (VFDs):

- 15.1 The work includes all labor, materials, and related items to completely furnish and install, start up and test, and place into service the Variable Frequency Drives (VFDs) indicated and scheduled on the Drawings and described in the Specifications.
- VFDs shall be as manufactured by ABB, Graham/Danfoss, or Square D. These are the only acceptable manufacturers. All VFDs for the project shall be by the same manufacturer (no exceptions).

- 15.3 VFDs shall be consist of a pulse width modulated (PWM) inverter designed for use on a standard NEMA Design B induction motor.
- The VFD shall be capable of operation form AC voltage in two rages $208-240 \text{ VAC} \pm 10\%$, or $380-480 \text{ VAC} \pm 10\%$. 50/60 HZ operation, $\pm 2 \text{ hertz}$.
- 15.5 The VFD enclosure shall be rated UL type 1 and shall be UL listed as a plenum rated, suitable operating conditions: 0 40° C continuous. Drives that have thermal cut out circuits, or that cannot operate continuously at 40° C shall not be acceptable. Altitude 0 to 3300 feet above sea level, up to 95% humidity, non-condensing.
- The VFD shall produce an adjustable AC voltage/frequency output for step less motor speed control utilizing sine wave coded Pulse Width Modulation (PWM) The Drive shall provide automatic power factor correction and a .98 displacement power factor by incorporating a full wave diode bridge rectifier. The VFD shall have an overload rating of 110% of nominal rated current for 1 minute out of every 10 minutes of operation, which is an acceptable overload for centrifugal loads.
- The VFD shall include a built-in first environment RFI/EMI filter and be CE and UL labeled. It shall also meet the CE requirement of EN61800-3 which provides an actual test procedure that shows that the VFD is immune from RFI/EMI interference and at the same time does not emit RFI/EMI noise that would interfere with other sensitive equipment near the VFD.
- The VFD shall include as a minimum a 5% dual DC link or AC line reactor for a clean harmonic signature, which aides in complying with IEEE-519-1992 recommended levels. The VFD manufacturer and representative shall assist in ensuring that the VFD's applied meet IEEE-519-1992 by completing a computer aided Harmonic Analysis of the complete system.
- The VFD shall include as a standard a built in digital keypad/display panel. This panel shall provide "Hand" off "Auto" selection, and a manual speed adjustment via up and down arrows. All faults and warnings shall be provided in "Plain English" for operation without a manual. The drive shall have a complete manual stored in memory that can be accessed with a single keystroke. This display shall be password protected and allow all setup parameters to be adjusted only by authorized personnel.
- 15.10 The VFD shall include built in Startup, Diagnostic, and Maintenance assistants, which allow for step-by-step startup procedures, troubleshooting, and the ability to indicate when the VFD and the system it is applied to needs preventive maintenance performed.
- 15.11 The VFD shall include a real time clock with a day/date stamp for troubleshooting purposes. In addition, with the use of this clock the drive shall be capable of stand-alone operation and act as a unitary controller.
- 15.12 The VFD shall include (2) Analog inputs either 4–20 madc or 0-10 vdc, (6) programmable Digital Inputs, (2) Programmable analog Outputs, (3) Form C Relay output rated 2 amps continuous minimum, and (2) PID Process controllers.
- 15.13 The VFD keypad shall include a backlit LCD display. The display shall be in complete English words for programming and fault diagnostics (LED and alpha-numeric codes are not acceptable). All VFD faults shall be displayed in English words.
- 15.14 BYPASS: As scheduled on the drawings, the drive shall be provided with an integral Bypass circuit which includes a pair of 115V electrically interlocked contactors for drive and bypass operation. The drive shall include

a main input circuit breaker, drive input service/isolation switch, and motor overload protection adjustable for either Class 10, 20 or 30 operation. The bypass shall include a built in status display which shows via colored LED's the system operational status including safeties and run permissives for ease of operation. The Bypass shall have its own interactive, programmable keypad. The Bypass shall provide single-phase protection for the motor while operating in bypass. Bypass that does not protect the motor from single-phase operation shall not be acceptable.

- 15.15 The drive and bypass system shall have embedded serial communication capabilities that allow direct connection to Modbus, Johnson Controls, Siemens and BACnet automation systems as part of the drives software suite without the need for extra hardware cards or gateways. The connection shall be tested by the BACnet Testing Labs (BTL) and be BTL Listed. The BACnet interface shall conform to the BACnet standard device type of an Applications Specific Controller (B-ASC). In addition, the drive shall be capable of interfacing with Lonworks with the addition of a communication module.
- 15.16 All VFDs shall be provided and installed in strict accordance with the manufacturer's recommendations.
- 15.17 Factory-authorized startup for each drive is mandatory. Provide a written record of the startup of each unit. Start up and programming by a factory-authorized technician. At startup, lockout any speed with the VFD that does not meet the vibration allowanced of the equipment manufacturers.
- 15.18 A parts and labor warranty of **3 years from startup and 2 years from the date of substantial completion** shall be included. Warranty shall include travel time and expenses.

PART 16 – GRAPHICS SCREENS AND TRENDS:

- All graphics screens shall be submitted for review by Engineer. Provide the following animated, color graphics screens minimally:
- 16.2 Entire floor plan home screen with OAT, Time, and Date displays.
 - Floor plan showing major zones,
 - Click major zone displays enlarged floor plan of the zone showing individual heat pump zones & numbers. Include link to respective mechanical room.
 - Click individual zone shows heat pump graphic. Display all data points from points list, occ/unocc schedule and setpoints, OAT, Time, and Date.
- 16.3 Color Graphic Screens shall be designed for all mechanical systems and shall include the following:
 - A graphic shall be the starting page with the building graphically indicated. Break up the floor plan into zones to match Contract Documents. The building shall be the point of reference to enter into the respective building control system.
 - All heat pump units including filters, humidifiers, associated VAV boxes, etc.
 - All terminal equipment including but not limited to zone dampers, etc.
 - All OA units.
 - Domestic hot water heaters and pumps.
 - The summation of all supply OA for each unit shall be displayed on the AHU graphic pages.
 - All floor plans indicating all actual room numbers, thermostats, and mechanical equipment. Operator shall be capable of clicking on any equipment and pull up the respective graphic screen.
- 16.4 Graphics to include floor plans with room numbers (as-built room numbers) and thermostat locations, links to flow diagrams for heat pumps, zone dampers, hydronic loop systems, outside air systems, domestic hot water,

and lighting controls.

- 16.5 All new graphics shall match the existing system graphics, unless noted otherwise.
- The graphical programming software shall allow for interactive mouse-driven placement of block icons on the graphic screen and connection of block inputs to block outputs by means of drawing lines to form a graphic logic diagram. The user shall not have to manually input text to assign block input/output interconnections. Blocks shall allow entry of adjustable settings and parameters via pop-up windows.
- The clarity of sequence shall be such that the user has the ability to verify that the system programming meets the specs without having to learn or interpret a manufacturer's unique programming language. Provide a means for testing and/or debugging the control programs off-line (not communicating with control units) using operator entered values for physical inputs and time. Provide a means for testing and/or debugging the control programs on-line (communicating with control units), showing actual physical inputs land all block outputs in real time.
- Provide a utility that shall allow the graphic logic diagrams to be directly compiled into application programs. Logic diagrams shall be viewable either off-line, or on-line with real-time output values.
- All graphic software shall be in the html web browser format and support multiple simultaneous screens to be opened and resizable in a "Windows" type environment. All functions, except text entry, shall be executable with a mouse. Graphic software shall provide for multitasking such that third party programs can be used while the Operator Workstation Software is on-line. Provide the ability to alarm graphically even when operator is in another software package. The software shall allow for Owner to create user defined, color graphic displays of geographic maps, building plans, floor plans, and mechanical and electrical system schematics.
- The contractor shall provide libraries of pre-engineered screens and symbols depicting standard air handling unit components (e.g., fans, coils, filters, dampers, etc.), mechanical system components (e.g., pumps, heat pumps, etc.), complete mechanical systems (e.g., VAV, etc.) and electrical symbols.
- 16.11 The graphic development package shall use a mouse or similar pointing device to allow the user to perform the following:
 - Define symbols
 - Position items on graphic screens
 - Attach physical or virtual points to a graphic
 - Define background screens
 - Define connecting lines and curves
 - Locate, orient and size descriptive text
 - Define and display colors for all elements
 - Establish correlation between symbols or text and associated system points or other displays.
 - Create hot spots or link triggers to other graphic displays or other functions in the software
- The TCC shall including programming of 25 point trends as directed by the Engineer. These can be requested at any time during the project including the warranty period. Trend "change of state" for digital inputs. Trend analog points in 30 minute increments. Maintain trend history for 30 days.

PART 17 - TIME SCHEDULES (ALL TIMES SHALL BE USER ADJUSTABLE):

During construction, the time schedule (for all equipment except OA unit) will be Occupied at 5:00 AM, Unoccupied at 10:30 PM. seven (7) days a week.

- When the system is fully tested and operational and after the Owner's staff have been fully instructed as to the operation of the system the schedule shall be as follows unless otherwise instructed:
- 17.3 Occupied: Monday through Friday Occupied mode at 7:30 AM, Unoccupied mode at 5:30 PM. Unoccupied for Saturday and Sunday.
- 17.4 All schedules shall be coordinated and confirmed with the Owner prior to final implementation.

SEQUENCE OF OPERATIONS:

PART 18 - GEOTHERMAL HEAT PUMP WATER LOOP CONTROL:

- 18.1 The Geothermal Heat Pump Water Loop System consists of circulating pumps (P-1A/P-1B) and associated pump VFD's. The system shall operate in occupied mode only.
- Each geothermal unit shall be provided with an unoccupied override switch. This shall place the system in operational mode for one (1) hour (adj.).
- 18.3 The heat pump water distribution is accomplished by pumps P-1A/P-1B. One pump is required to satisfy the building load; the other pump is for reserve. The pumps shall be set-up for automatic lead/lag operation. The pumps are to be constant flow. A variable speed pump controller unit (VFD) is provided by the TCC contractor to manually adjust the speed of the pumps.
- 18.4 Install temperature sensors on the supply and return of the geothermal loop to the building to be trended at the BAS.
- 18.5 Install water flow meter on supply side of geothermal system and connect to DDC to monitor and record flow.
- 18.6 Two (2) differential pressure sensors are located on the drawings to measure water differential pressure. This contractor shall provide all control wiring necessary for proper system operation. The differential pressure sensor shall be monitored by the unitary controller for the distribution pumps.
- The differential pressure shall be set at 7.5 p.s.i. (adj.) and averaged between the (2) sensors for setpoint. If the pump controller senses that the differential pressure is below the pressure setpoint, the speed of the lead pump shall increase. If the pump controller senses that the differential pressure is above the pressure setpoint, the speed of the lead pump shall decrease.

The heat pump loop water flow rate shall be determined from an Onicon F-3200 series in-line electromagnetic flow meter located in the Mechanical Room with 0.2% accuracy from 10-1500 gpm. This meter shall also be used in conjunction with the well field supply and return temperature sensors to provide system BTU Calculation.

HARDWIRE	Binary	Analog	Start/S	Alarm	Trend
	Status	Point	top		
Pump P-1A	Χ		Χ		
Pump P-1B	Χ		Χ		
Supply Water Temperature	Χ	Χ		Χ	Χ
Return Water Temperature	Χ	Χ		Χ	Χ
Geothermal Loop Water Flow.		Χ			Χ

Geothermal BTU Reading	Χ		Х
Differential Pressure	Χ		

PART 19 - GEOTHERMAL HEAT PUMPS:

- 19.1 All heat pumps shall operate under (field mounted) control of a local, stand-alone, microprocessor based DDC controller field installed in the unit. The units operate with a wall mounted thermostat or temperature sensor.
- 19.2 Each unit shall be placed into the occupied/unoccupied mode based upon the building's Global Time Schedule.
- 19.3 If communication is lost between the Global Time Schedule and the Heat Pump Controller, then the Heat Pump Controller shall be placed into the occupied mode until communication is restored.
- 19.4 In the event of a power outage, and generator activation, the heat-pumps shall be "re-started" sequentially based on zone.
- During the unoccupied mode, the heat pump shall not operate unless the space temperature falls outside unoccupied setpoints. Unoccupied set-points shall 10°F (adj.) above or below occupied setpoints.
- During the occupied mode, the fan and compressor(s) shall stage, and cycle as required to satisfy space thermostat/sensor setpoint. Whenever heating or cooling is required, the unit's three-wire, two-way, two-position control valve shall open and prove prior to compressor operation. The unit shall automatically changeover from heating to cooling. When space temperature is satisfied the fan and compressor shall be off and the control valve shall be closed. For units 3A, 3B, 5A and 5B, the fans shall remain on during occupied mode. These units shall not be provided with control valve on the water flow piping to the unit.
- 19.7 To prevent short cycling a minimum of 5 minute delay when transitioning between heat and cool modes.
- 19.8 A smoke detector shall be located in the return air stream of all units. If smoke is detected, then the system shall shutoff and an audio/visual alarm shall activate. Upon correction of the problem, the system shall be reset and shall return to normal operation. Coordinate with Fire Alarm System.
- 19.9 Provide a pushbutton override on all sensors. If the Global Time Schedule is in the unoccupied when a pushbutton override is activated, then the heat pumps shall be placed into operation for 1 hours (adj.).

HARDWIRE	Binary	Analog	Start/S	Alarm	Trend
	Status	Point	top		
Compressor	X		Х	Х	
Supply Fan	X		Х		
Reversing Valve	X		Χ		
Space Temperature		Х			Х
Supply Air Temp		Х			Х
Smoke Detectors (where required)				Χ	

PART 20 - OUTSIDE AIR ENERGY RECOVERY UNTS

- 20.1 Outdoor System consists of one energy recovery unit (OA-1 and OA-2).
- 20.2 Each system shall operate under the control of a local, stand-alone, microprocessor based DDC controller.
- 20.2.1 Each system shall be placed into the occupied/unoccupied mode based upon the user adjustable schedule at the Global Control Panel. These systems shall be in the occupied mode during all operating hours.
- 20.2.2 If communication is lost between the Global Control Panel and the Outside Air System Controller, then the Outside Air System shall be placed into the occupied mode until communication is restored.
- 20.2.3 In the unoccupied mode, the supply and exhaust fans shall be off, energy recovery wheel shall be off, outside air damper and exhaust air damper shall be fully closed.
- 20.2.4 In occupied mode, the energy recovery wheel shall start, and operation shall be proved via current switch. The outside air damper and exhaust air damper shall fully open and be proved via damper end switch, attached to damper blades. The supply fan and exhaust fan shall start, and operation shall be proved via current sensors. If the discharge air temperature for OA-1 falls below 68°F (adj), the unit electric heat shall stage on to maintain discharge air temperature of no lower then 68°F.
- 20.3 Freeze Protection: A low limit temperature sensor shall be located in the outside air duct on the discharge of the unit. If a temperature of 40 degrees F (adj.), or less is detected, then the outside air and exhaust air dampers shall fully close, and supply and exhaust air fan shall stop. Upon correction of the problem, the system shall be reset and shall return to normal operation. Fan shutdown shall be hardwired interlocked to the supply and exhaust air fans.
- 20.4 Provide and install a humidity sensor in the outside air duct upstream and downstream of the ERV.

HARDWIRE	Binary	Analog	Start/S	Alarm	Trend
	Status	Point	top		
Outside Air Fan	Х		Χ	Х	
Exhaust Air Fan	Х		Χ	Х	
Energy Recovery Wheel	Х		Х	Х	
Outside Air Damper	Х			Х	
Exhaust Air Damper	Х			Х	
Outside Air Temp (entering and leaving)		Χ		Х	Χ
Exhaust Air Temp (entering and leaving)		Χ		Х	Χ
Freeze Stat		Х		Х	
Outdoor RH		Χ			Χ
Electric Heat	Х		Χ		

PART 21 – ELECTRIC HEATER (EH-1A & -1B):

When the outdoor air temperature is 50 degrees F (adj.) or below, the heater shall be enabled. The unit is provided with an integral thermostat or temperature sensor. Control the space temperature to 65 degrees F. TCC to provide a relay to disable the heater when outdoor air temperature is above 50 degrees F. The TCC shall provide a space sensor to monitor temperature.

HARDWIRE	Binary	Analog	Start/S	Alarm	Trend
	Status	Point	top		

Heater Enable/Disable	Х		Х		
Space Temperature		Χ	Χ	Χ	Χ

PART 22 - DOMESTIC HOT WATER PUMP:

The TCC shall interlock the existing domestic water circulation to be started/stopped by the DDC based on occupancy. When the building is unoccupied the pump shall be off.

HARDWIRE	Binary Status	Analog Point	Start/S top	Alarm	Trend
Domestic Water Pump	Χ		Χ		

PART 23 - FLOW METER ALARM AND EMERGENCY SHUTDOWN FOR MAKE-UP WATER:

On the make-up water line, a line sized two-way, two-position normally open valve shall close if (after a time delay of 2 minute) the make-up water continues flowing at a rate of 3 gallons per minute while the system switch is in the normal operating position. An alarm shall be sent to the BAS. An audible alarm mounted on the control panel (mounted very near the make-up network) shall sound and an indicator light will provide visual indication of a problem. A momentary push button on the panel shall be used to silence/acknowledge the alarm and reset system for normal operation after any necessary repairs are made. A switch mounted on the panel shall be used to shut down the alarm while normal system fill operations are performed. This switch and all panel mounted devices are to be appropriately labeled. Provide and coordinate installation by mechanical contractor the valve and ONICON Model F-1310 Inline Turbine Flow meter. Flow meter to be full sized body, scaled 0-10 GPM range is 0-10 volt output.

HARDWIRE	Binary Status	Analog Point	Start/S top	Alarm	Trend
Hydronic make-up water GPM		Х		Х	
Hydronic Valve Open/Close	Χ			Χ	

PART 24 – EXISTING EXHAUST FANS:

There are (2) existing exhaust fans, located in Lounges 110 and 133. The TCC shall provide a wall switch to interlock these fans. The fans shall engage for 30 minutes (adj.) when switch is activated.

HARDW	IRE	Binary	Analog	Start/S	Alarm	Trend
		Status	Point	top		
Fan ON	OFF	Χ		Χ	Χ	

PART 25 - WELDING GASES EMERGENCY OFF SWITCH:

25.1 The TCC shall provide a red "mushroom" style switch to close a solenoid valve on the OXY/FUEL gas line. An audible and visual alarm shall sound when switch is closed. The switch will need to ma manually retracted for valve to open.

HARDWIRE	Binary	Analog	Start/S	Alarm	Trend
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PROJECT NO. 24-179.000 Harrison REMC - Addition and Renovation Harrison REMC Controls 25 0400 - 23 04/24/2025

	Status	Point	top		
Switch ON/OFF	Χ			Χ	

END OF SECTION 25 0400

26 0000 - 1 04/24/2025

INDEX

DIVISION 26 – ELECTRICAL

- 26 0010 GENERAL REQUIREMENTS FOR ELECTRICAL SYSTEMS
- 26 0500 COMMON WORK RESULTS FOR ELECTRICAL SYSTEMS
- 26 0519 LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
- 26 0526 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
- 26 0533 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS
- 26 0543 UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS
- 26 0548 SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS
- 26 0553 IDENTIFICATION FOR ELECTRICAL SYSTEMS
- 26 0573 POWER SYSTEM STUDIES
- 26 0923 LIGHTING CONTROL DEVICES
- 26 2200 LOW-VOLTAGE TRANSFORMERS
- 26 2416 PANELBOARDS
- 26 2726 WIRING DEVICES
- 26 2813 FUSES
- 26 2816 ENCLOSED SWITCHES AND CIRCUIT BREAKERS
- 26 2900 MOTOR CONTROLLERS
- 26 4100 FACILITY LIGHTNING PROTECTION
- 26 4300 SURGE PROTECTIVE DEVICES
- 26 5000 LIGHTING

DIVISION 27 – COMMUNICATIONS

- 27 0526 GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS
- 27 0528 PATHWAYS FOR COMMUNICATIONS SYSTEMS
- 27 0536 CABLE TRAYS FOR COMMUNICATIONS SYSTEMS
- 27 4100 LOW VOLTAGE SYSTEMS

SECTION 26 0010 - GENERAL REQUIREMENTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The Instructions to Bidders, General and Special Conditions, and all other contract documents shall apply to the Contractor's work as well as to each Sub Contractor's work. Each Contractor is directed to familiarize themself in detail with all documents pertinent to this Contract. In case of conflict between these General Provisions and the General and/or Special Conditions, the affected Contractor shall contact the Engineer for clarification and final determination.
- C. Each Contractor shall be governed by any alternates, unit prices and Addenda or other contract documents insofar as they may affect their part of the work.

1.2 SUMMARY

- A. Section Includes general requirements applicable to work specified in Divisions 26, 27, and 28.
- B. The work included in this division consists of the furnishing of all labor, equipment, transportation, supplies, material, and appurtenances and performing all operations necessary for the satisfactory installation of complete and operating Electrical Systems indicated on the drawings and/or specified herein.
- C. Any materials, labor, equipment, or services not mentioned specifically herein which may be necessary to complete or perfect any part of the Electrical Systems in a substantial manner, in compliance with the requirements stated, implied, or intended in the drawings and specifications, shall be included as part of this Contract. The Contractor shall give written notice of any materials or apparatus believed inadequate or unsuitable; in violation of laws, ordinances, rules or regulations of authorities having jurisdiction; and any necessary items of work omitted a minimum of ten days prior to bid. In the absence of such written notice and by the act of submitting a bid, it shall be understood that the Contractor has included the cost of all required items in their bid, and that they will be responsible for the approved satisfactory functioning of the entire system without extra compensations.
- D. It is not the intent of this section of the specifications (or the remainder of the contract documents) to make any specific Contractor, other than the Contractor holding the prime contract, responsible to the Owner, Architect and Engineer. All transactions such as submittal of shop drawings, claims for extra costs, requests for equipment or materials substitution, shall be done through the Contractor to the Architect (if applicable), then to the Engineer.
- E. This section of the Specifications or the arrangement of the contract documents shall not be construed as an attempt to arbitrarily assign responsibility for work, material, equipment or services to a particular trade Contractor or Sub-Contractor. Unless stated otherwise, the subdivision and assignment of work under the various sections shall be the responsibility of the Contractor holding the prime contract.

GENERAL REQUIREMENTS FOR ELECTRICAL SYSTEMS 26 0010 - 2 04/24/2025

- F. Any reference within these specifications to a specific entity, i.e., "Electrical Contractor" is not to be construed as an provide to limit or define the scope of work for that entity or assign work to a specific trade or contracting entity. Such assignments of responsibility are the responsibility of the Contractor holding the prime contract, unless otherwise provided herein.
- G. In each of the specifications and drawings referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears.

H. Intent and Interpretation

- 1. It is the intent of these specifications and all associated drawings that the Contractor provide finished work, tested, and ready for operation. Wherever the word "provide" is used, it shall mean "furnish and install complete, tested and ready for operation."
- 2. Minor details not usually shown or specified, but necessary for the proper installation and operation, shall be included in the work, the same as if herein specified or shown.
- 3. It is the intention of the Contract Documents to call for a complete and operational system, including all components, accessories, finish work, etc. as necessary for trouble free operation; tested and ready for operation. Anything that may be required, implied, or inferred by the Contract Documents shall be provided and included as part of the Bid.
- 4. All Contractors and Vendors providing a bid for this project shall review the Plans and Specifications and determine any modifications and/or adjustments necessary relative to the proposed equipment and materials with specific manufacturer's installation requirements. Include in the bid any necessary installation methods, features, options, accessories, etc. necessary to install the proposed equipment and materials, regardless of whether used as basis of design or being offered as a substitution in accordance with the specific manufacturer's installation requirements whether specifically detailed or not within the Plans and Specifications.
- 5. The Bidder/Proposer shall completely review the Contract Documents. Any interpretation as to design intent or scope shall be provided by the Engineer/ Architect. Should an interpretation be required, the Bidder/Proposer shall request a clarification not less than ten days prior to the submission of the proposal so that the condition may be clarified by Addendum. In the event of any conflict, discrepancy, or inconsistency develops, the interpretation of the Engineer shall be final.
- 6. The Contractor shall give written notice of any materials or apparatus believed inadequate or unsuitable; in violation of laws, ordinances, rules or regulations of authorities having jurisdiction; and any necessary items of work omitted a minimum of ten days prior to bid. In the absence of such written notice and by the act of submitting a bid, it shall be understood that the Contractor has included the cost of all required items in the bid, and that will be responsible for the approved satisfactory functioning of the entire system without extra compensations.

I. Drawings and Specifications

- 1. The drawings are diagrammatic only and indicate the general arrangement of the systems and are to be followed insofar as possible. If deviations from the layouts are necessitated by field conditions, detailed layouts of the proposed departures shall be submitted in writing to the Engineer for approval before proceeding with the work. The Contract Drawings are not intended to show every vertical or horizontal offset which may be necessary to complete the systems. Contractors shall, however, anticipate that additional offsets may be required and submit their bid accordingly.
- 2. The drawings and specifications are intended to supplement each other. No Contractor, bidder, proposer, or supplier shall take advantage of conflict between them, or between parts of either, but should this condition exist, the Contractor or supplier shall request a clarification of the condition at least ten days prior to the submission of bids so that the condition may be clarified by Addendum. In the event that such a condition arises after work is started, the interpretation of the Engineer shall be

GENERAL REQUIREMENTS FOR ELECTRICAL SYSTEMS 26 0010 - 3 04/24/2025

- the determining factor. In all instances, unless modified in writing and agreed upon by all parties thereto, the Contract to accomplish the work shall be binding on the affected Contractor.
- The drawings and specifications shall be considered to be cooperative and complimentary and anything appearing in the specifications which may not be indicated on the drawings or conversely, shall be considered as part of the Contract and must be executed the same as though indicated by both.
- 4. This Contractor shall make all their own measurements in the field and shall be responsible for correct fitting. They shall coordinate this work with all other branches of work in such a manner as to cause a minimum of conflict or delay.
- 5. The Engineer shall reserve the right to make minor adjustments in location of conduit, fixtures, outlets, switches, etc., where they consider such adjustments desirable in the interest of concealing work or presenting a better appearance.
- 6. Each Contractor shall evaluate ceiling heights called for on Architectural Plans and ensure that these heights may be maintained after all mechanical and electrical equipment is installed. Where the location of Electrical equipment may interfere with ceiling heights, the Contractor shall call this to the attention of the Engineer in writing prior to making the installation. Any such changes shall be anticipated and requested sufficiently in advance so as to not cause extra work on the part of the Contractor or unduly delay the work.
- 7. Should overlap of work between the various trades become evident, this shall be called to the attention of the Engineer. In such an event, neither trade shall assume that he is to be relieved of the work which is specified under his branch until instructions in writing are received from the Engineer.
- 8. The Electrical drawings are intended to show the approximate location of equipment, materials, etc. Dimensions given in figures on the drawings shall take precedence over scaled dimensions and all dimensions whether given in figures or scaled shall be verified in the field. In case of conflict between small- and large-scale drawings, the larger scale drawings shall take precedence.
- 9. The Electrical Contractor and their Sub-Contractors shall review all drawings in detail as they may relate to his work (structural, architectural, site survey, mechanical, etc.). Review all drawings for general coordination of work, responsibilities, ceiling clearances, wall penetration points, chase access, fixture elevations, etc. Make any pertinent coordination or apparent conflict comments to the Engineers at least ten days prior to bids, for issuance of clarification by written addendum.
- 10. Where on any of the drawings a portion of the work is drawn out and the remainder is indicated in outline, or not indicated at all, the parts drawn out shall apply to all other like portions of the work. Where ornament or other detail is indicated by starting only, such detail shall be continued throughout the courses or parts in which it occurs and shall also apply to all other similar parts of the work, unless otherwise indicated.

1.3 COST BREAKDOWN AND PAY APPLICATIONS

- A. Within thirty days after acceptance of the Contract, each Contractor is required to furnish to the Engineer one copy of a detailed cost breakdown on each respective area of work. These cost breakdowns shall be made on forms provided or approved by the Engineer or Architect. Payments will not be made until satisfactory cost breakdowns are submitted. Refer to Division 00 and 01 specification sections for additional requirements.
- B. In addition to cost breakdowns by specification section, the following shall also be provided: Material and labor shall be listed separately. These items are in addition to items listed in Division 01 specifications. Pay special attention to required withholding percentages for startup, testing, documentation, acceptance, owner training, etc. The breakdown shall be minimally as follows:

GENERAL REQUIREMENTS FOR ELECTRICAL SYSTEMS 26 0010 - 4

04/24/2025

Harrison REMC - Addition and Renovation Harrison REMC

- 1. Permitting
- 2. Mobilization
- 3. Electrical Submittals
- 4. Electrical Coordination Drawings
- 5. Temporary Power
- 6. Interior Lighting Materials & Labor
- 7. Exterior Lighting Materials & Labor
- 8. Lighting Controls Materials & Labor
- 9. Lighting and Lighting Controls Startup, Testing, & Verification (equal to 2.5% of Equipment Value)
- 10. Electrical Distribution Equipment Materials & Labor
- 11. Electrical Distribution Equipment Startup, Testing, & Verification (equal to 2.5% of Equipment Value)
- 12. Electrical Distribution Equipment Power System Study & Field Adjusting
- 13. Feeders Materials & Labor
- 14. Branch Circuiting Materials & Labor
- 15. Service Grounding Materials & Labor
- 16. Surge Suppression Materials & Labor
- 17. Electrical Devices Materials & Labor
- 18. Cable Trays Materials & Labor
- 19. Underground Duct Banks Materials & Labor
- 20. Fire Alarm Materials & Labor
- 21. Fire Alarm System Startup, Testing, & Verification (equal to 5% of Equipment Value)
- 22. Engine Generator Systems Startup, Testing, & Verification (equal to 2.5% of Equipment Value)
- 23. Owner Training
- 24. Punchlist
- 25. As-Built/Record Drawings
- 26. O&M Manuals
- 27. Warranty
- 28. Demobilization

1.4 REFERENCES

A. Abbreviations and Acronyms

- 1. A, AMP: Ampere
- 2. ADA: Americans with Disabilities Act.
- 3. AFF: Above Finished Floor
- AFG: Above Finished Grade
- 5. AHJ: Authority Having Jurisdiction
- 6. AHU: Air Handling Unit
- 7. AIC: Amps Interrupting Capacity
- 8. ANSI: American National Standards Institute.
- 9. ASA: American Standards Association.
- 10. ASTM: American Society for Testing Materials.
- 11. ASHRAE: American Society of Heating, Refrigeration and Air Conditioning Engineers.
- 12. ATS: Automatic Transfer Switch
- 13. A/V: Audio/Visual
- 14. AWG: American Wire Gauge
- 15. BAS: Building Automation System
- 16. BFG: Below Finished Grade

PROJECT NO. 24-179.000

Harrison REMC - Addition and Renovation Harrison REMC

GENERAL REQUIREMENTS FOR ELECTRICAL SYSTEMS

26 0010 - 5 04/24/2025

- 17. BICSI: Building Industry Consulting Services International
- 18. C: Conduit
- 19. CB: Circuit Breaker
- 20. CFCI: Contractor Furnished, Contractor Installed
- 21. CFOI: Contractor Furnished, Owner Installed
- 22. CKT: Circuit
- 23. CLG: Ceiling
- 24. CT: Current Transformer
- 25. CM: Construction Manager
- 26. DDC: Direct Digital Building Controls
- 27. DOAS: Dedicated Outdoor Air System
- 28. DWG: Drawing
- 29. EC: Electrical Contractor
- 30. ELEV: Elevator
- 31. EM: Emergency
- 32. EPO: Emergency Power Off
- 33. FA: Fire Alarm
- 34. FAA: Fire Alarm Annunciator
- 35. FACP: Fire Alarm Control Panel
- 36. FCC: United States Federal Communications Commission
- 37. FFE: Finished Floor Elevation
- 38. FLA: Full Load Amps
- 39. G, GND: Ground
- 40. GFCI: Ground Fault Circuit Interrupter
- 41. GC: General Contractor
- 42. HOA: Hands Off Auto
- 43. HP: Horsepower
- 44. IDF: Intermediate Distribution Frame
- 45. IECC: International Energy Conservation Code
- 46. ISO: International Standards Organization.
- 47. IT: Information Technology
- 48. KVA: Kilovolt-Amperes
- 49. KW: Kilowatt
- 50. KWH: Kilowatts Hours
- 51. LRA: Locked Rotor Amps
- 52. LTG: Lighting
- 53. MC: Mechanical Contractor
- 54. MCA: Minimum Circuit Ampacity
- 55. MCB: Main Circuit Breaker
- 56. MDF: Main Distribution Frame
- 57. MDP: Main Distribution Panel
- 58. MLO: Main Lugs Only
- 59. MOCP: Maximum Overcurrent Protection
- 60. MSB: Main Switchboard
- 61. N/A: Not Applicable
- 62. NEC: National Electrical Code
- 63. NECA: Standards for Installation.
- 64. NEMA: National Electrical Manufacturers Association.
- 65. NESC: National Electrical Safety Code.
- 66. NFPA: National Fire Protection Association.

GENERAL REQUIREMENTS FOR ELECTRICAL SYSTEMS 26 0010 - 6 04/24/2025

- 67. NIC: Not in Contract
- 68. NRTL: Nationally Recognized Testing Laboratory
- 69. NTS: Not to Scale
- 70. N/A: Not Applicable
- 71. OFCI: Owner Furnished, Contractor Installed
- 72. OFOI: Owner Furnished, Owner Installed
- 73. OSHA: Office of Safety and Health Administration.
- 74. P: Pole, Poles
- 75. PC: Plumbing Contractor
- 76. PIR: Passive Infrared
- 77. RFI: Request for Information
- 78. RIO: Rough-in Only
- 79. RM: Room
- 80. SPD: Surge Protection Device
- 81. SS: Stainless Steel
- 82. SWBD: Switchboard
- 83. TIA: Telecommunications Industry Association
- 84. TYP: Typical
- 85. UL: Underwriters Laboratories, Inc.
- 86. UON or UNO: Unless otherwise noted.
- 87. UG: Underground
- 88. V: Volt, Volts
- 89. VFD: Variable Frequency Drive
- 90. W: Watts
- 91. WG: Wire Guard
- 92. WP: Weather Proof
- 93. XFMR: Transformer

B. Definitions

- 1. Architect: The Architect of Record for the project, if applicable.
- 2. Basis of Design (BOD): Documentation of primary thought processes and assumptions behind design decisions made to meet design intent. Describes systems, components, conditions, and methods chosen to meet intent.
- 3. Bidder/Proposer: Any person, agency or entity submitting a proposal to any person, agency, or entity for any part of the work required under this contract.
- 4. Contract Documents: All documents pertinent to the quality and quantity of work to be performed on this project. Includes, but not limited to: Plans, Specifications, Instructions to Bidders, General and Special Conditions, Addenda, Alternates, Lists of Materials, Lists of Sub-Contractors, Unit Prices, Shop Drawings, Field Orders, Change Orders, Cost Breakdowns, Schedules of Value, Periodical Payment Requests, Construction Manager's Assignments, Architect's Supplemental Instructions, Construction Contract with Owner, etc.
- 5. Contractor: Any Contractor whether bidding, proposing, or working independently or under the supervision of a General Contractor, Prime Contractor, or Construction Manager and who installs any type of Electrical Work as specified in the Contract Documents.
- 6. Electrical Contractor: Any Contractor whether bidding or working independently or under the supervision of the entity holding the Prime Contract and who installs any type of Electrical work, such as: power, lighting, television, telecommunications, data, fiber optic, intercom, fire detection and alarm, security, video, underground or overhead electrical, etc.

GENERAL REQUIREMENTS FOR ELECTRICAL SYSTEMS 26 0010 - 7 04/24/2025

- 7. Electrical Sub-Contractor: Each or any Contractor contracted to, or employed by, the Electrical Contractor for any work required by the Electrical Contractor.
- 8. Engineer: The Consulting Mechanical-Electrical Engineer consulting to the Owner, Architect, or Other, etc.
- 9. Indicated: Listed in the Specifications, shown on the Plans or Addenda thereto.
- 10. Install: Install equipment furnished by others in complete working order.
- 11. Installer: Contractor or another entity engaged by Contractor as an employee, subcontractor, or subsubcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.
- 12. Furnish: Deliver to the site in good condition and turn over to the Contractor who is to install.
- 13. Prime Contractor: The Contractor who has been engaged by the Owner in a contractual relationship to accomplish the work.
- 14. Project: All of the work required under this Contract.
- 15. Provide: Furnish and install complete, tested, and ready for operation.
- 16. Start-Up: The activities where systems or equipment are initially tested and operated. Start-up is completed prior to functional testing.
- 17. Typical: Where indicated repeat this work, method or means each time the same or similar condition occurs whether indicated or not.
- 18. Vendor: Supplier of equipment.
- C. Reference Standards: Contractor is responsible for knowledge and application of current versions of all applicable standards and codes. Contractor shall adhere to the most recent revisions or version adopted by the Authorities Having Jurisdiction, including all relevant changes or addenda at the time of installation.
 - 1. IEEE Institute of Electrical and Electronics Engineers.
 - a. IEEE C2, National Electrical Safety Code
 - 2. NECA National Electrical Contractors Association.
 - a. NECA 1, Standard for Good Workmanship in Electrical Construction
 - 3. NFPA National Fire Protection Association.
 - a. NFPA 70, National Electrical Code (NEC)
 - 4. OSHA The Occupational Safety and Health Act

1.5 COORDINATION

A. Utility Company Requirements

- 1. Contact the utility company for specifics on construction of pads, conduit, etc., prior to bidding the work and determine all their requirements. All work shall be in accordance with their standards.
- 2. Each contractor, prior to bidding the work, is to contact the utility companies (electric and telecommunications) and determine the exact points of extension of all underground services in the field with a representative of each utility company. Also, obtain construction details on manholes, transformer pads, pedestal stub-ups, etc., from each utility company as applicable. Extension points indicated on the plans are approximate and are given for the bidder's information only.
- The Contractor shall provide the local utility company with a drawing produced by a licensed Land Surveyor or a licensed Engineer and acceptable to the utility that locates the centerline of the service and connection point. Coordinate further requirements with utility company.

GENERAL REQUIREMENTS FOR ELECTRICAL SYSTEMS 26 0010 - 8 04/24/2025

- 4. The Contractor is responsible for all fees, permit costs, etc., from the electrical utility, data, telephone, and cable TV companies. This includes any cost associated with the underground electrical service extension.
- B. Coordination with Existing Utilities and Structures
 - 1. The locations of all piping, conduits, cables, utilities, and manholes existing, or otherwise, that are present within the contract construction site, shall be subject to continuous uninterrupted maintenance with no exception unless the Owner of the utility grants permission for temporary interruption.
 - 2. Known utilities and structures as available to the Engineer are shown on the drawings. However, it is additionally required that, prior to any excavation being performed, each Contractor ascertain and mark all utilities or lines that would be endangered by the excavation. Contractor shall bear costs of repairing damaged utilities.
 - 3. If utilities or structures are installed within the construction project boundary, the Contractor shall first probe and make every effort to locate the lines prior to excavating in the respective area.
 - 4. Cutting into existing utilities and services shall be done in coordination with and as designated by the Owner of the utility. The Contractor shall work continuously to restore service(s) upon deliberate or accidental interruption, providing premium time and materials as needed without extra claim to the Owner.
 - 5. The Contractor shall repair to the satisfaction of the Engineer any surface or subsurface improvements damaged during the course of the work, unless such improvement is shown to be abandoned or removed.
 - 6. Machine excavation shall not be permitted within ten feet of existing gas or fuel lines. Hand excavate only in these areas, in accord with utility company, agency or other applicable laws, standards or regulations.
 - 7. Protect all new or existing lines from damage by traffic, etc. during construction.
 - 8. Protect existing trees, indicated to remain with fencing or other approved method. Hold all new subsurface lines outside the drip line of trees, offsetting as necessary to protect root structures. Refer to planting or landscaping plans, or in their absence, consult with the Architect.
- C. Interruption of Existing Services: In general, and to the extent possible, perform all work without interruption of the existing facilities' operations. Do not interrupt services to facilities occupied by Owner or others unless permitted under the following conditions:
 - 1. Notify the Owner, Architect, and Engineer no fewer than seven days in advance of proposed interruption of service.
 - 2. Provide the exact time the interruption will occur and the length of the interruption.
 - 3. Do not proceed with interruption of service without written permission from Owner, Architect, and Engineer.
 - 4. Failure to comply with this requirement may result in complete work stoppage by the Contractors involved until a complete schedule of interruptions can be developed.
 - 5. Contractor will not be entitled to additional compensation due to work stoppage mandated by unscheduled interruption.
 - 6. Coordinate interruptions with systems impacted by outages including but not limited to the following:
 - a. Generators
 - b. Emergency Lighting
 - c. Elevators
 - d. Fire Alarm Systems
 - 7. Whenever utilities are interrupted, either deliberately or accidentally, the Contractor shall work continuously to restore the service. The Contractor shall provide tools, materials, skilled journeymen

GENERAL REQUIREMENTS FOR ELECTRICAL SYSTEMS 26 0010 - 9 04/24/2025

of their own and other trades as necessary, premium time as needed and coordination with all applicable utilities, including payment of utility company charges (if any), all without requests for extra compensation to the Owner, except where otherwise provided for in the contract for the work.

D. Coordination Between Trades

- 1. The Contractor is expressly directed to read the General Conditions and all detailed sections of these specifications for all other trades and to study all drawings applicable to their work, including Architectural, Mechanical, Structural and other pertinent Drawings, to the end that complete coordination between trades will be affected.
- 2. The Contractor is responsible for the correct location of all rough-in and connections at every piece of equipment. Work not correctly located shall be relocated at the Contractor's expense.
- 3. It shall be the responsibility of each Contractor to leave the necessary room for other trades. No extra compensation or time will be allowed to cover the cost of removing fixtures, devices, conduit, ducts, etc. or equipment found encroaching on space required by others.
- 4. Where any work is to be installed in close proximity to, or will interfere with work of other trades, each shall cooperate in working out space conditions to make a satisfactory adjustment. If directed by the Engineer, the Contractor shall prepare composite working drawings and sections at a suitable scale not less than ¼ inch = 1 Foot, clearly indicating how his work is to be installed in relation to the work of other trades, or so as not to cause any interference with work of other trades. The Contractor shall make the necessary changes in his work to correct the condition without extra charge.
- 5. The Contractor shall furnish to other trades, as required, all necessary templates, patterns, setting plans, and shop details for the proper installation of work and for the purpose of coordinating adjacent work.

E. Temporary Services

- 1. The Contractor shall arrange for temporary electrical and other services required to accomplish the work. In the absence of other provisions in the contract, the Contractor shall provide for temporary services of all types, including the cost of connections, utility company fees, construction, removal, etc., in their bid.
- 2. All temporary services shall be removed by Contractor prior to acceptance of work.

F. Temporary Use of Equipment

- 1. The permanent electrical equipment, when installed, may be used for temporary services, subject to an agreement among the Contractors involved, the Owner, and with the consent of the Engineer. Should the permanent systems be used for this purpose, each Contractor shall pay for all temporary connections required and any replacements required due to damage without additional cost to the Owner, leaving the equipment and installation in "as new" condition. The Contractor may be required to bear utility costs, user fees, etc.
- 2. Permission to use the permanent equipment does not relieve the Contractors who utilize this equipment from the responsibility for any damages to the building construction and/or equipment which might result from its use.

G. Preinstallation Conference

- 1. Conduct a preinstallation conference at project site before each construction activity when required by other Sections and when required for coordination with other construction.
- 2. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have

GENERAL REQUIREMENTS FOR ELECTRICAL SYSTEMS 26 0010 - 10 04/24/2025

- preceded or will follow, shall attend the meeting. Advise Architect and Engineer of scheduled meeting dates.
- 3. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including any possible conflicts, requirements, limitations, and coordination with other work.
- 4. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
- 5. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
- 6. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date

1.6 SUBMITTALS

- A. Review of submittals by the Engineer applies only to conformance with the design intent of the project and general compliance with the information given in the contract documents. In all cases, the installing Contractor alone shall be responsible for furnishing the proper quantity of equipment and/or materials required, for seeing that all equipment fits the available space in a satisfactory manner and that piping, electrical and all other connections are suitably located.
- B. The Engineer's review of submittals, schedules or other required submittal data shall not relieve the Contractor from responsibility for the adaptability of the equipment or materials to the project, compliance with applicable codes, rules, regulations, information that pertains to fabrication and installation, dimensions and quantities, electrical characteristics, and coordination of the work with all other trades involved in this project.
- C. If a submittal deviates from the drawings or specifications because of Contractor's standard practice, approved substitution request, or any other reason, the submittal shall notify the designer of the deviation.
- D. Prior to the start of work the contractor shall submit the following. Work shall not proceed without the Engineer's and Owner's completed review of the submitted items.
- E. 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. Clearly and precisely mark red notations and yellow highlights on the 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. Rated capacities, operating characteristics, and electrical characteristics,
 - i. Wiring diagrams that show factory-installed wiring and interface points.

GENERAL REQUIREMENTS FOR ELECTRICAL SYSTEMS 26 0010 - 11 04/24/2025

- j. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
- 4. Format and Organization: submit bookmarked electronic PDF files complying with the following:
 - Cover: Clearly display the following information: Owner name, Project name, Submittal name, project submittal number, Contractor name and contact information, and applicable specification section numbers.
 - b. Table of Contents: Include a TOC that lists materials by section number, with a brief product description, manufacturer and part number, and list the submittal page number per product
 - c. Product Information
- F. Product Schedules: 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 Contractor 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.
- G. Shop Drawings: Prepare Project-specific information, drawn accurately to scale.
 - 1. Shop Drawings that are reproductions of the Contract Documents are not permitted and will be rejected.
 - 2. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - b. Mounting Details
 - c. Wiring diagrams and installation details
 - d. Identification of products.
 - e. Schedules.
 - f. Compliance with specified standards.
 - g. Notation of coordination requirements.
 - h. Notation of dimensions established by field measurement.
 - i. Seal and signature of professional engineer if specified.

H. Coordination Drawings:

- Detailed electronic coordination drawings shall be required for this project. The Engineer and the Engineer's Construction Administrator shall closely monitor progress and quality of the preparation of the electronic coordination drawings and may withhold pay requests as deemed appropriate.
- 2. Coordination Drawings shall be provided on this project by each Trade. Drawings shall be 30x42 sheet size and shall be at ¼-inch scale and shall match the drawing setup as included in the Architectural Drawings. Drawings shall be prepared in electronic format utilizing AutoCad software. The Architect and Engineer will supply electronic drawings files of the Contract Documents upon the Contractor's request and release.

GENERAL REQUIREMENTS FOR ELECTRICAL SYSTEMS 26 0010 - 12 04/24/2025

- 3. The basis for the Coordination Drawings shall be the sheet metal ductwork fabrication shop drawings, all electrical feeder conduits, groupings of branch circuit conduits, other conduits 2" and larger, and pneumatic tube system piping and components in ceiling spaces. These drawings shall indicate all ductwork as double lined with bottom elevations noted. The Coordination Drawings shall indicate:
 - Systems above ceilings in finished areas,
 - b. Systems supported from the structure in finished areas without ceilings,
 - c. Systems in the mechanical rooms, and
 - d. All wall, roof, floor penetrations.
- 4. The sheet metal fabrication shop drawings shall be completed in a timely manner so as not to conflict with construction schedule and phasing plan. At the Prime Contractor's discretion, these drawings shall be completed in phases to correspond with the project construction work sequencing. The Mechanical Contractor shall furnish an electronic copy of these ductwork shop drawings to all other Trades, specifically the Fire Protection and Electrical and other Contractors as requested by the Prime Contractor for the purpose of including other trades work on the Coordination Drawings.
- 5. Pre-Coordination Meetings with all necessary trades shall occur. During these meetings, the Contractors shall discuss locations/elevations where piping, conduits, cable path, etc. will be installed with respect to the sheet metal fabrication drawings and other trades. The sheet metal ductwork and gravity piping systems shall be given the first priority. Within 30 days of the meeting, each Trade shall provide the Mechanical Contractor electronic drawings of all of their systems (with elevation noted), coordinated with the ductwork and other trades for them to incorporate into the Coordination Drawings. Coordination Meetings shall then occur so that all conflicts can be resolved between Trades. All conflicts shall be resolved between all Trades at these Coordination Meetings and the Mechanical Contractor shall then amend the Drawings to include the Final Coordinated Work.
- 6. It is realized that not all systems can be completely detailed. The coordination drawings shall include the following at a minimum:
 - a. All supply/return/exhaust ductwork.
 - b. All above slab sanitary and roof drainage piping.
 - c. HVAC, fire protection and domestic water piping which are 2" in size and greater, excluding insulation.
 - d. Gas mains.
 - e. Electrical conduits which are 1.5" in size and greater.
 - f. J-hook and cable tray cabling paths
 - g. Groupings of smaller piping/conduits hung on a common hanger.
 - h. All wall, roof, floor penetrations.
 - Light fixtures.
- 7. After completion of the Final Coordination Drawings, a Final Review with the all Trades shall occur to provide any final comments and approval by all Trades. Other interim coordination meeting will be required to ensure successful coordination drawings. Any additional coordination items will be updated by the Mechanical Contractor. The Final Approved Coordination Drawings shall be distributed electronically (on CD) to each Trade by the Mechanical Contractor. The Mechanical Contractor shall also furnish a complete 30x42 paper set of drawings to the jobsite main office and shall utilize them for updates of field conditions/deviations that occur during construction. Final Approved Coordination Drawings shall also be distributed to the Construction Manager, Owner, Architect and Engineer for their Records. This process shall be completed prior to starting any work.
- 8. Each Contractor shall ensure that any deviations from the Coordination Drawings are recorded as they occur, in red erasable pencil on record drawings kept at the jobsite. Upon completion of a particular phase, the Mechanical Contractor shall incorporate all field deviations into the Coordination

GENERAL REQUIREMENTS FOR ELECTRICAL SYSTEMS 26 0010 - 13 04/24/2025

Drawings to be utilized as Record Drawings. The Engineer shall review the Record Documents from time to time to ensure compliance with this specification. Compliance shall be a contingency of final payment. Also, pay particular attention to Deviations in the Control Systems and all exterior utilities. Keep information in a set of drawings set aside at the job site especially for this purpose. The Record Drawings shall be distributed electronically (on CD) to the Construction Manager, Owner, Architect and Engineer for their Records.

- 9. The Mechanical Contractor is responsible to the Prime Contractor for the shop drawing layout of the following rooms and details:
 - a. Concrete pads and foundations
 - b. Equipment room layouts with actual equipment
 - c. Roof layouts
 - d. Trench locations and sizes
 - e. Dimensioned floor drain locations
 - f. Congested areas above ceilings adjacent to mechanical and electrical rooms
 - g. Dimensioned ductwork shop drawings
- 10. The Electrical Contractor is responsible to the General Contractor for the shop drawing layout of the following rooms and details:
 - a. Concrete pads and foundations
 - b. Equipment room layouts with actual equipment
 - c. Routes of feeder conduits and all other conduits 1.5" and larger
 - d. J-hook and cable tray cabling paths
 - e. Trench locations and sizes
 - f. Congested areas above ceilings adjacent to mechanical and electrical rooms
 - g. Light fixture locations
 - h. Exact layouts of all work in open ceiling areas
- 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.
- J. Closeout Submittals
 - Upon substantial completion of the project, provide a minimum of three bound copies with complex index and tabs to locate each item described below along with digital copy in PDF format on USB storage media.
 - 2. As-Built Record Documentation
 - a. The Contractor shall insure that any deviations from the design are being recorded daily, as necessary, on record drawings being maintained by the Contractor. Dimensions from fixed, visible permanent lines or landmarks shown in vertical and horizontal ways shall be utilized. Compliance shall be a requirement for final payment. Pay particular attention to the location of underfloor or underground exterior in-contract or utility-owned or leased service lines, main switches, and other appurtenances important to the maintenance and safety of the Electrical System. Deliver these record drawings to the Engineer as a system is completed, within ten days of the mark-up and/or while the accuracy of the mark-ups can be verified visually. Monthly payment may be withheld if the requirement is not complied with.
 - b. All underground utilities/piping installed as part of this project shall be surveyed by a land surveyor licensed in the State where the Work is being performed. This shall include underground electrical primary, communications, and structures. The survey shall include actual duct bank depths to top of conduit every 100 feet in length. The survey shall also

GENERAL REQUIREMENTS FOR ELECTRICAL SYSTEMS 26 0010 - 14 04/24/2025

- include benchmarks dimensions relative to above grade, fixed structures. The survey shall be furnished on electronic storage media in AutoCad ".dwg" format and ".pdf" format. The survey information shall be included in the closeout documentation.
- c. Refer to additional record drawing requirements within the general conditions and other sections of these specifications.

3. Start-Up and System Testing Certificates

a. Provide reports from all required testing to indicate procedures followed and complete results of all tests. Provide reports on manufacturer's standard forms for all equipment and system tests. Testing reports shall indicate applicable NEC, NFPA, UL, NETA, and/or ANSI standards.

4. Operation and Maintenance Manuals

- a. Provide operation and maintenance instructions and parts lists for all equipment provided in this contract. Formatting and content shall follow the guidelines outlined in the latest version of ASHRAE Application Handbook, Guideline.
- b. All instructions shall be submitted in draft, for approval, prior to final issue. Manufacturer's advertising literature or catalogs will not be acceptable for operating and maintenance instructions.
- c. The operation and maintenance document directory should provide easy access and be well organized and clearly identified.
- d. The operation and maintenance manuals shall contain the following information:
 - 1) Emergency information should be immediately available during emergencies and should include emergency and staff and/or agency notification procedures.
 - 2) Provide contacts (company name, address, phone number, email) where parts may be purchased for each principal item of equipment.
 - 3) Provide detailed maintenance instructions, including recommended preventative maintenance schedules for all equipment requiring maintenance. For lighting and lighting controls, provide recommended driver replacement schedule, provide a schedule for inspecting and recalibrating lighting controls, and provide a recommended settings list for all components with adjustable settings.
 - 4) General Information. Provide the following:
 - a) Building function
 - b) Building description
 - c) Operating standards and logs
 - 5) Technical Information. Provide the following:
 - a) System description
 - b) Operating routines and procedures
 - c) Seasonal start-up and shutdown
 - d) Special procedures
 - e) Basic troubleshooting
 - 6) Equipment data sheets. Provide the following:
 - a) Vendor and local representative's contact information
 - b) Operating and nameplate data
 - c) Warranty
 - d) Detailed operating instructions.
 - e) Tools required
 - f) Types of cleaners to use
 - 7) Maintenance program information. Provide the following:
 - a) Manufacturer's installation, operation, and maintenance instructions

GENERAL REQUIREMENTS FOR ELECTRICAL SYSTEMS 26 0010 - 15 04/24/2025

- b) Spare parts information
- c) Preventive maintenance actions
- d) Schedule of actions
- e) Action description
- f) History
- 8) Test reports document observed performance during start-up and commissioning.
- 9) Reference Division 01 specifications for additional requirements.
- e. Shop drawings will not be accepted as satisfying the requirement for Operation and Maintenance Manuals.
- f. Submittals: Provide complete copies of all reviewed submittals. Where submittals were returned "Furnish as Corrected", the contractor shall make the corrections noted by the engineer and submit final corrected shop drawings with close-out documentation.
- g. Parts List: Provide an inventory of all spare parts, special tools, attic stock, etc. that have been provided to the owner.
- 5. Warranty Documentation: Provide all documentation and certificates related to Contractor's warranty and all other specific manufacturer's warranties indicated in the construction documents.
- 6. Training Verification: Provide certification that all specified training has been completed. List training session dates, times, and types. Include any session materials and recordings.
- 7. Inspection Certificates: Provide certificates of inspection from electrical inspector, fire marshal, and any other required special inspections.
- 8. Reports and System Certifications: Provide final reports and any system certifications required in other specification sections.
- 9. Power Riser Diagram: Provide a framed and mounted full-size copy of the overall power riser diagram (under glass) to the Owner. Also, provide three vinyl-coated copies of same. Where an existing power riser diagram is present, the Contractor shall obtain the document from the Owner, and update in digital format with the scope of this project. Edits shall be in digital format and this work shall be closely coordinated with the Owner.
- 10. Software and Firmware Operational Documentation: Provide documentation, including the following:
 - Software operating and upgrade manuals.
 - b. Names, versions, and website addresses for locations of installed software.
 - c. Device address list.
 - d. Printouts of software application and graphic screens.
- 11. Software Back-ups: Provide software back-ups on USB media that is clearly and permanently labeled and provided with lanyard to prevent misplacement.

1.7 MAINTENANCE MATERIAL

- A. Spare Parts and Extra Stock Material
 - 1. Parts and Materials shall be properly marked and packaged for long-term storage.
- B. Special Tools and Keys:
 - 1. Provide, along with the equipment provided, any special wrenches or tools necessary to dismantle or service equipment or appliances.
 - 2. Wrenches shall include necessary keys, handles and operators for valves, switches, breakers, etc. and keys to electrical panels, emergency generators, alarm pull boxes and panels, etc.

GENERAL REQUIREMENTS FOR ELECTRICAL SYSTEMS 26 0010 - 16 04/24/2025

3. Provide at least two of any such special wrench, keys, etc. to the Owner prior to completion of the project. Obtain a receipt that this has been accomplished and forward a copy to the Architect and Engineer.

1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer shall be a firm engaged in the manufacture of specified products of types and sizes required, and whose products have been in satisfactory use in similar service for a minimum of five years unless otherwise approved.
 - The manufacturer shall have a valid ISO 9001 certification and an applicable quality assurance system that is regularly reviewed and audited by a third-party registrar. Manufacturing, inspection, and testing procedures shall be developed and controlled under the guidelines of the quality assurance system.
 - 2. Equipment shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

B. Installer Qualifications

- All Electrical Contractors bidding this project must have been a licensed company for a minimum of three years to qualify to bid this project. Individual employee experience does not supersede this requirement.
- 2. All subcontractors bidding the electrical work must have completed one project of 70 percent this subcontract cost size and two projects of 50 percent this subcontract cost size.
- 3. All electrical work shall be accomplished by qualified workers competent in the area of work for which they are responsible. Untrained and incompetent workers as evidenced by their workmanship shall be relieved of their responsibilities in those areas. The Engineer shall reserve the right to determine the quality of workmanship of any worker and unqualified or incompetent workers shall refrain from work in areas not satisfactory to them. Requests for relief of a worker shall be made through the normal channels of responsibility established by the Architect or the contract document provisions.
- 4. All electrical work shall be accomplished by Journeymen electricians under the direct supervision of a licensed Electrician.
- 5. Special electrical systems, such as Fire Alarm Systems, Telecommunications or Data Systems, Video Systems, Special Electronic Systems, Control Systems, etc., shall be installed by workers normally engaged or employed in these respective trades. Refer to Divisions 27 and 28 for additional requirements.
- C. Licensed Professional Engineer Qualifications: Professional Engineer possessing active qualifications in accordance with Division 01 and licensed by the State in which the Work is being performed.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver or install indoor equipment until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above equipment is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.10 FIELD CONDITIONS

A. Ambient Conditions:

- 1. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding 104 deg F.
 - b. Altitude: Not exceeding 6600 feet.

1.11 WARRANTIES

- A. Contractor Warranty: Contractor shall unconditionally guarantee all equipment, apparatus, materials, and workmanship entering into this Contract to be the best of its respective kind and shall replace all parts at their own expense, which fail or are proven defective within one year from Substantial Completion of the work by the Engineer. The effective date of completion of the work shall be the date each or any portion of the work is accepted by the Architect, Engineer, and Owner's Statement of Substantial Completion.
- B. Manufacturer Warranty: Items of equipment which have longer guarantees, as called for in these specifications or as otherwise offered by the manufacturer shall have warranties and guarantees completed in order and shall be in effect at the time of final acceptance of the work by the Engineer. The Contractor shall present the Engineer with such warranties and guarantees at the time of final acceptance of the work. The Owner reserves the right to use equipment installed by the Contractor prior to date of final acceptance. Such use of equipment shall in no way invalidate the guarantee except that the Owner shall be liable for any damage to equipment during this period due to negligence of his operator or other employee.
- C. The Warranties specified herein and other Sections shall not deprive the Owner of other rights the Owner may have under provisions of the Contract Documents and shall be in addition to, and run concurrently with other warranties made by the Contractor under requirements of the Contract Documents.

1.12 INDEMNIFICATION

A. The Contractor shall hold harmless and indemnify the Engineer, employees, officers, agents and consultants from all claims, loss, damage, actions, causes of actions, expense and/or liability resulting from, brought for, or on account of any personal injury or property damage received or sustained by any person, persons, (including third parties), or any property growing out of, occurring, or attributable to any work performed under or related to this contract, resulting in whole or in part from the negligence of the Contractor, any subcontractor, any employee, agent or representative.

1.13 HAZARDOUS MATERIALS

A. The Contractor is hereby advised that it is possible that asbestos and/or other hazardous materials are or were present in this building(s). Any worker, occupant, visitor, inspector, etc., who encounters any material of whose content they are not certain shall promptly report the existence and location of that material to the Contractor and/or Owner. The Contractor shall, as a part of their work, ensure their workers are aware of this potential and what they are to do in the event of suspicion. The Contractor shall also keep uninformed persons from the premises during construction. Furthermore, the Contractor shall insure that no one comes near to or in contact with any such material or fumes therefrom until its content can be ascertained to be non-hazardous.

- B. CMTA, Inc., Consulting Engineers, have no expertise in the determination of the presence of hazardous materials. Therefore, no attempt has been made by them to identify the existence or location of any such material. Furthermore, CMTA nor any affiliate thereof will neither offer nor make any recommendations relative to the removal, handling, or disposal of such material.
- C. If the work interfaces, connects or relates in any way with or to existing components which contain or bear any hazardous material, asbestos being one, then, it shall be the Contractor's sole responsibility to contact the Owner immediately.
- D. The Contractor by execution of the contract for any work and/or by the accomplishment of any work thereby agrees to bring no claim relative to hazardous materials for negligence, breach of contract, indemnity, or any other such item against CMTA, its principals, employees, agents or consultants. Also, the Contractor further agrees to defend, indemnify and hold CMTA, its principals, employees, agents and consultants, harmless from any such related claims which may be brought by any subcontractors, suppliers or any other third parties.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency suitable to the AHJ, and marked for intended location and application.
- B. Materials used shall present no environmental or toxicological hazards as defined by current industry standards and shall comply with OSHA and EPA standards, other applicable federal, state, and local laws.

C. Standard Products

- 1. Except where specifically noted otherwise, all equipment supplied by the Contractor shall be the standard products of a single manufacturer of known reputation and experience in the industry.
- Only equipment, components, and accessories in current production for at least five years beyond
 the completion date of this system shall be used and installed. Any equipment found to be obsolete
 or not in future production will be removed and replaced at Contractor's expense. This includes all
 equipment, materials and labor.
- 3. Products manufactured more than 2 years prior to date of delivery to site shall not be used, unless specified otherwise.
- D. Product numbers are subject to change by the manufacturer without notification. In the event a product number is invalid or conflicts with the written description, notify the Engineer in writing prior to ordering the material and performing installation work.

2.2 PRODUCT SUBSTITUTIONS

- A. Conform to the substitutions requirements and procedures outlined in Division 01.
- B. One substitution for each product specified will be considered and substitutions must be submitted to Engineer a minimum of 10 days prior to bid using the standard CSI substitution request form.

GENERAL REQUIREMENTS FOR ELECTRICAL SYSTEMS 26 0010 - 19 04/24/2025

- C. If prevailing laws of cities, towns, states or countries are more stringent than these specifications regarding such substitutions, then those laws shall prevail over these requirements.
- D. Where products are noted as "or equal", a product of equivalent design, manufacture, and performance will be considered. Submit product data (product information, catalog cut sheets, test data, etc.) to substantiate that the product is in fact equivalent to that specified. The burden of proof that the substituted product is equivalent to the specified product rests with the Contractor. Whenever material, process or equipment is specified in accordance with an industry specification (ANSI, TIA, etc), UL rating, or other association standard, present an affidavit from the manufacturer certifying that the product complies with the particular standard specification. When requested by the Engineer, submit supporting test data to substantiate compliance.
- E. Manufacturers' names and model numbers used in conjunction with materials, processes or equipment included in the contract documents are used to establish standards of quality, utility and appearance and shall not be construed as limiting competition. Materials, processes, or equipment that, in the opinion of the Engineer, are equivalent in quality, utility and appearance will be approved as substitutions to that specified when "or equal" follows the manufacturers' names or model number(s).
- F. When the Engineer accepts a substitution in writing, it is with the understanding that the Contractor guarantees the substituted product, component, article, or material to be equivalent to the one specified and dimensioned to fit within the construction according to contract documents. Do not provide substituted material, processes, or equipment without written authorization from the Engineer. Assumptions on the acceptability of a proposed substitution, prior to acceptance by the Engineer, are at the sole risk of the Contractor.
- G. Approved substitutions shall not relieve the Contractor of responsibilities for the proper execution of the work, or from provisions of the specifications.
- H. Contractor shall pay expenses, without additional charge to the Owner, in connection with substitution materials, processes and equipment, including the effect of substitution on their work or other Contractor's work.
- In all cases where substitutions affect other trades, the Contractor offering such substitutions shall advise all such Contractors of the change and shall reimburse them for all necessary changes in their work. Any Drawings, Specifications, Diagrams, etc., required to describe and coordinate such substitutions or deviations shall be professionally prepared at the responsible Contractor's expense. Review of Shop Drawings by the Engineer does not absolve the Contractor of this responsibility.
- J. Contractor shall be responsible and assume all costs for removal and replacement of any substituted product installed without prior written approval. Such costs shall include, but not be limited to labor, materials as well as any penalties, fees or costs incurred for late completion.

PART 3 - EXECUTION

3.1 INSTALLERS

- A. Supervision of Work: Each Contractor and Sub-Contractors shall personally supervise the work or have a competent superintendent on the project site at all times during progress of the work, with full authority to act in matters related to the project.
- B. Conduct of Workmen: The Contractor shall be responsible for the conduct of all workmen under their supervision. Misconduct on the part of any workmen to the extent of creating a safety hazard, or endangering the lives and property of others, shall result in the prompt relief of that workman. The consumption or influence of alcoholic beverages, narcotics or illegally used controlled substances on the jobsite is strictly forbidden. Possession of a fire-arm is prohibited and may result in prosecution. Foul or bad language, graffiti is strictly prohibited.
- C. No tobacco use, including smokeless tobacco, is allowed on property.

3.2 EXAMINATION

- A. Each Contractor shall inform themself of all of the conditions under which the work is to be performed, the site of the work, the structure of the ground, the obstacles that may be encountered, the availability and location of necessary facilities and all relevant matters concerning the work. All Contractors shall carefully examine all Drawings and Specifications and inform themselves of the kind and type of materials to be used throughout the project and which may, in any way, affect the execution of their work.
- B. Each Contractor shall fully acquaint themself with all existing conditions as to ingress and egress, distance of haul from supply points, routes for transportation of materials, facilities and services, availability of temporary or permanent utilities, etc. The Contractor shall include in their work all expenses or disbursements in connection with such matters and conditions. Each Contractor shall verify all work shown on the drawings and conditions at the site and shall report in writing to the Engineer ten days prior to bid, any apparent omissions or discrepancies in order that clarifications may be issued by written addendum. No allowance is to be made for lack of knowledge concerning such conditions after bids are accepted.

3.3 PREPARATION

A. Surveys, Measurements, and Grades

- 1. The Contractor shall lay out their work and be responsible for all necessary lines, levels, elevations, and measurements. They must verify the figures shown on the drawings before laying out the work and will be held responsible for any error resulting from their failure to do so.
- 2. Base all measurements, both horizontal and vertical, from established benchmarks. All work shall agree with these established lines and levels. Verify all measurements at site and check the correctness of same as related to the work.
- 3. Should the Contractor discover any discrepancy between actual measurements and those indicated, which prevents following good practice or the intent of the drawings and specifications, they shall notify the Engineer through normal channels of job communication and shall not proceed with his work until they have received instructions from the Engineer.

GENERAL REQUIREMENTS FOR ELECTRICAL SYSTEMS 26 0010 - 21 04/24/2025

3.4 INSTALLATION

A. At no time shall the contractor work on energized electrical equipment. Contractor shall comply with NFPA 70E requirements at all times throughout construction.

B. Permits and Fees

- 1. The Contractor shall give all necessary notices, obtain, and pay for all permits, government sales taxes, fees, and other costs in connection with their work. As necessary, the Contractor shall file all required plans, utility easement requests and drawings, survey information on line locations, load calculations, etc., prepare all documents and obtain all necessary approvals of all utility and governmental departments having jurisdiction; obtain all required certificates of inspection for their work and deliver same to the Engineer before request for final acceptance and final payment for the work
- 2. Ignorance of Codes, Rules, regulations, utility company requirements, laws, etc., shall not diminish or absolve Contractor's responsibilities to provide and complete all work in compliance with such.

C. Codes and Regulations

- 1. The Contractor shall include in the work, without extra cost, any labor, materials, services, apparatus, or drawings required in order to comply with all applicable laws, ordinances, rules and regulations, whether or not shown on drawings and/or specified.
- 2. All materials furnished and all work installed shall comply with the adopted edition of the National Electrical Codes, National Fire Codes of the National Fire Protection Association, the requirements of local utility companies, and with the requirements of all governmental agencies or departments having jurisdiction.
- All electrical work is to be constructed and installed in accordance with plans and specifications which
 have been approved in their entirety and/or reflect any changes requested by the AHJ, as applicable
 or required. Electrical work shall not commence until such plans are in the hands of the Electrical
 Contractor.
- 4. The Contractor shall insure their work is accomplished in accord with OSHA Standards and any other applicable government requirements.
- 5. Where conflict arises between any code and the contract documents, the code shall apply except in the instance where the plans and specifications exceed the requirements of the code. Any changes required as a result of these conflicts shall be brought to the attention of the Engineer at least ten working days prior to bid date, otherwise the Contractor shall make the required changes at their own expense. The provisions of the codes constitute minimum standards for wiring methods, materials, equipment and construction and compliance therewith will be required for all electrical work, except where the drawings and specifications require better materials, equipment, and construction than these minimum standards, in which case the drawings and specifications shall be the minimum standards.

D. Materials and Workmanship

- 1. All electrical equipment, materials and articles incorporated in the work shall be new and of equal quality to the specified basis of design. All workmanship shall be first-class and shall be performed by electricians skilled and regularly employed in their respective trades.
- 2. The Contractor shall determine that the equipment he proposes to furnish can be brought into the building(s) and installed within the space available. All equipment shall be installed so that all parts are readily accessible for inspection, maintenance, replacement, etc. Extra compensation will not

GENERAL REQUIREMENTS FOR ELECTRICAL SYSTEMS 26 0010 - 22 04/24/2025

- be allowed for relocation of equipment for accessibility or for dismantling equipment to obtain entrance into the building(s).
- 3. All fixtures, devices and wiring required shall be installed to make up complete systems as indicated on the drawings and specified herein.
- 4. All electrical materials, equipment and appliances shall conform to the latest standards of the National Electric Manufacturers Association (NEMA) and the National Board of Fire Underwriters (NBFU) and shall be approved by the Owner's insuring agency if so required.
- 5. Comply with National Electrical Contractors Association (NECA) performance standards that are published as National Electrical Installation Standards (NEIS).
- 6. All applicable equipment and devices provided shall meet all FCC requirements and restrictions.

E. Weatherproofing

- Where any work penetrates waterproofing, including waterproof concrete, the method of installation shall be as approved by the Architect and/or Engineer before work is done. The Contractor shall furnish all necessary sleeves, caulking and flashing required to make openings absolutely watertight.
- 2. Wherever work penetrates roofing, it shall be done in a manner that will not diminish or void the roofing guarantee or warranty in any way. Coordinate all such work with the roofing installer.

F. Equipment Access

- The Contractor shall be responsible for the sufficiency of the size of shafts and chases, the adequate clearance in partitions and above suspended ceilings for the proper installation of their work. Cooperate with the Prime Contractor and all other Contractors whose work is in the same space and advise each Contractor of equipment requirements. Such spaces and clearances shall be kept to the minimum size required to ensure adequate clearance and access.
- 2. The Contractor shall locate all equipment which must be serviced, operated, or maintained in fully accessible positions. Equipment shall include but not be limited to junction boxes, pull boxes, contactors, panels, disconnects, controllers, switchgear, etc. Minor deviations from drawings may be made to allow for better accessibility, and any change shall be approved where the equipment is concealed.
- 3. Each Contractor shall provide (or arrange for the provision by other trades) the access panels for each concealed junction box, pull box, fixtures or electrical device requiring access or service as shown on Engineer's plans or as required. Locations of these panels shall be identified in sufficient time to be installed in the normal course of work. All access panels shall be installed in accord with the Architect's standards for such work. In the absence of such specifications, at a minimum such work shall comply with the specifications below. All locations for access panels which are not specifically indicated on the drawings shall be submitted to and approved by the architect prior to ordering.
- 4. Access Doors; in Ceilings or Walls:
 - In mechanical, electrical, and service spaces: 14-gauge aluminum brushed satin finish, 1" border.
 - b. In finished areas: 14-gauge primed steel with 1" border to accept the architectural finishes specified for the space. Confirm these provisions with the Architect prior to obtaining materials or installing any such work.
 - c. In fire or smoke rated partitions, access doors shall be provided that equal or exceed the required rating of the construction they are mounted in.

G. Connections

- Provide rough-in and final connections to all electrically operated equipment furnished under the Work of the contract documents. Carefully coordinate with equipment suppliers, manufacturer's representatives, vendors, and other trades to provide complete electrical and dimensional interface to all equipment.
- 2. Provide all power wiring complete from power source to motor or equipment junction box, including power wiring through starters or contactors. Install all starters not factory mounted on equipment.
- 3. Provide all control, interlock, sensor, thermocouple, and other connections required for equipment operation. Coordinate ampacity and voltage characteristics for all motors and equipment.
- 4. Prior to bidding the work, coordinate power, control, sensor, interlock and all other wiring requirements for equipment or motors with all other trades, to ensure all needed wiring is provided. Failure to provide such coordination shall not be justification for claims of extra compensation of a time extension to the Contract.
- 5. At no times shall the contractor work on energized electrical equipment. Comply with NFPA 70E requirements at all times during construction.
- H. Scaffolding, Rigging, and Hoisting: The Contractor shall furnish all scaffolding, rigging, hoisting, and services necessary for erection and delivery into the premises of any equipment and apparatus furnished. All such temporary appurtenances shall be set up in strict accord with OSHA Standards and Requirements. Remove same from premises when no longer required.

3.5 RESTORATION

A. The Contractor shall replace to their original condition all paving, curbing surfaces, drainage ditches, structures, fences, shrubs, existing or new building surfaces and appurtenances, and any other items damaged or removed by his operations. Replacement and repairs shall be in accordance with good construction practice and shall match materials employed in the original construction of the item to be replaced. All repairs shall be to the satisfaction of the Engineer, and in accord with the Architect's standards for such work, as applicable. Patchwork on new construction will not be accepted.

3.6 IDENTIFICATION AND OPERATING INSTRUCTIONS

- A. Provide all equipment with a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.
- B. Provide operating instructions for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:
 - 1. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
 - 2. Start up, proper adjustment, operating, lubrication, and shutdown procedures.
 - 3. Safety precautions.
 - 4. The procedure in the event of equipment failure.
 - 5. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

GENERAL REQUIREMENTS FOR ELECTRICAL SYSTEMS 26 0010 - 24 04/24/2025

C. Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

3.7 SYSTEM TESTING, VERIFICATION, AND START-UP

- A. The Contractor (and Sub-Contractors) shall be responsible for starting-up, testing, checking, examining, inspecting, and verifying their systems.
- B. The Electrical Contractor shall designate an individual under their employment to lead the start-up, testing and verification process. This person should not be the project manager or job site superintendent, but a person dedicated to making this critical task successful and completed in a timely manner.
- C. A pre-start-up conference shall be held with the Architect, Owner, Contractors, and the Manufacturer providing startup services. The purpose of this meeting will be to discuss the goals, procedures, etc. for start-up.
- D. The Contractor shall include in the bid to provide systems startup and verification for all electrical systems specified for this project. Specific startup, testing, and verification requirements are included throughout the Electrical specifications. In general, as part of the verification process, equipment suppliers shall perform start-up by their factory authorized technicians (unless noted otherwise) and shall complete and submit start-up reports/checklists. Submit start-up reports to the Engineer. The Contractor shall have appropriate trades on site to correct all deficiencies noted by the factory representative. For each deficiency noted, documentation of corrective action (including date and time) shall be submitted to the Engineer and Owner.
- E. Where manufacturer start-up is not specified for a particular piece of equipment or system, the Contractor shall be responsible to perform start-up in strict accordance with manufacturer's instructions.
- F. The Contractor shall be responsible for completion of a System Verification Checklist (SVC) / Manufacturer's Checklists. Furnish to the Testing Agent and Engineer. Sample checklists shall be submitted to the Engineer, Owner, and Testing Agent for approval.
- G. The completed reports shall be organized and bound together in a tabbed binder and submitted for review and approval.

3.8 FIELD QUALITY CONTROL

A. Inspections

- 1. Before requesting a final review of the installation from the Architect and/or Engineer, the Contractor shall thoroughly inspect the installation to assure that the work is complete in every detail and that all requirements of the Contract Documents have been fulfilled. Failure to accomplish this may result in charges from the Architect and/or Engineers for unnecessary and undue work on their part.
- 2. Owner's and Engineer's inspections: Two inspections will be held to generate and then review punchlist items. All site inspections and visits thereafter shall be billed to the Contractor at the Engineer's standard hourly rates.
- 3. The Contractor shall provide as a part of this contract electrical inspection by a competent Electrical Inspection Agency (local or state as specific to project), licensed to provide such services. The name

GENERAL REQUIREMENTS FOR ELECTRICAL SYSTEMS 26 0010 - 25 04/24/2025

- of this agency shall be included in the list of materials of the Form of Proposal by the Contractor. All costs incidental to the provision of electrical inspections shall be borne by the Electrical Contractor.
- 4. The Contractor shall advise each Inspection Agency in writing (with an information copy of the correspondence to the Architect and/or Engineer) when they anticipate commencing work. Failure of the Inspection Agency to inspect the work in the stage following and submit the related reports may result in the Contractor's having to expose concealed work not so inspected. Costs associated with any rework, cutting, and patching will be at the expense of the responsible Contractor.
- 5. Inspections shall be scheduled for rough-in as well as finished work. The rough inspections shall be divided into as many inspections as may be necessary to correct deficiencies. Report of each such inspection visit shall be submitted to the Architect, Engineer, and the Contractor within three days of the inspection.
- 6. Approval by an Inspector does not relieve the Contractor from the responsibilities of furnishing equipment having a quality of performance equivalent to the requirements set forth in these plans and specifications. All work under this contract is subject to the review of the Architect and/or Engineer, whose decision is binding.
- 7. Before final acceptance, the Contractor shall furnish three copies of the certificates of final approval by the Electrical Inspector (as well as all other inspection certificates) to the Engineer with one copy of each to the appropriate government agencies, as applicable. Final payment for the work shall be contingent upon completion of this requirement.

B. Punch Lists

- 1. The Contractor shall review each area and prepare a punch list for each of the subcontractors, as applicable, for at least three stages of the project.
 - a. For review of in-wall work that will be concealed by drywall or other materials well before substantial completion.
 - b. For review of the above-ceiling work that will be concealed by tile or other materials well before substantial completion.
 - c. For review of all other work as the project nears substantial completion.
- 2. When all work from the Contractor's punch list is complete at each of these stages and prior to completing ceiling installations (or at the final punch list stage), the Contractor shall request that the Engineer develop a punch list. This request is to be made in writing two weeks prior to the proposed date.
- After all corrections have been made from the Engineer's punch list, the Contractor shall review and initial off on each item. This signed-off punch list shall be submitted to the Engineer. The Engineer shall return to the site once to review each punch list and all work prior to the ceilings being installed and at the final punch list review.
- 4. At the engineer's option, the contractor shall supply digital photographs via email or file-share of any installed work
- 5. If additional visits are required by the Engineer to review work not completed by this review, the Engineer shall be reimbursed directly by the Contractor by check or money order (due 10 days from date of each additional visit) at a rate of \$125.00 per hour for extra trips required to complete either of the above-ceiling or final punch lists.
- 6. All panelboard fronts shall be removed prior to final punch list inspection and re-installed after completion. Directories for each panelboard shall be completed and available for review by the Engineer at that time.

C. Non-Conforming Work

GENERAL REQUIREMENTS FOR ELECTRICAL SYSTEMS 26 0010 - 26 04/24/2025

D. Manufacturer Services

3.9 CLEANING

- A. The Contractor shall, at all times, keep the area of work presentable to the public and clean of rubbish caused by their operations; and at the completion of the work, shall remove all rubbish, all 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 Engineer may cause cleaning to be done by others and charge the cost of same to the responsible Contractor. Each Contractor shall be responsible for all damage from fire which originates in, or is propagated by, accumulations of rubbish or debris.
- B. After completion of all work and before final acceptance of the work, each Contractor shall thoroughly clean all equipment and materials and shall remove all foreign matter such as grease, dirt, plaster, labels, stickers, etc., from the exterior of materials, equipment, and all associated fabrication. Pay particular attention to finished area surfaces such as lighting fixture lenses, lamps, reflectors, panels, etc.

3.10 TRAINING

- A. Upon completion of all work and all tests, each Contractor shall furnish the necessary skilled labor and helpers for operating all systems and equipment for a period of three days of eight hours each, or as otherwise specified. During this period, instruct the Owner or their representative fully in the operations, adjustment, and maintenance of all equipment furnished. Give at least one week's written notice to the Owner, Architect and Engineer in advance of this period. The Engineer may attend any such training sessions or operational demonstrations. The Contractor shall certify in writing to the Engineer that such demonstrations have taken place, noting the date, time and names of the Owner's representative that were present.
- B. Training shall be accompanied by complete as-built documentation and the technical systems operation manual.
- C. The training shall be accomplished by a factory trained representative. Include a minimum of Two hours for each system described here-in unless noted otherwise. Each equipment representative shall be represented wherever their equipment is used.
- D. Demonstration and Training Videos: These training sessions shall be videotaped by the Installer. Submit two copies within seven days of end of each training module. On each copy, provide an applied label with the following information:
 - 1. Name of Project.
 - 2. Name and address of photographer.
 - 3. Name of Architect and Construction Manager.
 - 4. Name of Contractor.
 - 5. Date video was recorded.
- E. Brochures: Furnish Owner a complete set of operating instructions and diagrams.

GENERAL REQUIREMENTS FOR ELECTRICAL SYSTEMS 26 0010 - 27 04/24/2025

- F. Instruction Program: Submit outline of instructional program for demonstration and training, including a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
- G. At completion of training, submit two complete training manual(s) for Owner's use.
- H. Qualification Data: For facilitator, instructor and photographer.
- I. Attendance Record: For each training module, submit list of participants and length of instruction time.

3.11 PROTECTION

A. The Contractor shall be entirely responsible for all material and equipment furnished for their work and special care shall be taken to properly protect all parts thereof from damage during the construction period. Such protection shall be by a means acceptable to the Engineer. Equipment damaged while stored on site either before or after installation shall be repaired or replaced (as determined by the Engineer) by the responsible Contractor. Electrical equipment exposed to the weather shall be replaced by the Contractor at their own expense.

END OF SECTION 26 0010

SECTION 26 0500 - COMMON WORK RESULTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 Specification Sections, and Section 26 0010 "General Requirements for Electrical Systems" apply to this Section.

1.2 SUMMARY

A. Section Includes:

- 1. Slotted Support Systems.
- 2. Conduit and Cable Supports.
- 3. Mounting, Anchoring, and Attachment Components.
- 4. Fabricated Metal Supports.
- 5. Concrete Bases.
- 6. Vibration Isolation pads.
- 7. Sleeves for penetration of non-fire-rated construction walls and floors.
- 8. Sleeve-seal systems.
- 9. Firestopping.
- 10. Cutting and Patching
- 11. Painting

B. Related Requirements:

1. Refer to Section 26 0548 "Seismic Controls for Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.3 REFERENCES

A. Abbreviations and Acronyms

- 1. EMT: Electrical Metallic Tubing.
- 2. FMC: Flexible Metal Conduit.
- 3. GRC/GRS: Galvanized Rigid Steel Conduit.
- 4. LFMC: Liquid-tight flexible metal conduit.
- 5. RMC: Rigid Metal Conduit

B. Definitions

 Channel: A continuous slotted channel (strut) with inturned lips suitable for assembly into multiple configurations

COMMON WORK RESULTS FOR ELECTRICAL SYSTEMS 26 0500 - 2 04/24/2025

- C. Reference Standards: The following publications are referred to in the text by the basic designation only. The edition/revision of the referenced publications shall be the latest version as of the date of the Contract Documents, unless otherwise specified.
 - 1. Metal Framing Manufacturers Association (MFMA)
 - a. MFMA-4: Metal Framing Standards Publication
 - b. MFMA-103: Guidelines for the use of Metal Framing

1.4 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.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations with Division 07 Section "Roof Accessories."

1.5 SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of components, profiles, and finishes.
 - 2. Include rated capacities.
- B. Shop Drawings: For fabrication and installation details and include calculations for the following:
 - 1. Slotted channel systems.
 - 2. Equipment supports.
 - 3. Concrete Bases for Equipment.
 - 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: Signed and sealed by a qualified professional engineer. For field assembled or fabricated hangers and supports for electrical systems.
 - 1. Include design calculations and details of trapeze hangers.
- D. Qualification Data: For professional engineer.

1.6 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 GENERAL REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency acceptable to the authority having jurisdiction, and marked for intended location and application.
- B. Delegated Design: Design support systems, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

2.2 SLOTTED SUPPORT SYSTEMS

- A. Description: Preformed, continuous slot, bolted channels with associated fittings and hardware.
 - 1. Available Manufacturers: Subject to compliance with requirements, provide products from one of the following or an approved equal:
 - a. Eaton B-Line.
 - b. Kindorf.
 - c. nVent Caddy.
 - d. Power-Strut.
 - e. SuperStrut.
 - f. Unistrut.
 - 2. Comply with MFMA-4 for factory fabricated components suitable for field assembly.
 - 3. Material and Finish for channel, fittings, and accessories:
 - a. Steel: Minimum 16 gauge, Hot-dip galvanized after fabrication and applied according to ASTM A123 or A153 suitable for indoor or outdoor wet locations.
 - 4. Channel Dimensions: Minimum 1-5/8 inches wide with varying heights and welded combinations selected to meet applicable load criteria.

2.3 CONDUIT AND CABLE SUPPORTS

- A. Available Manufacturers: Subject to compliance with requirements, provide products from one of the following or an approved equal:
 - 1. Eaton B-Line
 - 2. nVent Caddy
 - 3. Thomas & Betts
- B. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Provide plugs with number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported.

COMMON WORK RESULTS FOR ELECTRICAL SYSTEMS 26 0500 - 4 04/24/2025

- D. Device Box Mounting Brackets: Factory-fabricated sheet steel brackets for support of device boxes adjacent to or between studs.
- E. Through-Stud Cable and Raceway Support Clips: Factory-fabricated spring steel clip for cables or raceways where run horizontally through metal studs.
- F. Roof-mounted Raceway Support Blocking: Non-penetrating, factory-fabricated support blocking for use under roof-mounted raceways. Wedge-shaped blocking constructed of 100% recycled UV-resistant Rubber with integral galvanized steel strut to accept raceway support clips.
- G. Tee Bar Grid Box Hanger: Factory-fabricated metal electrical box hanger for supporting boxes at locations between ceiling system t-grid components. Height adjustable for various electrical box depths. Attached to ceiling tee bar with screws or integral clamp for stability. Includes tab for independent support wire attachment.

2.4 MOUNTING, ANCHORING, AND ATTACHMENT COMPONENTS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Eaton B-Line
 - 2. Empire Industries.
 - 3. Hilti.
 - 4. ITW.
 - 5. MKT Fastening.
- B. Description: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated or stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - 2. Concrete Inserts: Steel, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
 - 3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 - 4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 - 5. Toggle Bolts: All-steel springhead type.
 - 6. Hanger Rods: Solid, threaded steel.

2.5 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

2.6 VIBRATION ISOLATION PADS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Korfund Maxi-Flex Pads or a comparable product by one of the following:
 - 1. Ace Mountings Co.
 - 2. California Dynamics Corporation.
 - Eaton B-Line.
 - 4. Kinetics Noise Control.
 - Mason Industries.
 - 6. Vibration Eliminator Co.
 - 7. VMC Group
- B. Description: Molded, oil resistant, non-skid elastomeric pads arranged in 2-inch square segments.
- C. Size: Factory or field cut to match the requirements of supported equipment.
- D. Load Rating from 120 lbs. up to 360 lbs. per 2-inch segment.

2.7 SLEEVES

- A. Wall and Floor Sleeves:
 - 1. Galvanized Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.

2.8 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable. Link Seal system or approved equal.
 - 1. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 2. Pressure Plates: Glass reinforced nylon polymer.
 - 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.9 FIRESTOPPING FOR ELECTRICAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products from one of the following or approved equal:
 - 1. Hilti
 - 2. Specified Technologies Inc (STI)
 - Wiremold
- B. Source Limitations: Obtain firestopping systems through one source from a single manufacturer.

C. General Requirements:

- 1. Firestopping systems shall bear UL classification marking corresponding to its Fire Resistance Directory.
- 2. Comply with testing requirements set forth in ASTM E814 or UL 1479.
- 3. Provide through-penetration firestop systems that are compatible with one another, with the substrates forming openings, and with the items penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.
- 4. Provide components for each through-penetration firestop system that are needed to install fill materials. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.
- D. Fire rated cable pathways: Re-penetrable, maintenance-free cable management devices for use with cable bundles penetrating through fire rated walls or floors.
 - 1. Shall contain a built-in fire sealing system sufficient to maintain the hourly rating of the fire rated wall or floor being penetrated.
 - 2. The system shall adjust to the installed cable loading and shall permit cables to be installed, removed, or retrofitted without the need to remove or reinstall firestop materials.
 - 3. Shall be engineered to allow two or more devices to be ganged together with wall plates for larger cable capacities.
- E. Fire-rated cable grommets: Molded, two-piece grommet with sealing membrane for use with single cables or small bundles at through or membrane wall penetrations.
 - 1. System shall be installed around cables and shall lock tightly into the wall assembly.
- F. Outlet Box Putty Pads: Non-hardening, moldable, intumescent material shaped into preformed pads for use with metallic outlet boxes.
- G. Refer to Division 07 for requirements related to other firestopping systems and materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation devices for compliance with manufacturer's installation requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Examine substrates and conditions for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

COMMON WORK RESULTS FOR ELECTRICAL SYSTEMS 26 0500 - 7 04/24/2025

3.2 CUTTING AND PATCHING

- A. Unless otherwise indicated, provide cutting and patching necessary to install the work specified. Patching shall match adjacent surfaces to the satisfaction of the Engineer and shall be in accordance with the Architect's standards for such work.
- B. Do not cut structural elements without reinforcing the structure to maintain the designed weight bearing and stiffness. Coordinate approved reinforcement method with Architect and Structural Engineer.

3.3 SUPPORT SYSTEM APPLICATION

- A. Comply with NFPA 70, NECA 1, NECA 101, and MFMA-103 for application of hangers and supports for electrical equipment and systems except where requirements of this Section are more stringent.
- B. Maximum Horizontal and Vertical Support Spacing for Raceway(s): Space supports for raceways as required by NFPA 70.
- C. Minimum Hanger Rod Size for Raceway Supports: 3/8-inch diameter unless noted otherwise.
- D. Single Raceways:
 - 1. For Raceways 1-1/4-inch and smaller: Install adjustable steel band hanger suspended on threaded rod
 - 2. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/4-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.
- E. Multiple Raceways and single raceways larger than 1-1/4-inch:
 - 1. Install trapeze-type supports fabricated with slotted support system suspended on threaded rods for horizontal applications and fastened to building structure for vertical applications.
 - 2. Size so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - 3. Secure raceways and cables to these supports with two-bolt steel conduit clamps or single-bolt steel conduit clamps using spring friction action for retention in support channel.

3.4 SUPPORT SYSTEM INSTALLATION

- A. Comply with NFPA 70, NECA 1, NECA 101, and MFMA-103 for installation requirements except where requirements of this Article are more stringent.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components multiplied by a safety factor of four with a minimum of 200 lbs.
- C. Mounting and Anchorage of Surface-Mounted or Recessed-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

COMMON WORK RESULTS FOR ELECTRICAL SYSTEMS 26 0500 - 8 04/24/2025

- 1. To Wood: Fasten with lag screws or through bolts.
- 2. To New Concrete: Bolt to concrete inserts.
 - a. Where support anchors are required, establish their type and locate in concrete construction before concrete is poured. Fit each hanger rod with a nut at its upper end, and set nut in a universal concrete insert in the form. Where supported weight exceeds holding strength of a single insert, pass rods through top slot of inserts and interlock with reinforcing steel. Also, where particularly heavy loads are to be supported, suspend hanger rod or rods from a structural angle spanning two or more inserts and securely bolted thereto to distribute the weight.
- 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
- 4. To Existing Concrete: Self-drilling concrete anchors or expansion anchor fasteners.
- 5. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69 or Springtension clamps.
- 6. To Light Steel: Sheet metal screws.
- 7. For Surface-Mounted Items on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to structure. Attachment to gypsum wall board is not acceptable as sole support means; slotted-channel rack solidly attached to structure or light-gauge metal framing at both ends is required.
- 8. For Recessed-Mounted Items in Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices to intermediate light-gauge metal framing members on each side of device or provide slotted-channel racks within hollow wall attached to structure by means that meet anchorage requirements. Attachment to gypsum wall board is not acceptable as sole support means.
- D. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars or existing raceways embedded in slab. Verify reinforcing locations with Structural Engineer and X-Ray existing concrete structures as required.
- E. Do not support items such as equipment, piping, conduit, and other similar items that exceed 2 inches in diameter from the bottom of slabs. Where intermediate support is required between structural members, use slotted steel channels support systems attached to beams or joists to avoid attachment to slabs.
- F. Slotted Support Systems
 - 1. Install slotted channel systems level and plumb.
 - 2. Remove burrs from all exposed cut edges prior to installation.
- G. Wall Stud and Ceiling Supports
 - 1. Fasten junction, pull and devices boxes securely to the building construction, independent of raceway system.
 - 2. Install Device Box Mounting Brackets supported between two studs. Attach all device boxes to two studs, device box stabilizers are prohibited.
 - 3. Install Tee Bar Grid Box Hanger supported between two ceiling grid tee bars where devices boxes are located flush in recessed suspended ceilings. Install at least one independent support rod from box hanger to structure.

- 4. Install Through-Stud Cable and Raceway Support Clips where cables or raceways run horizontally through metal studs.
- H. Install Roof-mounted Raceway Support Blocking where raceways run on across roofing.
 - Coordinate installation of roof supports with items specified in Division 07 Section "Roof Accessories." Provide products compatible with rooftop materials included in the Work to maintain warranty of roof system.

Threaded Rod Hardware

- 1. Provide minimum of two lock nuts per threaded support rod except where lock nut tightens against a threaded socket, one locknut may be used.
- 2. Trim rod excess to within 1-inch of locknut, de-burr, and provide protective endcap.
- J. Support raceways at a distance above suspended ceilings to permit removal of ceiling panels and luminaires.
- K. Locate raceways and supports so as not to hinder system functions or code required equipment clearances.
- L. Provide independent supports and hang all electrical raceways and devices from the building structure with UL listed and approved materials. Utilizing the support systems of other trade's work is prohibited, except with written approval from the Engineer.
- M. Provide riser support clamps for vertical conduit runs and install at each floor level penetration and at additional locations required to support weight of system.
- N. Tighten all bolted connections to proper torque values in accordance with manufacturer's written instructions.
- O. Provide supports to maintain 1/4-inch air space between raceway and mounting surface where raceways are mounted exposed in wet or corrosive locations and where directly attached to concrete or masonry.
- P. The use of tie wire or perforated metal tape for support or fastening of raceway is prohibited.
- Q. Where galvanized wire is used for cable supports above suspended ceilings, provide minimum #12 support wire independent of ceiling system secured at both ends. Paint or provide tag to distinguish supports from ceiling system.
- R. Welding directly on raceways, fittings, or outlet boxes is prohibited.

3.5 INSTALLATION OF VIBRATION ISOLATION PADS

- A. Select vibration device load ratings to match equipment loading and deflection criteria.
- B. Arrange pads in single or multiple layers of sufficient stiffness for uniform loading.
- C. Install pre-cut segments in accordance with manufacturer's written instructions to match shape of equipment base.

3.6 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.7 CONCRETE EQUIPMENT BASES

- A. Housekeeping Pads: Construct concrete housekeeping pads a minimum of 4-inches thick and 6-inches larger in both directions than supported unit.
- B. Exterior Equipment Pads: Construct exterior equipment pads a minimum of 8-inches thick and 6-inches larger in both directions than supported unit unless noted otherwise.
- C. Use 4000-psi, 28-day compressive-strength concrete unless otherwise noted. Comply with Division 03 Section "Cast-in-Place Concrete" and ACI standards for subbase requirements, concrete materials, reinforcement, placement, and cover requirements.
 - 1. Reinforce pads with a minimum #4 rebar on 12-inch centers each way or equivalent welded wire fabric. Support reinforcement and tie together to prevent displacement during construction.
 - 2. For interior pads, provide #4 dowels at 24-inch centers each way (minimum of 4) to anchor to structural slab below. Embed dowels into slab a minimum of 3-inches.
 - 3. Provide rubbed finish for all surfaces.
 - 4. Provide ¾-inch chamfer at all exposed edges.
 - 5. Provide Engineer approved repairs if pad surface is rough or shows signs of honeycomb.
 - 6. Provide crown for exterior pads with a slope of 1/8-inch per foot.
 - 7. Do not set heavy equipment on pad for at least 7 days after pour unless approved by Engineer.
- D. Anchor equipment to concrete base.
 - 1. Locate anchors to be a minimum of 10 bolt diameters from edge of the base.
 - 2. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 3. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 4. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.8 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Coordinate all required openings and provide sleeves and inserts prior to construction of wall and floor systems. Where openings are missed or incorrectly located, provide core-drilling and patching at no additional expense to owner.
- C. Install sleeves without compromising structural integrity of wall or floor.

COMMON WORK RESULTS FOR ELECTRICAL SYSTEMS 26 0500 - 11 04/24/2025

- D. Sleeves for Conduits or Cable Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
 - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
 - a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint.
 - Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
 - 2. Unless sleeve seal systems are used, size pipe sleeves to provide a minimum 1/4-inchannular clear space between sleeve and raceway. Where conduit motion due to expansion and contraction will occur, provide sleeves a minimum of two conduit sizes larger than the nominal conduit diameter.
 - 3. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls.
 - For conduit penetrations, cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
 - b. For cable penetrations, extend sleeve a minimum of 2-inches beyond surface of wall and provide plastic insulated bushing.
 - 4. Install sleeves for floor penetrations. Extend sleeves installed in floors a minimum of 6-inchesabove finished floor level unless noted otherwise. Install sleeves during erection of floors.
 - 5. Fasten sleeves securely in floors, walls, so that they will not become displaced when concrete is poured or when other construction occurs around them. Take precautions to prevent concrete, plaster or other materials being forced into the space between pipe and sleeve during construction.
- E. Sleeves for Cables Penetrating Non-Fire-Rated Gypsum Board Assemblies:
 - 1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 2. Seal space outside of sleeves with approved joint compound or acoustical sealant for gypsum board assemblies.
- F. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units and counter flashing applied in coordination with roofing work. Coordinate all work with roofing system to maintain roof warranty.
- G. Exterior-Wall and Floor Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seal system. Size sleeves to allow formanufacturer recommended annular clear space between raceway or cable and sleeve for installing sleeve-seal system. Where sleeves are installed in core drilled openings, grout sleeve into the opening.
- H. Where sleeves are installed exposed in finished spaces, provide metal escutcheon plates of size to match the sleeve.
- I. Sleeve-Seal-System:
 - 1. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
 - 2. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve

seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.9 ELECTRICAL SYSTEM FIRESTOPPING INSTALLATION

- A. Install firestopping at all penetrations of fire-rated assemblies. Comply with requirements in Division 07 and as outlined below.
- B. Coordinate location and proper selection of firestop devices with fire rated assembly. Ensure cast-in place devices are installed before placement of concrete.
- C. Install firestop materials in accordance with UL Fire Resistance Directory and manufacturer's written instructions.
- D. Affix permanent label to each side of penetration immediately adjacent to firestopping to communicate to futures installers and code authorities the following:
 - 1. Fire-stop product/system used
 - 2. Installation Company
 - 3. Penetration Hour Rating
 - 4. Installation Date
- E. Examine sealed penetration areas to ensure proper installation before concealing or enclosing areas. Keep areas of work accessible until inspection by applicable code authorities.

3.10 PAINTING

- A. Touchup: Comply with requirements in Division 09 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 26 0500

SECTION 26 0519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General, Special and Supplementary Conditions, Division 01 Specification Sections, and Section 26 0010 "General Requirements for Electrical Systems" apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Building wire and cable rated 600 V and less.
 - 2. Connectors, splices, and terminations rated 600 V and less.
 - 3. Control Voltage Conductors and Cables.

1.3 REFERENCES

A. Abbreviations

1. RoHS: Restriction of Hazardous Substances.

B. Definitions

- 1. Low Voltage: Circuits and equipment operating at more than 50VAC but less than 1000VAC for building electrical distribution systems.
- 2. Control Voltage: Circuits and equipment operating at less than 50VAC for remote-control and signaling power-limited circuits.
- 3. Plenum: A space forming part of the air distribution system to which one or more air ducts are connected. An air duct is a passageway, other than a plenum, for transporting air to or from heating, ventilating, or air-conditioning equipment.
- 4. Homerun: The run of raceway(s) and cable(s) between the panelboard or switchboard and the junction box in the area served where branch circuit cables originate.

1.4 SUBMITTALS

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

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

2.2 BUILDING WIRE AND CABLE

- 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. Alpha Wire Company.
 - 2. Cerro Wire LLC.
 - 3. Encore Wire Corporation.
 - 4. General Cable Technologies Corporation.
 - 5. Okonite Compony.
 - 6. Southwire Company.
- B. Building Wire Description: Flexible, insulated, and uninsulated, drawn current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- C. Cable Description: A factory assembly of one or more current-carrying insulated conductors in an overall protective sheath.
- D. General Requirements:
 - Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 - 2. RoHS compliant.
 - 3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- E. Copper Conductors: 98% conductive annealed copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.
- F. Conductor Insulation:
 - 1. 600V, 90°C.
 - 2. Comply with ANSI/NEMA WC 70/ICEA S-95-658.
 - 3. THHN/THWN-2: Comply with UL 83.
 - 4. XHHW-2: Comply with UL 44.
 - RHW-2: Comply with UL 44 and UL 2196.
- G. Mineral Insulated Cable, Type MI
 - 1. Solid copper conductors encased in compressed metal oxide with an outer metallic sheath
 - 2. UL 2196 for fire resistance.

- 3. Insulation: Compressed magnesium oxide
- 4. Sheath: Copper

2.3 SPLICING DEVICES & CONNECTORS

- 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. 3M; Electrical Products Division.
 - 2. AFC Cable Systems, Inc.
 - 3. Burndy
 - 4. Gardner Bender.
 - 5. Hubbell Power Systems, Inc.
 - 6. Ideal Industries, Inc.
 - 7. ILSCO.
 - 8. NSi Industries LLC.
 - 9. O-Z/Gedney;
 - 10. Thomas & Betts.
 - 11. Tyco Electronics Corp.
- B. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- C. Material: Tin plated copper
- D. Twist-On Wire Connectors: spring pressure type, 600V, 105°C insulation, capable of connecting two or more wires up to #8 AWG in a pigtail application.
- E. Crimp Sleeve Splices: butt or parallel crimp type, copper sleeve with nylon cover and skirted insulators, capable of permanent connection of two or more wires up to #10 AWG.
- F. Compression Splices: standard or long barrel type, 90°C, with cold shrink tubing, for use with hydraulic crimping tool, capable of permanent connection of wires #6 AWG and larger.
- G. Ring or Flanged Fork Tongue Terminals: crimp type, 600V, 105°C insulation, insulated serrated barrel, capable of terminating wires up to #10 AWG.
- H. No aluminum splicing devices or connectors are permitted.

2.4 CONTROL VOLTAGE CONDUCTORS AND CABLE

- A. Control Cable: NFPA 70, Type CMG or CMP
 - 1. Single or Multi-pair, twisted, minimum No. 18 AWG, stranded tinned copper conductors.
 - 2. PVC insulation.
 - 3. Shielded or Unshielded.
 - 4. Flame Resistance:
 - a. CMG: Comply with UL1685.

- b. CMP: Comply with NFPA 262.
- B. Class 1, 2, and 3 Control Circuits: Stranded Copper, Type THHN/THWN-2

PART 3 - EXECUTION

3.1 CONDUCTOR AND INSULATION APPLICATION

- A. Feeders and Branch Circuits: Copper. THHN/THWN-2. Solid for #10 AWG and smaller; stranded for #8 AWG and larger.
 - 1. Provide XHHW-2 insulation for the following:
 - a. Circuits routed exposed on rooftops.
 - Conductors on the load side of a Variable Frequency Drive.
- B. Conductors for motors or vibrating or oscillating equipment: Extra flexible stranded.
- C. Cord Drops and Portable Appliance Connections: Type SOOW, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- D. Conductor sizes indicated on drawings are based upon 75 degree C rating unless noted otherwise.
- E. Minimum branch circuit or feeder size:
 - 1. Not less than #12 AWG copper wire unless noted otherwise.
- F. Minimum control circuit conductor sizes:
 - 1. Class 1 remote-control and signal circuits; No 14 AWG.
 - 2. Class 2 low-energy, remote-control, and signal circuits; No. 16 AWG.
 - 3. Class 3 low-energy, remote-control, alarm, and signal circuits; No 12 AWG
- G. Provide all wire for the project in new and undamaged condition. Deliver in standard coils or reels. Wires and cables manufactured more than 24 months prior to date of delivery to the site are not acceptable.

3.2 EXAMINATION

- A. Prior to installing conductors and cables:
 - 1. Verify that raceway installation is complete according to Section 26 0533 "Raceways and Boxes for Electrical Systems" and ready for installation of conductors and cables.
 - 2. Verify that raceways are properly sized in accordance with NEC.
 - 3. Visually inspect exposed raceways to ensure that raceways are not damaged and bends are not deformed.
 - 4. Verify that raceways do not exceed the maximum number of bends between pull-points.
 - 5. Verify raceways have been cleaned of all dirt and debris.

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3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Pulling Conductors in Raceways

- 1. Pull cables in accordance with cable manufacturer and pulling equipment manufacturer recommendations as well as applicable sections of the National Electric Code.
- 2. Use installation equipment, tools, and materials as necessary, such as sheaves, pulling eyes, basket grips, winches, cable reels and/or cable reel jacks, duct entrance funnels, and pulling tension gauges, and approved pulling lubricants where required to facilitate cable pulling without damage to cables or raceway.
- Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not use lubricants that harden or become adhesive with age. Apply lubricant where cables enter ducts and conduits and at all intermediate access points on long or difficult pulls.
- 4. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values. Utilize special remote readout equipment to ensure compliance.
- Avoid abrasion and other damage to cables during installation. Provide physical protection of cables, such as using appropriately sized flexible cable guides or feed-in tubes, at the entrance of boxes and raceways.
- 6. If basket-grip type cable-pulling devices are used to pull cable in place, cut off the section of cable under the grip before splicing and terminating.

B. Bend Radius

- 1. Handle conductors and cables carefully. Make bends in cables and conductors such that cables, conductors, sheaths, armor, etc., are not damaged.
- 2. Do not bend conductors and cables to less than the NEC and manufacturer recommended minimum bending radius.
- 3. Ensure that tools and accessories used to install conductors and cables, such as rollers, sheaves, trolley assemblies, tube guides, and/or raceways, are properly sized and utilized to be greater than the minimum bending radii of conductors and cables.
- 4. Minimize bending where conductors and cables enter or exit raceways, cabinets, and boxes. Do not install cables that have been bent or kinked to a radius less than the recommended dimension.
- 5. Install conductors only after insulating bushings are in place.
- C. If multiple circuits are pulled in a single homerun, provide a dedicated neutral for each phase conductor. In these cases, a maximum of seven conductors (six current carrying and one ground) are permitted in a single conduit except for switch legs and travelers in multi-point switching arrangements. De-rate conductors per NEC.
- D. Multi-wire branch circuits with a shared neutral are not permitted unless specifically noted on the drawings. Where indicated, group the phases and neutral together with cable ties in the panelboard and in all pull boxes.
- E. Install conductors for isolated power systems in as short a run of conduit as practicable. The use of pulling compound or lubricant is not permitted on conductors in isolated power systems.
- F. Voltage Drop:

- 1. Adjust conductors and conduit sizes accordingly based on actual field installed conditions.
- 2. Size and Install all feeders and branch circuits for a maximum 2% voltage drop in feeders and 3% in branch circuits with a maximum total voltage drop of 5%.
- 3. Calculate using a load equal to 80% of the supply breaker rating unless the circuit breaker is rated to carry 100% of the load.
- 4. Where the conductor length from the panel to the first outlet on a circuit exceeds the values below, adjust branch circuit conductors from the panel to the first outlet. Increase the conductor size of remaining branch circuit as needed to meet above voltage drop limitations.
 - a. For 277VAC homeruns exceeding 125-feet, #10 AWG minimum
 - b. For 120VAC homeruns exceeding 50-feet, #10 AWG minimum
 - c. For 120VAC homeruns exceeding 100-feet, #8 AWG minimum

G. Aluminum Conductors

- 1. The use of aluminum conductors is not permitted.
- H. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- I. Install cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours.
- J. Bundle cables where run in groups using listed supports. Provide independent supports directly from structure, do not route through structure or on work of other trades.
- K. Metal Clad Cable, Type MC
 - 1. The use of metal clad cable is not permitted, except for connections to ceiling mounted recessed and semi-recessed luminaires concealed in accessible ceiling where the maximum length is limited to 72-inches.

L. Control Circuit Conductors and Cables

- 1. Use insulated spade lugs for wire and cable connection to screw terminals.
- 2. Conductors installed within environmental air plenums shall be per NEC. Article 800 and other applicable codes, with FEP-type insulation or an approved equivalent. Provide plenum-rated cable supports where plastic straps or other supports, etc., are installed in plenum areas.
- 3. Where indicated, systems and control conductors that are installed exposed shall not be routed across ceilings or ductwork. Provide independent supports anchored to building structure or other permanent support members.
- 4. Install in such a manner as to not interfere with the access to or operation of equipment or removal of ceiling tiles.
- 5. Nylon tie-wraps shall be installed in such a manner so as to bundle conductors neatly, allowing runouts of single conductors or groups to drop down to equipment served.
- 6. Install grommets where dropping out of trays or into panels or service columns.
- 7. Install sleeves with bushings where penetrating partitions.
- 8. Provide firestopping for penetrations of fire rated assemblies with approved materials.

3.4 SPLICES, TAPS, CONNECTIONS, AND TERMINATIONS

A. Prepare cable in accordance with the conductor, cable, splice and termination component manufacturers' recommendations and instructions.

- B. Cut conductors and cables using tools and methods which ensure a square cut. Do not nick or damage conductors.
- C. Ensure conductor inserts fully into the connector or termination with the insulation fitting closely to the connector or termination.
- D. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B. Where a tightening torque is indicated as a numeric value on equipment or in installation instructions provided by the manufacturer, a calibrated torque tools shall be used to achieve that indicated torque value, unless the equipment manufacturer has provided installation instructions for an alternative method of achieving the required torque.

E. Splices and Taps

- 1. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than un-spliced conductors.
- 2. Make splices and taps in junction boxes or other enclosure approved for the wiring method.
- 3. For conductors #10 AWG and smaller conductors, use pressure crimp type connections.
- 4. For conductors #8 AWG and larger, use a hydraulic compression type connection, with cold shrink tubing and tape to restore full insulation value of the wire being spliced.

F. Connections and Terminations

- 1. Ensure that conductor temperature and ampacity ratings are compatible with connectors, terminals, and equipment to which they are to be connected.
- 2. Provide crimp-applied ring or flanged fork type terminals for motor and equipment terminals where such terminals are provided on motor and equipment leads or on all stranded wire terminations using #10 AWG or smaller conductors.
- 3. Motor Connections shall use connection lugs with motor stub splice insulators.
- G. Wiring at Outlets: Install conductors at each outlet with at least 12 inches of slack.
- H. All cables and wiring, regardless of voltage, installed in manholes or cable vaults shall be routed in such a manner to provide a minimum of 10 feet of slack cable for future splicing. Install cables along walls by utilizing the longer route from entry to exit. If both routes are symmetrical, provide a loop of cable secured to wall. All cables shall be tied to insulated cable supports on wall-mounted racks, spaced a maximum of three feet apart.

3.5 PROTECTION

- A. Intentional or unintentional painting of exposed low-voltage and/or control-voltage cabling insulation is prohibited. Ensure that exposed cabling is adequately protected from direct painting or overspray whether painting is required within the electrical specifications or required by other disciplines/trades.
- B. Review the project's painting requirements for all disciplines and provide protection as required.
- C. Where exposed cabling is being installed in exposed ceiling or wall spaces that are required to be painted, provide cabling in enclosed raceways or provide alternate options for cable colors to engineer for approval.

3.6 IDENTIFICATION

- A. Comply with Section 26 0553 "Identification for Electrical Systems."
 - 1. Identify all conductors by means of labels placed on conductors in all junction boxes and at each terminal point with labels indicating source, circuit number or terminal number.
 - 2. Identify each spare conductor at each end with identity number and location of other end of conductor and identify as spare conductor.
 - 3. Identify each control voltage conductor or cable on each end and at each terminal with a number-coded identification tag. Each wire must have a unique tag.
- B. Provide conductors, in all sizes of cable, with continuous solid insulation color(s) from the manufacturer. Taped ends shall not be acceptable.
 - 1. Conductors shall be color coded as follows:
 - a. 120/208 Volt Conductors
 - 1) Phase A: Black
 - 2) Phase B: Red
 - 3) Phase C: Blue
 - 4) Neutral: White
 - 5) Ground: Green
 - 6) Isolated Ground: Green/Yellow
 - b. 277/480 Volt Conductors
 - 1) Phase A: Brown
 - 2) Phase B: Orange
 - 3) Phase C: Yellow
 - 4) Neutral: Gray or White with Brown tracer
 - 5) Ground: Green
 - 6) Isolated Ground: Green/Yellow
 - 2. Control voltage wiring color coding shall be consistent throughout the project and shall match existing equipment and standards where applicable. Color coding for each system shall be unique.
 - 3. Conductors within enclosures that may be energized when enclosure disconnect is off yellow or taped with 1/2" yellow tape every 6" of length, inside enclosure. Provide lamacoid plate warning sign on front of enclosure where this condition occurs.
 - 4. DC Wiring:
 - a. Positive: Light Blueb. Negative: Dark Blue

3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Visual Inspections:
 - 1. Compare cable data with drawings and specifications.
 - 2. Inspect exposed sections of cable for physical damage and correct connections in accordance with drawings.
 - 3. Inspect bolted electrical connections for high resistance. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data.

- 4. Inspect compression-applied connectors for correct cable match and indentation.
- 5. Inspect for correct identification and arrangements.
- 6. Inspect cable jacket insulation and condition.

C. Electrical Tests:

- Perform insulation resistance testing for all electrical distribution system feeders unless notes otherwise. Testing may be witnessed by the Engineer and/or Commissioning agent. Schedule all tests with Architect with sufficient notice.
- 2. Insulation resistance tests shall be performed at a DC voltage of 1,000 volts for 600 volt rated equipment, and at a DC voltage of 500 volts for 120-300 volt rated equipment. Test duration shall be one minute. Minimum acceptable (temperature corrected) resistance is 25 megaohms for 120-300 volt rated equipment and 100 megaohms for 600 volt rated equipment and wiring.
- 3. Test instruments shall be calibrated to national standards within the last 12 months.
- D. Test and Inspection Reports: Prepare a written report to record the following:
 - 1. Test procedures used.
 - 2. Results that comply with requirements.
 - 3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- E. Cables will be considered defective if they do not pass tests and inspections. Remove and replace malfunctioning units and retest as specified above.
- F. Submit test results to Architect and Engineer for approval

END OF SECTION 26 0519

SECTION 26 0526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General, Special and Supplementary Conditions, Division 01 Specification Sections, and Section 26 0010 "General Requirements for Electrical Systems" apply to this Section.

1.2 SUMMARY

- A. Description: Grounding and Bonding for electrical systems covers several different but interrelated systems including Electrical System Grounding, Equipment Grounding System, Grounding Electrode System, and interfaces with telecommunications bonding infrastructure as well as lighting protection systems.
- B. Section includes requirements for electrical system and equipment grounding, plus the following special applications:
 - 1. Underground distribution grounding.
 - 2. Grounding electrodes.
 - 3. Ground bonding common with lightning protection system.

C. Related Requirements:

1. Refer to Section 27 0526 "Grounding and Bonding for Communications Systems" for requirements associated with the telecommunications bonding infrastructure.

1.3 REFERENCES

A. Abbreviations

MGB: Main Grounding Busbar

B. Definitions

- 1. Grounding: Establishing a direct or indirect connection to Earth or some conducting body that serves in place of Earth.
- 2. Bonding: Method by which all non-energized conductive materials are effectively interconnected to create a low impedance path.
- C. Reference Standards: The following publications are referred to in the text by the basic designation only. The edition/revision of the referenced publications shall be the latest version as of the date of the Contract Documents, unless otherwise specified.
 - 1. National Electrical Contractors Association (NECA)
 - a. NECA 331 Standard for Building and Service Entrance Grounding and Bonding

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Coordination Drawings: Plans showing dimensioned locations of grounding electrodes, test wells, and other grounding features.
- C. Field quality-control reports. Provide test reports for each test specified in the field quality control section. Include copies of current equipment calibration certification.

D. Closeout Submittal:

- 1. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.
- 2. In addition to items specified in Division 01 and Section 26 0010 "General Requirements for Electrical Systems", include the following:
 - a. Instructions for periodic testing and inspection of grounding systems and features based on NETA MTS and NFPA 70B.
 - Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not
 - 2) Include recommended testing intervals.
- 3. As-Built Data: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:
 - a. Test wells.
 - b. Grounding electrodes and connections.
 - c. Grounding arrangements and connections for separately derived systems.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency acceptable to authorities having jurisdiction and marked for intended location and application.
- B. Comply with NFPA 70 and UL 467 for grounding and bonding materials and equipment.

2.2 MANUFACTURERS:

- A. Subject to compliance with requirements, provide products by one of the following:
 - 1. ABB Blackburn
 - 2. Eaton B-Line
 - 3. Harger
 - 4. Hubbell Burndy

- 5. Ilsco
- 6. nVent Erico
- 7. Panduit
- 8. VFC Lyncole

2.3 CONDUCTORS

- A. Insulated Copper Conductors: Comply with Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables".
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.
- C. Straps/Jumpers: Copper tape, braided conductors pre-terminated with copper ferrules, cross-sectional area no less than a No. 6 AWG conductor.

2.4 ELECTRICAL SYSTEM BUSBARS

A. Grounding Busbar: Predrilled rectangular bars of annealed copper, minimum 1/4 by 4 inches in cross section, with 9/32-inchholes spaced 1-1/8 inchesapart. Size busbar length to accommodate initial conductor installation plus a 50% growth factor. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 1000 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.5 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Welded Connectors: Exothermic-welding kits consisting of graphite molds, copper oxide and aluminum weld metal, and electronic ignition system. Provide types recommended by kit manufacturer for materials being joined and installation conditions.
- C. Irreversible Compression Connectors: Tin-plated copper, for installation using a hydraulic compression tool and die matched to connector type. Provide with die code or other visual indicator to ensure proper connector selection and uniform compression for a permanent connection.
 - 1. Taps: C-type, H-type, or Figure 6/8 type.
 - 2. Splices: Long Barrel straight or tee.
 - 3. Terminals: Two-hole lug long barrel type.
- D. Mechanical Connectors: Tin-plated high strength copper alloy or high strength cast bronze
 - 1. Water Service Pipe Clamps: Heavy-Duty, two-piece saddle type with stainless steel bolts.
 - 2. Pipe Clamps: Heavy-Duty, U-bolt type with silicon bronze hardware.
 - 3. Lay-in Lug Connector: Heavy-Duty, open face lug with hex head set screw.

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS 26 0526 - 4 04/24/2025

2.6 GROUNDING ELECTRODES

- A. Ground Rods: 10 mil pure electrolytic copper coating with molecular bond to high strength steel core; 3/4 inch by 10 feet with chamfered end. Ensure ground rods are die-stamped near the top with the name and trademark of the manufacturer and the length in feet.
- B. Chemical-Enhanced Grounding Electrodes: Self-contained, maintenance free system consisting of a 10-foot copper tube with drilled holes, straight or L-shaped, charged with nonhazardous electrolytic chemical salts. Basis of Design: Lyncole XIT.
 - 1. Termination: Factory-attached No. 4/0 AWG copper conductor at least 48 inches long.
 - Backfill Material: Electrode manufacturer's recommended enhancement material.
- C. Enhanced Composite Backfill: Electrically conductive, environmentally safe, maintenance free backfill material with neutral PH properties that creates a stable, non-corrosive, low resistance connection between a grounding electrode and earth. Basis of Design: Erico Ground Enhancement Material (GEM).
- D. Test Well: Lightweight polymer concrete, Tier 15 rated, non-slip cover, suitable for non-deliberate incidental traffic. 12-inch by 12-inch minimum, 12-inches deep unless noted otherwise, with "GROUND" legend unless noted otherwise.

PART 3 - EXECUTION

3.1 GENERAL

- A. Bond grounding bus and all non-current carrying metallic parts of raceways systems and equipment to common ground in accordance with the National Electrical Code, NECA 331, as shown on the Contract Drawings, and in accordance with the requirements of the local authority having jurisdiction.
- B. The size of the grounding and bonding conductors shall be not less than that given in Article No. 250 of the National Electrical Code, and/or as shown on the Contract Drawings.
- C. Interconnect all grounding systems in or on the structure to provide a common ground potential.
- D. Bond all outlet, junction, pull boxes, and enclosures to the equipment grounding conductor with a grounding pigtail.

3.2 APPLICATIONS

- A. Conductors: Install solid conductor for #10 AWG and smaller, and stranded conductors for #8 AWG and larger unless otherwise indicated.
 - Install bare conductors where not specifically identified as bare or insulated except where installed
 in conduit with associated phase conductors. Install insulated conductors in conduit with insulation
 of the same material as the associated phase conductors with which it is installed.
 - 2. Provide insulated conductors not exceeding No. 8 AWG in size with green colored insulation. Identify conductors larger than No. 6 AWG with 4-inch green tape at each termination and at all junction and pull boxes.

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS 26 0526 - 5 04/24/2025

- B. Underground Grounding Electrode Conductors: Install bare copper conductor, sized per NEC or as indicated on drawings, whichever is larger.
 - 1. Bury at least 24 inches below grade or below the frost line depth, whichever is greater.
 - 2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.
- C. Electrical System Grounding Busbar: Install in electrical rooms housing service equipment, and elsewhere as indicated to provide a common connection point for individual grounding electrode conductors and bonding jumpers.
 - 1. Install bus horizontally, on insulated spacers 4 inches minimum from wall, 18 inches above finished floor unless otherwise indicated.
 - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.
 - 3. Provide green laminated plastic nameplate with 1/2" high white letters indicating function of ground bus (i.e. "Service Main Ground Busbar").
- D. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Connections: Mechanical connectors.
 - 2. Underground and Exposed Exterior Connections: Exothermic welded connectors except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Mechanical connectors.
 - 4. Connections to Structural Steel: Exothermic welded connectors.
 - 5. Connections to Busbars: Irreversible compression connectors.

3.3 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the neutral bus except where service equipment neutral and ground bussing complies with exceptions listed in the NEC. Install a main bonding jumper between the neutral bus and ground bus. Provide external grounding busbar and install grounding electrode conductor to interconnect main grounding busbar and neutral bus.
- B. Where ground fault protection is installed, ensure interconnection of neutral bus and ground bus does not interfere with correct operation of fault protection.

3.4 GROUNDING SEPARATELY DERIVED SYSTEMS

- A. Transformers: Provide grounding in accordance with the NEC and the following:
 - 1. System Bonding Jumper (SBJ): Install at the source enclosure between the grounded terminal (neutral) and the equipment grounding terminal.
 - 2. Supply Side Bonding Jumper (SSBJ): Install wire type SSBJ to bond the source enclosure to the enclosure at the first disconnect or overcurrent protective device.
 - 3. Grounding Electrode Conductor (GEC): Install at the source enclosure from the SBJ connection point to the building grounding electrode system.
 - 4. Bonding Jumpers: Where the metal water piping and/or the metal structural steel building frame in the area served by the separately derived system are not used as a grounding electrode, provide bonding jumper to the GEC connection point at the source enclosure.

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS 26 0526 - 6 04/24/2025

5. Equipment Grounding Conductor (EGC): Bond the EGC of the primary feeder to the equipment grounding terminal.

3.5 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements for utility equipment.
- B. Exterior Pad-Mounted Equipment: Install a minimum of two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with equipment by connecting them to underground grounding conductors and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inchesfrom the foundation.

3.6 EQUIPMENT GROUNDING AND BONDING

- A. Equipment Grounding Conductors: Install insulated equipment grounding conductors with all feeders and branch circuits. Provide conductors of the same wire/cable type as the ungrounded current carrying conductors.
- B. Increase equipment grounding conductor sizes in accordance with NEC article 250 where ungrounded current carrying conductor sizes are increased to minimize voltage drop.
- C. Provide all circuits with a dedicated equipment grounding conductor unless noted otherwise.
- D. Provide an equipment grounding conductor to each outlet on circuits protected by a GFCI circuit breaker.
- E. At all metallic outlet, junction and pull boxes, bond the equipment grounding conductor to the enclosure.
- F. Metal Poles Supporting Outdoor Lighting Fixtures: Install a ground rod and a separate insulated equipment grounding conductor at each pole in addition to grounding conductor installed with branch-circuit conductors.

3.7 INSTALLATION

- A. Grounding Electrode Conductors and Bonding Jumpers: Securely fasten and route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
 - 1. Route conductors to maintain a downward or horizontal direction to ground with a minimum bend radius of 8-inches.
 - 2. Protection: Install above grade conductors No 6 AWG or larger exposed to physical damage and all conductors smaller than No. 6 AWG in schedule 80 PVC conduit. Where metallic conduit is required, bond each conduit end to the electrode or ground conductor as close to the openings as possible with a full-size conductor and bonding bushing to create an electrically parallel path.
 - 3. Clearance: Maintain a minimum separation of 12-inches from open telecommunications cable groups.

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS 26 0526 - 7 04/24/2025

- B. Bonding for Lightning Protection Systems: Where lightning protection systems are installed comply with NFPA70, NFPA 780, and UL 96 for bonding the lightning protection system grounding electrodes with the building grounding electrode system.
 - Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor.
 - 2. Do not use conductors and electrodes for grounding the lightning protection system in place of the grounding electrodes required by this specification and section 250.50 of NFPA 70.
- C. Ground Rods: Auger 6 inch diameter hole to depth 6 inches shorter than the ground rod length. Drive rods a minimum of 12 inches into the bottom of the hole until tops are 12 inches below final grade. After installing connections, backfill around ground rod with enhanced composite backfill.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
 - 2. Except at test wells, use exothermic welds for all below-grade connections to ground rods.
 - 3. For grounding electrode system at the service, install at least three rods spaced at least two-rod lengths from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- D. Test Wells: Ground rod driven through drilled hole in bottom of handhole.
 - 1. Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
- E. Chemical Enhanced Grounding Electrodes: Install in accordance with electrode manufacturer's recommendations. Install test well at each chemical enhanced grounding electrode.
- F. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts. Install straps and jumpers such that it does not restrict movement of the structure to which it is connected.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- G. Grounding and Bonding for Piping:
 - Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes using a mechanical connector. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 - 2. Water Meter: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 - 3. Other Metal Piping: Bond each aboveground portion of metal piping systems, including gas piping, downstream from its equipment shutoff valve in an accessible location.
 - 4. Except for water piping, do not utilize piping systems as a ground path where dielectric fittings are utilized. Do not use bonding jumpers to bridge over such fittings.

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS 26 0526 - 8 04/24/2025

- 5. Do not use underground portions of natural gas, flammable gas, or liquid fuel piping as grounding electrodes.
- H. Grounding for Steel Building Structure:
 - Where the building's steel frame is made discontinuous by masonry breaks or expansion joints, provide an accessible No. 500 kcmil bare copper jumper with exothermic weld connections to bond steel sections together, making the steel frame electrically continuous. The installation of the bonding jumpers shall be reviewed by the Engineer before covering.
 - 2. Provide a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.
- I. Concrete-Encased Grounding Electrode (Ufer Ground): Provide and fabricate in accordance with NFPA 70; use a minimum of 20 feet bare copper conductor no smaller than #4 AWG located in building footing that has direct contact with earth.
 - 1. If concrete foundation is less than 20 feet long, coil excess conductor within base of foundation.
 - 2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts using exothermic weld connections. Extend grounding conductor below grade and connect to building's ground ring or to grounding electrode external to concrete.
- J. Exothermic Welded Connections: Provide in kit form and selected for the specific types, sizes, and combinations of conductors and other items to be connected.
 - 1. An electronic ignition system shall be used and weld metal shall be a self-contained, sealed system with a bi-metallic fuse to start the reaction.
 - 2. Comply with AWS Standards and manufacturer's instructions for procedures, appearance, and quality of welds; and methods used in correcting welding work.
 - 3. Ensure process joins all strands and does not cause the parts to be damaged or weakened.
 - 4. Completed connection or joint must be equal or larger in size than the conductors joined and have the same current-carrying capacity as the largest conductor.
- K. Mechanical Connections: Install mechanical connections in accessible locations.
 - 1. Tighten connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values.
 - 2. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with tightening torque values specified in UL 486A to assure permanent and effective grounding.
- L. Connections between Dissimilar Metals: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
 - 1. Clean surfaces and apply antioxidant compound prior to installation of connections.
 - 2. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
 - 3. Make connections with clean, bare metal at points of contact.
 - 4. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
 - 5. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
 - 6. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS 26 0526 - 9 04/24/2025

3.8 FIELD QUALITY CONTROL

A. Buried or concealed grounding electrode systems shall be accepted by Engineer and Owner Representative before backfilling or covering.

B. Tests and Inspections:

- 1. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
- 2. Bond Resistance Test: Test the bonding connections of the system using a certified microohmmeter, taking two-point resistance measurements across each bond in the grounding electrode system. The maximum acceptable value of each bond is 0.5 milliohms.
- 3. After completing installation of the grounding electrode system and finished grade, but before permanent electrical circuits have been energized, test for compliance with requirements.
- 4. Grounding Electrode Resistance Test: Test completed grounding electrode system at service disconnect enclosure grounding terminal and at ground test wells using a manufacturer calibrated and certified 3-point ground resistance tester.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by three-point fall-of-potential method according to IEEE 81.
 - c. Disconnect and isolate the grounding electrode conductor from the electrical system at the main ground bus before testing.
 - d. Install outer test probe outside the sphere of influence of the grounding electrode system. This value is typically 10 times the size of the grounding electrode system, between 300 and 500 feet from the main ground bus.
 - e. Install inner test probe at 10 equally spaced intervals, in a straight line between the grounding electrode system connection and the outer test probe and note the resistance reading at each location.
 - f. The resistance measurements taken from the flat part of the curve shall be averaged to determine the grounding electrode system resistance to earth.
 - g. If large variations are noted in the resistance measurements, the outer test probe should be relocated further from grounding electrode system (outside its sphere of influence) to achieve some degree of flatness on the resistance curve.
 - h. Excessive Ground Resistance: If resistance to ground exceeds 5-ohms, notify Engineer promptly and include recommendations to reduce ground resistance. If deemed necessary by the Engineer, additional electrodes shall be placed and the measurement process repeated until the desired ground potential achieved.
- 5. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include test probe locations, observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- 6. Patient Care Vicinity Ground Testing
 - a. Test ground leakage current at all fixed conductive equipment and surfaces in patient care areas as required per NEC and local/state mandates.
 - b. Record results for all testing and include a full report in close-out documentation.
- C. Grounding system will be considered defective if it does not pass tests and inspections.

PROJECT NO. 24-179.000 Harrison REMC - Addition and Renovation Harrison REMC GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS 26 0526 - 10 04/24/2025

D. Prepare detailed test and inspection reports and submit to Engineer for review.

END OF SECTION 26 0526

SECTION 26 0533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General, Special and Supplementary Conditions, Division 01 Specification Sections, and Section 26 0010 – General Requirements for Electrical Systems apply to this Section.

1.2 SUMMARY

A. This section is intended to specify the raceways, fittings, boxes, cabinets, specialties and related items necessary to complete the work as shown on the drawings and specified herein.

B. Section Includes:

- 1. Metal conduits and fittings
- 2. Nonmetallic conduits and fittings
- 3. Surface metal raceway
- 4. Metal wireways and auxiliary gutters.
- 5. Boxes, enclosures, and cabinets
- 6. Wall ducts and trench ducts.

C. Related Requirements:

- 1. Refer to Division 07 firestopping section and Section 26 0010 "General Requirements for Electrical Systems" for penetration firestopping requirements related to electrical pathways and boxes.
- 2. Refer to Section 27 0528 "Pathways for Communications Systems" for supplemental pathway requirements related to communications systems.

1.3 REFERENCES

A. Abbreviations

- 1. EMT: Electrical Metallic Tubing
- 2. FMC: Flexible Metal Conduit
- 3. GRC: Galvanized Rigid Steel Conduit
- 4. IMC: Intermediate Metal Conduit
- 5. LFMC: Liquid-tight Flexible Metal Conduit.
- 6. RAC: Rigid Aluminum Conduit
- 7. RMC: Rigid Metal Conduit

B. Definitions

- 1. Outlet: A point on the wiring system at which current is taken to supply utilization equipment.
- 2. Raceway: an enclosed channel designed for enclosing and protecting electrical, communications, and signaling wires and cables.

- C. Reference Standards: The following publications are referred to in the text by the basic designation only. The edition/revision of the referenced publications shall be the latest version as of the date of the Contract Documents, unless otherwise specified.
 - 1. National Electrical Contractors Association (NECA)
 - a. NECA 101 Standard for Installing Steel Conduits (RMC, IMC, EMT)
 - b. NECA 111 Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC)
 - 2. National Electrical Manufacturers Association (NEMA)
 - NEMA FB 2.10 Selection and Installation Guidelines for Fittings for Use with Non-Flexible Metallic Conduit or Tubing (Rigid Metal Conduit, Intermediate Metal Conduit, and Electrical Metallic Tubing)
 - b. NEMA FB 2.20 Selection and Installation Guidelines for Fittings for Use with Flexible Electrical Conduit and Cable
 - c. NEMA RV 3 Application and Installation Guidelines for Flexible and Liquid-tight Flexible Metal Conduits

1.4 SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop drawings: For custom enclosures, cabinets, or boxes.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

2.2 METAL CONDUIT AND FITTINGS

- 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. AFC Cable Systems, Inc.
 - 2. Allied Tube & Conduit.
 - 3. Anamet Electrical, Inc.
 - 4. Calconduit
 - 5. Electri-Flex Company.
 - 6. Nucor Tubular Products.
 - 7. O-Z/Gedney.
 - 8. Picoma Industries.
 - 9. Robroy Industries.
 - 10. Southwire Company.
 - 11. Thomas & Betts Corporation.

- 12. Western Tube and Conduit Corporation.
- 13. Wheatland Tube Company.
- B. Electrical Metallic Tubing (EMT) and Elbows:
 - 1. Comply with ANSI C80.3 and UL 797.
- C. Galvanized Rigid Steel Conduit (GRC, RMC) and Elbows:
 - 1. Comply with ANSI C80.1 and UL 6.
 - 2. Zinc coating both inside and outside by means of hot-dip galvanizing.
 - 3. Use only threaded fittings for GRC.
- D. PVC Coated Galvanized Rigid Steel Conduit (GRC) and Elbows:
 - 1. Comply with NEMA RN 1
 - 2. Minimum 40 mil thick PVC exterior coating with overlapping sleeves protecting threaded joints.
 - 3. Minimum 2 mil thick urethane interior coating.
 - 4. Clear urethane coating over hot-dip galvanized threads.
- E. Intermediate Metal Conduit (IMC) and Elbows:
 - 1. Comply with ANSI C80.6 and UL 1242
- F. Rigid Aluminum Conduit (RAC) and Elbows:
 - 1. Comply with ANSI C80.5 and UL 6A.
- G. Flexible Metal Conduit (FMC):
 - 1. Comply with UL 1.
 - 2. Continuous interlocked hot-dip zinc galvanized steel with smooth interior and exterior.
 - 3. Suitable for dry locations.
- H. Liquid-tight Flexible Metal Conduit (LFMC):
 - 1. Comply with UL 360.
 - 2. Continuous interlocked hot-dip zinc galvanized steel core with smooth interior and exterior.
 - 3. Suitable for wet and dry locations, direct burial applications, and concrete encasement.
 - 4. Sunlight resistant, flame retardant thermoplastic PVC jacket resistant to heat, oil, and chemical breakdown.
- Metal Fittings
 - 1. Comply with NEMA FB1 and UL 514B.
 - 2. Listed and labelled for type of conduit, location, and use.
 - 3. Fittings for EMT:
 - a. Compression type, zinc-plated galvanized steel.
 - b. Concrete-tight- or rain-tight, hardened steel locknuts, and nylon insulating throats.
 - 4. Fittings for GRC and IMC:
 - a. Threaded zinc plated steel.
 - b. Concrete-tight- or rain-tight, nylon insulating throats.

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS 26 0533 - 4 04/24/2025

- Conduit Bodies:
 - a. Material: gray iron or heavy copper-free cast aluminum
 - b. Available in varying configurations with integral bushing and gasketed coverplate.
- 6. Expansion/Deflection Fittings: UL 651 listed, manufactured coupling accommodating 3/4-inch linear movement from normal and 30-degree angular movement in all directions
 - a. Basis of Design: OZ/Gedney DX
 - b. PVC or steel sleeve to match conduit type with neoprene jacket, rated for environmental conditions where installed.
 - c. Integral braided copper bonding jumper.
- 7. Fittings for FMC and LFMC:
 - a. LFMC: Tubular Steel, zinc-plated with gland nut, sealing ring, high tensile grounding ferrule, insulated throat, and body for liquid tight connection.
- 8. Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
- 9. "Kwik-Couple" type fittings are not permitted.
- 10. Indentation, set-screw, or die-cast fittings are not permitted.
- J. Joint Compound for threaded conduit: UL 2419 listed for use in conduit assemblies and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.3 NON-METALLIC CONDUITS AND FITTINGS

- 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. Allied Tube & Conduit
 - 2. Cantex
 - 3. Carlon
 - 4. Heritage Plastics
 - 5. National Pipe & Plastics
 - 6. Prime Conduit
- B. Rigid Polyvinylchloride (PVC) Conduit:
 - 1. Comply with NEMA TC-2 and UL 651.
 - 2. Sunlight resistant and suitable for use with 90 degree C conductors.
 - 3. Type EPC-40 suitable for normal duty applications.
 - 4. Type EPC-80 suitable for heavy duty applications.
- C. Non-Metallic Fittings
 - 1. Comply with NEMA TC 3 and UL514B.
 - 2. Listed and labelled for type of conduit, location, and use.
 - 3. Compatible with conduit type and material.
 - 4. Solvents and Adhesives: as recommended by conduit manufacturer.

2.4 SURFACE MOUNTED METAL RACEWAY

- A. Manufacturers: Subject to compliance with requirements, provide products from one of the following:
 - 1. Hubbell
 - 2. Mono-Systems
 - 3. Wiremold
- B. Source Limitations: Obtain surface metal raceway, components, outlets, and fittings from single manufacturer.
- C. Single and Multi-Channel Raceways:
 - 1. Two-piece design with base and snap on cover complying with UL 5, suitable for use with electrical branch circuit wiring, data/voice network cabling, and low voltage wiring.
 - 2. Material: Galvanized Steel
 - 3. Finish: Manufacturer's standard enamel finish in color selected by Architect, suitable for field painting to match adjacent surfaces.
 - 4. Size: Available in varying widths, selected to accommodate number of conductors and services indicated on drawings with a maximum of 40-percent fill.
- D. For multi-channel configurations, provide integral divider separating raceway into equal compartments for power and low voltage wiring.
- E. Fittings: Include clips, straps, couplings, elbows, tees, connectors, and bushings suitable for interconnecting raceway segments in various configurations. Fittings to overlap raceway and hide uneven cuts. Material and finish to match raceway.
- F. Device Boxes: single and multi-gang configurations, suitable for mounting standard devices and faceplates. Material and finish to match raceway.
- G. Device Plates: sized to match raceway width with openings suitable for mounting various standard power and communications devices. Material and finish to match raceway.
- H. Device Brackets: suitable for mounting standard single or two-gang devices horizontally or vertically within large raceways.
- I. Plugmold: steel surface metal raceway with integral Simplex NEMA 5-20R outlets spaced 12-inches on center or as indicated on drawings.

2.5 METAL WIREWAYS AND AUXILIARY GUTTERS

- 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. Eaton B-Line
 - 2. Hubbell Wiegmann.
 - 3. nVent Hoffman.
 - 4. Square D.

- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise required by environmental application, and sized according to NFPA 70. Minimum of 14-gauge steel before finishes are applied.
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for a complete system.
 - 1. Provide knockouts on all runs, unless otherwise indicated or prohibited by codes.
 - 2. Provide dividers to separate conductors of different insulation levels or where required by equipment vendor installation instructions.
- D. Wireway Covers: Furnish with continuous hinged covers on all runs and removable covers on all fittings unless otherwise noted, to allow a continuous unobstructed path for conductor installation.
- E. Finish: Manufacturer's standard enamel finish resistant to corrosion, moisture, and oil.
- F. Size: available in nominal sizes 2-1/2-inch by 2-1/2-inch, 4-inch by 4-inch, 6-inch by 6-inch or 12-inch by 12-inch.
- G. Install supports to allow unobstructed access to wireway interior. Use minimum 1/4-inch rod hangers for up to 4-inch by 4-inch wireway, 3/8-inch rod up to 8-inch by 8-inch wireway, and 1/2-inch rod for 12-inch by 12-inch wireway.

2.6 BOXES, ENCLOSURES, AND CABINETS

- 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. Eaton Crouse-Hinds.
 - 2. Emerson/Appleton Electric.
 - 3. FSR Inc.
 - 4. Garvin Industries
 - Hoffman.
 - 6. Hubbell Killark.
 - 7. Milbank Manufacturing Co.
 - 8. Mono-Systems, Inc.
 - O-Z/Gednev.
 - 10. RACO / Hubbell.
 - 11. Stahlin Non-Metallic Enclosures.
 - 12. Thomas & Betts.
 - 13. Wiremold / Legrand.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets shall be listed for intended use.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy or aluminum, Type FD, with gasketed cover.

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS 26 0533 - 7 04/24/2025

- E. Luminaire Outlet Boxes: Non-adjustable, designed for attachment of luminaires, listed and marked for the maximum allowable weight with at least a 2.0 safety factor for the anticipated fixture weight.
- F. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb.
- G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1, constructed of code gauge, galvanized steel with sides formed and corner seams riveted or welded before galvanizing
- H. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- For box extensions and mud rings used to accommodate building finishes, provide with same material as recessed box.
- J. Minimum Device Box Dimensions unless noted otherwise:
 - 1. Single gang: 4-inches square by 2-1/8-inches deep with single gang extension ring.
 - 2. Two gang: 4-inches square by 2-1/8-inches deep with two-gang extension ring.
 - 3. Three gang: 8-5/8-inches by 4-1/2-inches by 2-1/2-inches deep with three gang extension ring.
 - 4. Four gang: 10-7/16-inches by 4-1/2-inches by 2-1/2-inches deep with four gang extension ring.
- K. Gangable boxes are prohibited.
- L. Boxes assembled with sheet metal screws are prohibited.
- M. Hinged Cover Enclosures: Comply with UL 50 and NEMA 250, suitable for installed environment with continuous-hinge cover and flush latch unless noted otherwise.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Nonmetallic Enclosures: Fiberglass
 - 3. Interior Panels: Steel, all sides finished with manufacturer's standard enamel.

2.7 WALL AND TRENCH DUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Hubbell.
 - 2. MonoSystems.
 - 3. Square D.
 - 4. Wiremold/Legrand.
- B. Source Limitations: Unless otherwise approved by the engineer, all sections, joints, fasteners, dividers and other such components required for a complete trench and wall duct assembly as indicated on drawings shall be from a single manufacturer.
- C. Comply with UL 209.
- D. Wall and Trench Ducts shall be constructed of code gauge steel, 14 gauge minimum. For MRI applications, provide aluminum duct and fittings.
 - 1. Provide wall ducts with a factory prime painted finish, suitable for field finish painting.

- 2. Provide trench ducts with corrosion resistant finish.
- E. Where wall duct type raceways are indicated to be installed flush, they shall be a minimum 3 ½-inch deep by 10-inches wide unless noted otherwise on drawings,
 - 1. Furnish with screw covers to overlap flange 1-inch on each side.
 - 2. Covers shall be furnished in nominal 3-foot lengths.
 - 3. Provide fully grommeted openings or bushed nipples as needed in coverplates to pass cables thru.
 - 4. Where indicated or required, provide transition fittings between horizontal runs of wireway and wall ducts to properly interface each raceway system.
- F. Wall ducts, if indicated to be surface mounted, shall be furnished with flangeless coverplates.
- G. Nominal depth of trench duct shall be adjustable from 2 3/8-inch to 3 ½-inch, minimum 12-inches wide unless noted otherwise on drawings.
- H. Furnish trench duct with flat turns, riser transition fittings to wall duct or panelboard as shown, concrete tight couplings, internal barriers as required to separate services, reducers, end closers, tees and all other fittings as indicated or required.
- I. Trench duct internal barriers shall be Z-channel, adjustable height, partition dividers and shall be flush to the back of the coverplate.
- J. Furnish coverplates of aluminum or steel, ¼-inch thickness minimum, with flush fasteners in nominal 24-inch lengths. Furnish grommeted openings or nipples with insulated bushings as required. Trench duct coverplates shall not deflect more than .125-inch with application of a 300-pound concentrated load. Provide coverplate supports as required by the manufacturer to meet the deflection criteria above.
- K. For trench ducts, provide an aluminum tile trim flange with a carpet or tile insert to match the floor finish (verify and coordinate with architectural floor finishes). Refer to architectural drawings, where applicable.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for selection of raceways. Consult Architect for resolution of conflicting requirements.
- B. Apply raceway products as specified below unless otherwise indicated:
 - 1. Refer to Section 26 0543, "Underground Ducts and Raceways for Electrical Systems" for additional requirements related to raceways installed underground outside of the building footprint.
 - 2. Exterior and Exposed: GRC
 - 3. Concealed Underslab: GRC or PVC Type EPC-40 where approved.
 - 4. Interior, Concealed in Ceilings, Walls, and Partitions: EMT, IMC, or GRC
 - Interior, Concealed in Concrete or Grouted Masonry Walls and Partitions below grade: IMC or GRC
 - 6. Interior, Damp or Wet Locations: GRC

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS 26 0533 - 9 04/24/2025

- 7. Interior, Where exposed and Not Subject to Physical Damage: EMT, GRC, or IMC. Raceway locations include the following:
 - a. Electrical Rooms
- 8. Interior, Where Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms (below 8'-0").
 - d. Gymnasiums.
- 9. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
- 10. Connection to ceiling mounted recessed and semi-recessed luminaires and electrical devices: FMC.
- 11. Boxes and Enclosures: NEMA 250, Type 1 except as follows:
 - Damp or Wet locations: NEMA 250, Type 3R
 - b. Commercial/Institutional Kitchens and Cafeterias: NEMA 250, Type 3R
 - c. Corrosive environments: NEMA 250, Type 4X
- 12. Exposed Boxes subject to physical damage: Die cast metal boxes with threaded hubs.
- 13. EMT is not permitted underslab, embedded in concrete slabs, or where exposed to physical damage.
- 14. Non-metallic conduit is not permitted for the following applications unless approved by the Engineer:
 - a. Interior Locations including environmental air plenums.
 - b. Applications where a redundant ground fault path is required by code.
- 15. Flexible non-metallic conduit is not permitted.
- 16. Unless otherwise indicated on the drawings, intermediate metal conduit (IMC) may be used in any location in place of rigid galvanized steel conduit (GRC), where permitted by codes, and where approved by the Engineer.
- C. Minimum Raceway Size: 3/4-inch trade size unless noted otherwise on the drawings.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
 - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 - PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
 - 3. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.
 - 4. Flexible Conduit: Use only steel fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- E. Install nonferrous conduit for Magnetic Resonance Imaging (MRI) areas as indicated on drawings. Where aluminum raceways are installed for such circuits and pass-through concrete, install in nonmetallic sleeve.

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS 26 0533 - 10 04/24/2025

- F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth or where prolonged contact with construction materials will degrade the aluminum.
- G. Install raceways and fittings in a manner to avoid use of dissimilar metals that would result in galvanic action corrosion.
- H. Install surface conduits or raceways only where indicated on Drawings.
- Do not install surface conduits or raceways on exterior facades unless approved by Engineer.
- J. Do not install nonmetallic conduit where ambient temperature or operating temperature of the conductors exceeds the rating of the raceway.
- K. Conduit installed embedded in concrete slabs is not permitted.

3.2 RACEWAY INSTALLATION

- A. Comply with requirements in Section 26 0500 "Common Work Results for Electrical Systems" for hangers and supports.
- B. Comply with NECA 1, NECA 101, NECA 111 and manufacturer's written instruction for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- C. Complete raceway installation before starting conductor installation.
- D. Comply with utility company requirements for raceways and boxes containing utility company conductors.
- E. Size raceways to conform with Annex C, of the National Electrical Code, unless otherwise shown on the Contract Drawings.
- F. Level and square raceway runs and install at proper elevations and required heights. Hold tight to structure wherever possible, to maximize available space and not restrict other trades.
- G. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated.
- H. Install conduits with runs parallel or perpendicular to building lines, walls, structural members or intersections of vertical planes and ceilings, with right angle turns consisting of cast metal fittings or symmetrical bends unless otherwise shown. Randomly routed conduits are not acceptable.
- Make bends in raceway using large-radius preformed elbows. Provide concentric bends for parallel runs of conduit. Conform with NFPA 70 minimum radii requirements for field bending. Use only equipment specifically designed for material and size involved.
- J. Install no more than the equivalent of three 90-degree bends in any conduit run. Support within 12-inchesof changes in direction.
- K. Provide junction boxes or pull boxes so that conduit runs do not exceed 100 feet, or as shown on the Contract Drawings. Size junction boxes per NEC, Article 370.

- L. Provide conduit supports spaced not more than 8-feet apart.
- M. Support conduit within 12-inches of enclosures to which attached.
- N. Do not drill into bar joists to support raceways or cables.
- O. Install conduits at least 12-inches away from flues, steam, or hot water pipes.
- P. Conduit installed under concrete slabs is permitted for feeders and for branch circuits serving floor outlets. Underslab conduit is prohibited for other locations unless noted on the drawings or with permission of the engineer. Where approved, comply with the following:
 - 1. Locate raceway a minimum of 12-inches below the bottom of slab.
 - 2. Provide minimum 2-inch spacing between conduits to ensure proper compaction of structural fill.
 - 3. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 - 4. Transition underslab RNC to GRC for all bends larger than 20-degrees and for all stub-ups through a slab on grade. Arrange stub-ups so curved portions of bends are not visible above finished slab. Extend GRC stub-ups a minimum of 6" above the concrete slab. Schedule 80 PVC stub-ups are allowed where approved by engineer.
 - 5. Seal around conduits when penetrating vapor barriers.
 - 6. Coat coat all underslab rigid steel conduit with two coats of bitumastic paint such as "Asphaltum".
- Q. Where raceways are subject to environmental changes, locate seals immediately at the boundary so no fittings or boxes are between the seal and the change of environments that would allow migration of condensation within the raceway system. Seal the interior of all raceways at the following points:
 - 1. Where conduits pass from cold to warm locations, such as boundaries of refrigerated spaces and at building wall and roof penetrations.
 - 2. Where an underground service raceway enters a building or structure.
 - 3. Conduit extending from interior to exterior of building.
 - 4. Conduit extending into pressurized duct and equipment.
 - 5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
 - 6. Where otherwise required by NFPA 70.
- R. Install conduits in a manner to ensure against collection of trapped condensation. Arrange all runs of conduit to be devoid of traps. Provide trapped conduit runs with explosion proof drains at low points.
- S. At hazardous locations, install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed non-shrink sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish like that of adjacent plates or surfaces.
- T. Coordinate with other trades, including metal and concrete deck trades, as necessary to interface installation of electrical raceways and components.
- U. Complete installation of electrical raceways before starting installation of cables or wires within raceways.
- V. Take precautions to prevent the lodgment of dirt, plaster, or trash in all conduit or tubing, fittings and boxes during construction. Use mandrel to clean all conduit for floor boxes or conduit below grade and ensure its swabbed free of debris or moisture before wiring is installed.

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS 26 0533 - 12 04/24/2025

- W. Unless using GRC, do not locate conduits, cables, raceways, and enclosures within 2 inches of bottom of metal-corrugated sheet roof decking, measured from the lowest surface of the roof decking to the top of the conduit, cable, raceway, or box.
- X. Conduits, cables, raceways, and enclosures are not permitted in concealed locations of metal-corrugated sheet decking type roofing.
- Y. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72-inchesof flexible conduit for ceiling mounted recessed and semi-recessed luminaires, and 36-inches for all other equipment subject to vibration, noise transmission, or movement, and for transformers and motors.
 - 1. Install as a single piece with clamp-on insulated throat connectors designed for the purpose.
 - 2. Provide strain relief fittings where subject to vibration.
 - 3. Provide an equipment grounding conductor and bonding jumper at all locations.
 - 4. For LFMC, provide a minimum of 18-inches and loop to avoid restraining vibrating equipment.
- Z. Stub-ups to Accessible Ceilings:
 - 1. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or into an enclosure.
 - 2. Where conduits terminate at a cable tray pathway, provide listed fitting to secure conduit to cable tray.
- AA. Mechanically fasten conduit terminations at a wireway, provide metal insulated bushings, and bond to the wireway with bonding jumper.
- BB. Furnish conduit bodies in proper configurations, avoiding excessive openings. Any openings that are left shall be properly plugged. Wiring splices within conduit bodies are not permitted.
- CC. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- DD. Provide a completely separate raceway system, including junction boxes and pull-boxes, for each emergency power, optional stand-by, and normal power system for complete separation in accordance with NEC.
- EE. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inchesof secured slack at each end of pull wire. Secure pull string at each end and cap raceways.
- FF. Coordinate with vendors and provide extra pull-strings as required to ensure enough pull strings.
- GG. Cut conduit perpendicular to the length. For conduits 2-inchtrade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length. Ream inside of conduit to remove burrs.
- HH. Raceway Fittings: Install fittings in accordance with NEMA FB 2.10 guidelines
 - 1. Install raceways square to enclosures and terminate with appropriate fitting:
 - 2. For enclosures without hubs, terminate with appropriate fitting, insulated throat liner, and casehardened locknuts on both sides of enclosure wall.

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS 26 0533 - 13 04/24/2025

- 3. Terminate rigid conduits with threaded hubs or with locknuts on inside and outside of enclosure and insulated throat metal bushing.
- 4. Install locknuts hand tight, plus one-quarter turn more.
- 5. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- 6. All threaded fittings shall engage a minimum of seven full threads. Fasteners shall be properly torqued to manufacturer's recommendations.
- 7. Split sleeve insulators are not permitted.
- II. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

JJ. Expansion-Joint Fittings:

- 1. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
- 2. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- KK. Where raceways penetrate rooms or walls with acoustical requirements, seal raceway openings on both sides of penetration with acoustically rated putty or sealant.

LL. Surface Raceways:

- 1. Provide surface metal raceways where indicated on drawings or approved by the Engineer.
- 2. Provide all trim and cover fittings, flush feed boxes, splices, and outlet fittings necessary for a complete installation.
- 3. Provide multi service raceway with divider for locations that require power and low-voltage wiring.
- 4. Install surface raceway with a minimum 2-inch radius control at bend points.
- Secure surface raceway with two-hole straps at intervals not exceeding 24-inches and within 6inches of boxes, transitions, and turns. Provide no less than two supports per straight raceway
 section. Support surface raceway according to manufacturer's written instructions. Tape and glue
 are not acceptable support methods.
- 6. Provide box connector and junction box immediately above ceiling for transitioning raceway to conduit.

MM. Trench and Wall Ducts:

- 1. Trench and wall duct assemblies shall be constructed and installed in an electrically and mechanically continuous manner and in accordance with the manufacturer's installation instructions and recommendations.
- 2. Where wall ducts are installed flush either vertically or horizontally as a collector duct, provide proper blocking and support in stud walls, adding a layer of studs as needed to prevent undercutting major structural elements of walls. Flush mounted wall ducts trim flange shall be set tight to wall surface with 1/16-inch tolerance each way.
- 3. Trench duct is to be installed flush with finished concrete floor slab with a vertical tolerance to adjacent surfaces of 1/16-inch plus or minus. Adjust duct position by adjusting leveling screws as required.
- 4. Prior to concrete pour around trench duct, seal any gaps in the system with sealing compound recommended by trench duct manufacturer or tape to prevent mortar or concrete from entering system.

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS 26 0533 - 14 04/24/2025

- 5. Adjust partition dividers and support columns as required to be level with the bottom of the cover plate. Weld dividers in place at 2-foot on center.
- 6. Prior to installation of cables, remove any burs or sharp edges on material and clean inside of duct of any moisture, dust or debris.

3.3 BOX AND ENCLOSURE INSTALLATION

- A. Provide electrical outlets and enclosures as required for splices, taps, wire pulling, and equipment connections.
- B. Provide pull boxes as required to maintain conduit run and bend limitations specified herein.
- C. Size all outlets, pull boxes, junction boxes, cabinets, etc., per adopted edition of the National Electrical Code.
- D. Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- E. Install interior and exterior outlet boxes recessed in building construction with face or cover flush with finished surfaces unless noted otherwise. Where outlet boxes are installed in walls of glazed tile, brick, concrete block, or in walls covered by wood wainscot or paneling, provide deep box to ensure the outlet boxes are installed straight and secure in walls.
- F. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements and architectural elevations. Install boxes with height measured to center of box unless otherwise indicated.
- G. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box. Do not split the mortar joint
- H. Provided 3/4-inch rigid conduit pendants where lighting fixtures, appliances, or wiring devices are to be suspended from ceiling outlet boxes. Outlet boxes shall be malleable iron, provided with self-aligning covers with swivel ball joint and #14-gauge steel locking ring. Provide safety chain between building structure and housing for all fixtures, appliances, or devices greater than 10 lbs weight. Install fixtures plumb and level. Cover pendants shall be finished to match fixtures.
- I. Horizontally separate boxes mounted on opposite sides of walls, so they are not in the same vertical channel.
- J. Locate boxes so that cover or plate does not span different building finishes.
- K. Provide spanner bars to support all boxes from more than one side by spanning two framing members.
- L. Fasten boxes up to 4-11/16 square size to their mounting surface or support with two fasteners of proper size. Fasten larger sizes with four fasteners, minimum.
- M. Support boxes recessed in ceilings independent of ceiling tiles and ceiling grid.

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS 26 0533 - 15 04/24/2025

- N. Fasten junction and pull boxes to, or support from, building structure. Do not support boxes by conduits or ceiling support wires.
- O. Provide all cabinets and boxes for NEMA 1 applications with knockouts, as necessary, or field cut with approved cutting tools which will provide a clean, symmetrically cut opening to maintain UL listing of enclosure.
- P. Replace any unused knockouts or openings with a listed knockout closure.
- Q. Coordinate with equipment vendors to provide special sized outlet boxes to support installed equipment.
- R. Where boxes and enclosures are located in areas or on walls with acoustical requirements, seal openings and knockouts in back and sides of boxes with acoustically rated putty or sealant and provide gasket for wall plates and covers.

3.4 GROUNDING AND BONDING

- A. Comply with requirements in Section 26 0526 "Grounding and Bonding for Electrical Systems".
- B. Bond all metal boxes, junction boxes and pull boxes with pigtails to the equipment grounding conductor.
- C. Provide insulated throat grounding bushings with appropriately sized bonding jumpers for the following locations to maintain electrical continuity between the raceway and enclosure:
 - 1. Metal raceways and enclosures that contain service conductors.
 - 2. Metal raceways and enclosures that contain grounding electrode conductors.
 - 3. Where metal raceways containing circuits over 250V terminate in a concentric or eccentric knockout at cabinets, enclosures, or sheet metal pull boxes listed in accordance with UL 50.
 - 4. Where the integrity of a concentric or eccentric knockout has been compromised.

3.5 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.
- B. Protect threads on conduits and fittings with plastic protectors or other means to prevent damage prior to installation.
- C. Provide protection for all conduit stubbed through floor during construction with plastic caps approved for this purpose.

3.6 IDENTIFICATION

A. Comply with requirements in Section 26 0553 "Identification for Electrical Systems."

PROJECT NO. 24-179.000 Harrison REMC - Addition and Renovation Harrison REMC

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS 26 0533 - 16 04/24/2025

B. Identify all junction, outlet and pull boxes in data/mechanical/electrical rooms and above ceilings with panel and circuit designation on outside of covers. Identify all exposed junction, outlet and pull boxes in finished areas with panel and circuit designation on inside of covers.

3.7 PAINTING

- A. Raceways installed in exterior locations shall receive one coat of primer, two coats finish paint after preparation of galvanizing, color selected by Architect.
- B. Exposed raceways in painted interior areas shall be painted to match adjacent finishes.

END OF SECTION 26 0533

SECTION 26 0543 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General, Special and Supplementary Conditions, Division 01 Specification Sections, and Section 26 0010 "General Requirements for Electrical Systems" apply to this Section.

1.2 SUMMARY

A. Section Includes:

- 1. Direct-buried and concrete-encased conduits, ducts, and duct accessories.
- 2. Handholes and boxes.
- 3. Utility Structure accessories.

B. Related Requirements:

1. Refer to Section 26 0533 "Raceways and Boxes for Electrical Systems" for pathway requirements installed under building slabs.

1.3 REFERENCES

A. Abbreviations

- 1. GRC: Galvanized rigid conduit.
- 2. IMC: Intermediate metal conduit.
- 3. RNC: Rigid nonmetallic conduit.

B. Definitions

- 1. Backfill: Earth or other controlled material placed in trenches for filling and grading back to a finished state.
 - a. Initial Backfill (encasement): Backfill placed beside and over conduit arrangements in a trench, including haunches to support sides of conduits.
 - b. Final Backfill: Backfill placed over initial backfill to fill a trench.
- Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying conduit.
- 3. Duct: A single or multiple underground conduits encased in concrete or direct buried.
- 4. Duct Bank: An arrangement of two or more ducts installed together.
- 5. Encasement: Material placed around a duct or duct bank to provide additional protection.
- 6. Trafficways: Locations where vehicular or pedestrian traffic is a normal course of events.

- C. Reference Standards: The following publications are referred to in the text by the basic designation only. The edition/revision of the referenced publications shall be the latest version as of the date of the Contract Documents, unless otherwise specified.
 - 1. National Electrical Manufacturers Association (NEMA):
 - NEMA TCB-2 "Guidelines for the Selection and Installation of Underground Nonmetallic Raceways".

1.4 **SUBMITTALS**

- A. Product Data: For each type of product.
- B. Duct-Bank Coordination Drawings: Show duct profiles and coordination with other utilities and underground structures along with dimensions from buildings or other benchmarks.
 - 1. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.
- C. Field quality-control reports including digital photographs of all concealed work.
- **Closeout Submittals** D.
 - In addition to items specified in Division 01 and Section 26 0010 "General Requirements for 1. Electrical Systems", ensure all utilities, structures, and underground conduits are surveyed and recorded on as-built drawings.

1.5 FIELD CONDITIONS

A. Ground Water: Assume ground-water level is at grade level unless a lower water table is noted on Drawings.

PART 2 - PRODUCTS

2.1 **GENERAL REQUIREMENTS**

- Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, A. by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with IEEE C2 and NFPA 70.

2.2 **CONDUITS AND FITTINGS**

Α. Comply with 26 0533 "Raceways and Boxes for Electrical Systems".

2.3 DUCT ACCESSORIES

- A. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and size of ducts with which used, and selected to provide minimum duct spacing indicated while supporting ducts during encasement or backfilling.
- B. Fabric Innerduct: Continuous, nylon resin polyester, multi -pocket fabric innerduct, with internal pull tape. Maxcell or equal.
- C. Pull Line: Flat, woven, polyester or polyaramid tape, low stretch, pre-lubricated for reduced friction. Strength suitable for required pulling tensions with a minimum of 200-lb. Muletape or equal.
- D. Underground Detectable Warning Tape: Flexible tape constructed with solid aluminum foil backing and clear film laminate, 6-inches wide, 5-mil overall thickness.
 - 1. Suitable for the method of installation and locating underground utility lines.
 - 2. Chemically inert tape material and ink, resistant to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
 - 3. Comply with APWA Uniform Color Code.
 - 4. Inscriptions for Red-Colored Tapes: "CAUTION BURIED ELECTRIC LINE BELOW".
 - 5. Inscriptions for Orange-Colored Tapes: "CAUTION BURIED COMMUNICATIONS LINE BELOW".
- E. Duct Sealants: Re-enterable, two-part, closed-cell urethane foam capable of sealing conduits with multiple cable configurations.
 - 1. Capable of withstanding temperatures from -40 deg F to 200 deg F and holding 22 feet waterhead pressure continuous.
 - 2. Chemically resistant to gasoline, oils, dilute acids, and bases.
 - 3. Compatible with cable jacket and shall not affect the physical or electrical properties of wire and cable.
 - 4. Workable at temperatures as low as 35 deg F.
 - 5. UL94 Class HBF fire retardant rating.

2.4 POLYMER CONCRETE HANDHOLES AND BOXES

- A. Description: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two.
- B. 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. Armorcast
 - 2. NewBasis
 - 3. Oldcastle
 - 4. Hubbell Quazite
- C. General Requirements:
 - 1. Comply with SCTE 77. Minimum Tier 15.
 - 2. Color: Gray.
 - 3. Configuration: Designed for flush burial with open bottom unless otherwise indicated.

- 4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
- 5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
- 6. Cover Legend: Molded lettering, as indicated for each service.

2.5 PRECAST CONCRETE MANHOLES AND HANDHOLES

- A. Description: Factory fabricated, one-piece units and units with interlocking mating sections, complete with accessories, hardware, and features. Frame and cover shall have load rating consistent with that of structure.
- B. 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. Christy Concrete Products
 - 2. Oldcastle
 - 3. Utility Concrete Products
 - 4. Utility Vault Co
- C. Comply with ASTM C 858.
- D. Precast reinforced-concrete, H-20 structural load rating according to AASHTO HB 17.
- E. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks, plus an additional 12 inches vertically and horizontally to accommodate alignment variations.
 - 1. Locate windows no less than 6 inches from interior surfaces of walls, floors, or roofs of structure, but close enough to corners to facilitate racking of cables on walls.
 - 2. Provide window opening with cast-in-place, welded-wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.
 - 3. Provide window opening frame with at least two additional No. 3 steel reinforcing bars in concrete around each opening.
 - 4. Provide windows 1-1/2 to 2 inches thick.
- F. Duct Entrances in Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.
 - 1. Type and size shall match fittings to duct or conduit to be terminated.
 - 2. Fittings shall align with elevations of approaching ducts and be located near interior corners of structures to facilitate racking of cable.
- G. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.
- H. Provide ventilation openings where indicated on drawings.

- I. Frames, Covers, and Chimney Components: Comply with structural design loading specified for structure.
 - 1. Frame and Cover: Weatherproof, gray cast iron complying with ASTM A 48/A 48M, Class 35 cast iron with milled cover-to-frame bearing surfaces; diameter, 32 inches.
 - a. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 - b. Special Covers: Recess in face of cover designed to accept finish material in paved areas.
 - 2. Cover Legend: Cast in. Selected to suit system.
 - a. All covers shall be provided with 2-inch lettering and with the structure number, assigned by Owner, welded onto the cover if not provided by the manufacturer.
 - b. All covers shall be provided with stainless steel drop handles.
 - 3. Chimney Components: Precast concrete rings with dimensions matched to those of roof opening.
 - a. Mortar for Chimney Ring and Frame and Cover Joints: Comply with ASTM C 270, Type M, except for quantities less than 2.0 cu. ft. (60 L) where packaged mix complying with ASTM C 387, Type M, may be used.
 - b. Seal joints watertight using preformed plastic or rubber conforming to ASTM C 990. Install sealing material according to the sealant manufacturers' printed instructions.
- J. Sump Frame and Grate: ASTM A 48/A 48M, Class 30B, gray cast iron.
- K. Pulling Eyes in Concrete Walls: Eyebolt with reinforcing-bar fastening insert, 2-inch diameter eye, and 1-bv-4 inch bolt.
 - 1. Working Load Embedded in 6-Inch, 4000-psi Concrete: 13,000-lbf minimum tension.
- L. Pulling-In and Lifting Irons in Concrete Floors: 7/8-inch diameter, hot-dip galvanized, bent steel rod; stress relieved after forming; and fastened to reinforcing rod. Exposed triangular opening.
 - 1. Ultimate Yield Strength: 40,000-lbf shear and 60,000-lbf tension.
- M. Bolting Inserts for Concrete Utility Structure Cable Racks and Other Attachments: Flared, threaded inserts of noncorrosive, chemical-resistant, nonconductive thermoplastic material; 1/2-inch ID by 2-3/4 inches deep, flared to 1-1/4 inches minimum at base.
- N. Tested Ultimate Pullout Strength: 12,000 lbf minimum.
- O. Ground Rod Sleeve: 3-inch, PVC conduit sleeve in floors 2 inches from the wall adjacent to, but not underneath, the ducts routed from the facility.
- P. Expansion Anchors for Installation after Concrete Is Cast: Zinc-plated, carbon-steel-wedge type with stainless-steel expander clip with 1/2-inch bolt, 5300-lbf rated pullout strength, and minimum 6800-lbf rated shear strength.
- Q. Cable Rack Assembly: Steel, hot dip galvanized, except insulators.
 - 1. Stanchions: T-section or channel; 2-1/4-inch nominal size; punched with 14 holes on 1-1/2-inch centers for cable-arm attachment.

- 2. Arms: 1-1/2 inches wide, lengths ranging from 3 inches with 450-lb minimum capacity to 18 inches with 250-lb minimum capacity. Arms shall have slots along full length for cable ties and be arranged for secure mounting in horizontal position at any vertical location on stanchions.
- 3. Insulators: High-glaze, wet-process porcelain arranged for mounting on cable arms.
- R. Fixed Ladders & Extension: Arranged for attachment to wall of manhole. Ladder and mounting brackets and braces shall be fabricated from hot-dip galvanized steel.

2.6 SOURCE QUALITY CONTROL

- A. Test and inspect precast concrete utility structures according to ASTM C 1037.
- B. Nonconcrete Handhole and Pull-Box Prototype Test: Test prototypes of manholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
 - 1. Tests of materials shall be performed by an independent testing agency.
 - 2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
 - 3. Testing machine pressure gages shall have current calibration certification, complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Coordinate layout and installation of ducts, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field. Notify Architect if there are obstructions or conflicts between areas of excavation and existing structures or archaeological features to remain.
- B. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of ducts and duct banks, as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by Architect.
- C. All necessary precautions shall be taken by the contractor during construction to prevent the lodging of dirt, plaster or trash in all conduit, tubing, fittings and boxes.

3.2 UNDERGROUND DUCT APPLICATION

- A. Apply underground duct products as specified unless noted otherwise:
 - 1. Refer to Section 26 0533, "Raceways and Boxes for Electrical Systems" for additional requirements related to underground conduit below building slabs.
 - 2. Ducts for Utility Company primary conductors: comply with utility company standards unless noted otherwise.

- 3. Ducts for Electrical Service Secondary Conductors: RNC, Type EPC-40 PVC, in concrete-encased duct bank unless otherwise indicated.
- 4. Ducts for Electrical Cables greater than 600 V: RNC, Type EPC-40 PVC, in concrete-encased duct bank unless otherwise indicated.
- 5. Ducts for Electrical Feeders 600 V and Less: RNC, Type EPC-40 PVC, in concrete-encased duct bank unless otherwise indicated.
- 6. Ducts for Electrical Branch Circuits: RNC, Type EPC-40 PVC, in direct buried duct bank unless otherwise indicated.
- 7. Ducts for Communications Cables: RNC, Type EPC-40 PVC, in direct buried duct bank unless otherwise indicated.
- 8. Underground Ducts 600V and less Crossing Driveways and Roadways: RNC, Type EPC-40-PVC, encased in reinforced concrete. Extend reinforcement a minimum of 5-feet beyond the edge of paved surfaces.
- B. Minimum Cover Requirements: Provide reinforced concrete encasement where minimum depths are not achievable.
 - 1. Electrical Primary or Conductors more than 600V: 48-inches unless otherwise indicated by utility company requirements.
 - 2. Electrical Secondary Service and Feeders: 36-inches
 - 3. Electrical Branch Circuits: 24-inches
 - 4. Communications: 30-inches
- C. Transition RNC to GRC for all stub-ups and building enclosure penetrations. Use fittings manufactured for RNC-to-GRC transition.
 - 1. Arrange stub-ups so curved portions of bends are not visible above grade. Increase burial depth where required to maintain cover for curves and bends.
 - 2. Do not use steel raceways for equipment stub-ups where prohibited by utility company standards.
- D. Minimum Underground Raceway Size: 1-inch trade size unless noted otherwise on the drawings.

3.3 EARTHWORK

- A. Contractor shall accept the site as they find it and remove all trash, rubbish, and material from the site prior to starting excavation work.
- B. Subsurface Data
 - Subsurface investigations have been performed and the results provided with the contract documents. The information was obtained primarily for use in preparing foundation design. Each contractor may draw their own conclusions therefrom. No responsibility is assumed by the Owner for subsoil quality or conditions other than at the locations and at the time the investigations were made.
 - Materials to be excavated shall be unclassified, and shall include earth, rock, or any other material
 encountered in the excavation to the depth and extent indicated on the drawings and specified
 herein. No adjustment in the contract sum will be made on account of the presence or absence of
 rock, shale, or other materials encountered in excavating.
- C. Benchmarks and Monuments

1. Carefully maintain all benchmarks, monuments, and other reference points. If disturbed or destroyed, replace as directed.

D. Excavation:

- 1. Remove rock by using hand or power tools only. Blasting is not permitted unless authorized in writing by the Architect.
- 2. Any damage to existing structures, exterior services, or rock intended for bearing shall be corrected by the Contractor at their own expense.
- Take necessary precautions to control runoff of eroded earth onto the property of others or against
 the structures. All such damage or any other damage incurred in the course of excavation, shall be
 corrected by the Contractor at their own expense.

E. Trenching:

- 1. Cut trenches neatly and uniformly. Work with extreme care near existing ducts, conduits, and other utilities to avoid damaging them.
- 2. Width: Excavate trench a minimum of 3 inches wider than duct bank on each side with a minimum trench width of 12-inches.
- 3. Depth: Excavate to a minimum depth that equals ductbank height plus minimum cover requirements.
- Hand excavate trench bottom to provide uniform bearing and support of conduits on an undisturbed subgrade matching slope requirement. Remove all debris, stones, and other projections.
 - a. For rock or other unyielding soils, excavate trenches 6-inches deeper than required elevation and provide level 6-inch compacted sand bedding course.
 - b. For unstable soils or where bedding course is subject to washout, provide concrete trench bottom.
- 5. Keep trenches free from water while construction is in progress. Installation of conduit or cable in trenches with water is not permitted. Contractor is responsible for all costs associated with dewatering of trenches.
- F. Final Backfill: Comply with Division 31 and as indicated below:
 - 1. Use satisfactory soil to backfill trenches to final subgrade elevation unless required otherwise by Civil or Structural subgrade requirements.
 - 2. Install final backfill in 6-inch layers.
 - 3. Compact all backfill to 95% standard proctor density.
 - 4. Mechanical means for compaction can be used once conduits have been covered with at least 12-inches of hand tamped backfill. Do not use heavy-duty, hydraulic-operated, compaction equipment.

G. Restoration:

- 1. Replace area immediately after backfilling is completed or after construction in immediate area is complete.
- 2. Restore all surface features at areas disturbed by excavation, storing of dirt, cable laying, and other work, and re-establish original grades unless otherwise indicated.
- 3. Restore vegetation and include 6-inches of clean topsoil, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Division 32.

H. Cut and patch existing pavement in the path of underground ducts and utility structures according to the "Cutting and Patching" requirements in Division 01 and Section 26 0010, "General Requirements for Electrical".

3.4 DUCT INSTALLATION

- A. Install ducts, spacers, and accessories into ductbank configurations to accommodate duct quantities and sizes indicated on drawings.
- B. Install ducts according to NEMA TCB 2.
- C. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes, to drain in both directions. Install ducts in such a manner to avoid traps and insure against collection of moisture.
- D. Curves and Bends:
 - 1. Use 5-degree angle couplings for small changes in direction.
 - 2. Use manufactured long sweep bends with a minimum radius of 36 inches vertically and 60-inches horizontally, unless otherwise indicated.
 - 3. Field manufactured bends are acceptable for a bend radius greater than 35-feet. Install field bends in accordance with NEMA TCB 2.
 - 4. Electrical duct and duct banks: Install no more than the equivalent of three 90-degree bends in any conduit run.
 - 5. Communications duct and duct banks: Install no more than the equivalent of two 90-degree bends in any conduit run and a maximum of 600 feet between pull points.
- E. Joints: Use solvent-cemented joints in non-metallic ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same horizontal or vertical plane to ensure encasement or backfill fully surrounds each raceway.
- F. Installation Adjacent to High-Temperature Steam Lines: Where duct banks are installed parallel to underground steam lines, provide minimum 6-foot separation or perform calculations showing the duct bank will not be subject to environmental temperatures above 40 deg C. Where environmental temperatures are calculated to rise above 40 deg C, and anywhere the duct bank crosses above an underground steam line, install insulation blankets listed for direct burial to isolate the duct bank from the steam line.
- G. Installation Adjacent to Other Utilities:
 - 1. Provide minimum 12-inches of earth or 3-inches of concrete between power and communications ducts.
 - 2. Provide minimum 24-inches of earth between power or communications ducts and other parallel utilities. At utility crossings, provide minimum 6-inches of separation except provide 12-inches separation where crossing utility is gas or other line that transports flammable material.
 - 3. Do not locate power and communications ducts below water and sewer lines.
- H. Duct Entrances to Manholes and Concrete Handholes: Use end bells, spaced approximately 10 inches o.c. for 5-inch ducts, and vary proportionately for other duct sizes.

- 1. Begin change from regular spacing to end-bell spacing 10 feet (3 m) from the end bell without reducing duct line slope and without forming a trap in the line.
- 2. Direct-Buried Duct Banks: Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to manhole or handhole. Install an expansion fitting near the center of all straight line direct-buried duct banks with calculated expansion of more than 3/4 inch (19 mm).
- 3. Grout end bells into structure walls from both sides to provide watertight entrances.
- I. Building Penetrations: Make a transition from underground duct to GRC at least 10 feet outside the building wall, without reducing duct line slope away from the building and without forming a trap in the line. Use fittings manufactured for RNC-to-GRC transition. Provide sleeves at building penetration and make water-tight with sleeve seal.

J. Duct Support

- 1. For concrete encased applications, support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
- 2. Separator Installation: Space separators at a maximum of 5-feet to prevent sagging and deforming of ducts. Place spacers within 24-inches of duct ends. Stagger separators approximately 6 inches between tiers.
- 3. Minimum Space between Ducts: 3 inches between ducts and between ducts and exterior envelope wall.

K. Concrete-Encased Ducts:

- 1. Secure separators to earth and to ducts to prevent floating during encasement. Tie entire assembly together using non-ferrous tie-wires or straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
- Reinforcement: Where indicated, reinforce concrete-encased duct banks for their entire length.
 Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
- 3. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
- 4. Concrete Cover: Install a minimum of 3 inches of concrete cover between edge of duct and exterior envelope wall.
- 5. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
 - a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations or use other specific measures to prevent expansion-contraction damage.
 - b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing-rod dowels extending a minimum of 18 inches into concrete on both sides of joint near corners of envelope.

6. Concrete Encasement:

- a. Use normal strength concrete, minimum 3000 psi at 28 days, 6-to-8-inch slump, with maximum 1/2 inch aggregate.
- Comply with requirements in "Concrete Placement" Article in Division 03. Place concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope.

- c. Do not allow a heavy mass of concrete to fall directly onto ducts. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces.
- d. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.
- 7. Complete final backfilling after concrete has cured.

L. Direct-Buried Duct Banks:

- 1. Set elevation of bottom of duct bank below frost line.
- 2. After installing first tier of ducts, install initial backfill and compact.
- 3. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process.
- 4. Perform initial backfilling/encasement in 2-inch lifts. Compact to 95% standard proctor density.
- 5. Repeat procedure after placing each tier. After placing last tier, hand place backfill to 4 inches over ducts and hand tamp.
- 6. Firmly tamp initial backfill around ducts to provide maximum supporting strength. Use hand tamper only.
- 7. After placing initial backfill over final tier, make final duct connections at end of run and complete backfilling.
- 8. Initial backfill/encasement material shall be crushed stone, sand, or pea gravel with a maximum aggregate size of 1/2-inch.
- M. Warning Tape: Bury warning tape approximately 12 inches above all ducts. Align tape parallel to and within 3 inches of centerline of duct bank. Provide an additional warning tape for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional tapes 12 inches apart, horizontally.
- N. Install pull tape in all spare ducts with 3ft of slack tied off and secured at each pull point.

O. Duct Sealing:

- 1. Provide temporary plugs of all ducts upon completion of each portion of work to prevent ingress of foreign material into the duct.
- 2. After conductors have been installed seal all ducts, including spare ducts, at building entrances and equipment terminations. Use sealing compound and foam plugs capable of withstanding at least 15-psig hydrostatic pressure.

3.5 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

- A. Install hand-holes and boxes level and plumb and with orientation and depth coordinated with connecting ducts, to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of ducts, and seal joint between box and extension as recommended by manufacturer.
- B. Unless otherwise indicated, support units on a12-inch thick level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas and trafficways, set cover flush with finished grade. Set covers of other handholes 1 inch above finished grade. Install handholes and boxes with bottom below frost line.

- D. Field cut openings for ducts and conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.
- E. For enclosures installed in asphalt paving, form and pour a concrete ring encircling, and in contact with, enclosure and with top surface screeded to top of box cover frame. Bottom of ring shall rest on compacted earth.
 - 1. Concrete: 3000 psi, 28-day strength, complying with Division 03, with a troweled finish.
 - 2. Dimensions: minimum 10 inches wide and 12 inches deep or as shown on drawings.

3.6 GROUNDING

- A. Comply with Section 26 0526 "Grounding and Bonding for Electrical Systems".
 - 1. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide #1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, non-shrink grout.
 - 2. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with #4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

3.7 IDENTIFICATION

- A. Comply with Section 26 0553 "Identification for Electrical Systems"
 - 1. Where ducts transition through manholes or handholes, and at each termination point, provide each duct with a unique identifier to indicate origination point.
 - 2. Cover legends shall be consistent with the owner's standard practices, especially within existing facilities, unless otherwise require by codes.

3.8 FIELD QUALITY CONTROL

- A. Prior to covering duct or underground structures, perform visual inspections to verify the following:
 - 1. Proper installation depths and slopes have been maintained.
 - 2. Proper vertical and horizontal spacing in multi-duct formations.

PROJECT NO. 24-179.000 UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS Harrison REMC - Addition and Renovation 26 0543 - 13 Harrison REMC 04/24/2025

- 3. All conduit sections have been properly jointed.
- 4. Proper bend radius of curved sections have been maintained.
- 5. Check for damage at changes in grades or at bends.
- B. Perform the following tests and inspections and prepare test reports:
 - 1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
 - 2. Pull solid aluminum or wood test mandrel through duct to prove joint integrity and adequate bend radii, and test for duct deflections or out of round conditions. Provide a minimum 6-inch- long mandrel 1/2-inch smaller in diameter than diameter of duct. If obstructions are discovered, remove obstructions and retest.
 - Test manhole grounding to ensure electrical continuity of grounding and bonding connections.
 Measure and report ground resistance as specified in Section 26 0526 "Grounding and Bonding for Electrical Systems."
- C. Correct deficiencies, replace affected duct sections, and retest as specified above to demonstrate compliance.
- D. Prepare detailed test and inspection reports with accompanying digital photographs.
- E. Concealed Work Photographs: Before proceeding with installing backfill that will conceal work, take photographs sufficient in number, with annotated descriptions, to record nature and location of concealed Work.

3.9 CLEANING

- A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of all ducts until duct cleaner indicates that duct is clear of dirt and debris. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.
- B. Clean internal surfaces of manholes and handholes, including sump. Remove dirt and foreign material.

END OF SECTION 26 0543

SECTION 26 0548 - SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 Specification Sections, and Section 26 0010 "General Requirements for Electrical Systems" apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - Seismic restraint bracing
 - 2. Seismic restraint accessories
- B. Related Requirements:
 - 1. Refer to Section 26 0500 "Common Work Results for Electrical Systems" for commonly used electrical supports and installation requirements.

1.3 REFERENCES

- A. Abbreviations and Acronyms
- B. Definitions
 - 1. Designated Seismic System: An electrical component that requires design in accordance with ASCE 7, Ch. 13 and for which the Component Importance Factor is greater than 1.00.
 - 2. Seismic Restraint: A fixed device (a seismic brace, an anchor bolt or stud, or a fastening assembly) used to prevent vertical or horizontal movement, or both vertical and horizontal movement, of an electrical system component during an earthquake.
- C. Reference Standards: The following publications are referred to in the text by the basic designation only. The edition/revision of the referenced publications shall be the latest version as of the date of the Contract Documents, unless otherwise specified.
 - 1. American Society of Civil Engineers (ASCE)
 - a. ASCE/SEI 7, Minimum Design Loads and Associated Criteria for Buildings and Other Structures
 - 2. Federal Emergency Management Agency (FEMA)
 - a. FEMA 413, Installing Seismic Restraints for Electrical Equipment

1.4 SUBMITTALS

- A. Product Data: Submit for each type of product specified.
- B. Delegated Design Submittals: For each seismic restraint device.
 - Include design calculations and details for selecting seismic restraints complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 2. Design Calculations: Calculate static and dynamic loading caused by equipment weight, operation, and seismic forces required to select seismic restraints and for designing vibration isolation bases.
 - 3. Seismic Restraint Details:
 - Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
 - 4. Coordinate seismic-restraint and vibration isolation details and calculations with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
- C. Qualification Data: For professional engineer and testing agency.
- D. Field quality-control reports.
- E. Closeout Submittals
 - 1. Maintenance Contract
 - 2. Operation and Maintenance Data
 - 3. Warranty Documentation
 - 4. Record Documentation
 - 5. Sustainable Design Closeout Documentation

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated and that is acceptable to authorities having jurisdiction.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code Steel."

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. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- C. Comply with NFPA 70.
- D. Seismic-Restraint Loading:
 - 1. Site Class as Defined in the IBC: C.
 - 2. Assigned Seismic Use Group or Building Category as Defined in the IBC: IV.
 - a. Component Importance Factor: 1.5.
 - b. Component Response Modification Factor: 3.0.
 - c. Component Amplification Factor: 3.0.
 - 3. Design Spectral Response Acceleration at Short Periods (0.2 Second): 0.282.
 - 4. Design Spectral Response Acceleration at 1.0-Second Period: 0.131.

2.2 SEISMIC RESTRAINT BRACINGS

- A. Manufacturers: Subject to compliance with requirements.
- B. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end, with other matching components, and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.3 SEISMIC RESTRAINT ACCESSORIES

- A. Hanger-Rod Stiffener: [Steel tube or steel slotted-support-system sleeve with internally bolted connections] [Reinforcing steel angle clamped] to hanger rod.
- B. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to bracings.
- C. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings and matched to type and size of anchor bolts and studs.
- D. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings and matched to type and size of attachment devices used.

E. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

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

3.3 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.
- B. Equipment and Hanger Restraints:
 - 1. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
 - 2. Install seismic-restraint devices using methods approved by [an evaluation service member of ICC-ES] [OSHPD] [an agency acceptable to authorities having jurisdiction] providing required submittals for component.
- C. Install restraints so they do not bend across edges of adjacent equipment or building structure.
- D. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS 26 0548 - 5 04/24/2025

E. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

F. Drilled-in Anchors:

- 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
- 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
- 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
- 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
- 5. Set anchors to manufacturer's recommended torque using a torque wrench.
- 6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where connection is terminated to equipment that is anchored to a different structural element from the one supporting them as they approach equipment

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: [Owner will engage] [Engage] a qualified testing agency to perform tests and inspections.
- B. Perform the following tests and inspections [with the assistance of a factory-authorized service representative]:
 - 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 - 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
 - 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
 - 4. Test at least [four] < Insert number > of each type and size of installed anchors and fasteners selected by Architect.
 - 5. Test to 90 percent of rated proof load of device.
- C. Seismic controls will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 26 0548

SECTION 26 0553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General, Special and Supplementary Conditions, Division 01 Specification Sections, and Section 26 0010 "General Requirements for Electrical Systems" apply to this Section.

1.2 SUMMARY

A. Section Includes:

- 1. Equipment Nameplates.
- 2. Cable and Conductor Labels.
- 3. Wiring Device Labels
- 4. Safety Labels.
- 5. Instruction Signs.
- 6. Miscellaneous identification products.

B. Related Requirements

- 1. Refer to Section 26 0573, "Power System Studies" for additional requirements related to fault current and arc flash labeling.
- 2. Refer to Section 27 0553, "Identification for Communications Systems" for additional requirements related to labeling of communications equipment and cabling.

1.3 REFERENCES

A. Abbreviations

B. Definitions

- 1. Emergency Systems: Those systems legally required and classed as emergency by NFPA 70 Article 700, municipal, state, other codes, or by any government agency having jurisdiction.
- 2. Essential Electrical Systems: Those systems designed to ensure continuity of electrical power to designated areas and functions of a healthcare facility during disruption of normal power sources, and to minimize disruption within the internal wiring system.
- C. Reference Standards: The following publications are referred to in the text by the basic designation only. The edition/revision of the referenced publications shall be the latest version as of the date of the Contract Documents, unless otherwise specified.
 - 1. American National Standards Institute (ANSI)
 - a. ANSI Z535.4, "Product Safety Signs and Labels"

- 2. National Fire Protection Association (NFPA)
 - a. NFPA 70E, "Standard for Electrical Safety in the Workplace"
- 3. Occupational Safety and Health Administration (OSHA)
 - a. 29 CFR 1910.144, "Safety color code for marking physical hazards"
 - b. 29 CFR 1910.145, "Specifications for accident prevention signs and tags"
- 4. Underwriters Laboratories Inc (UL)
 - a. UL 969, "Marking and Labeling Systems"

1.4 SUBMITTALS

- A. Product Data: For each electrical identification product indicated.
 - 1. Include project specific examples of each label type.
- B. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.
- C. Closeout Submittal:
 - 1. In addition to items specified in Division 01 and Section 26 0010 "General Requirements for Electrical Systems", include the following:
 - a. Provide electronic Excel files of all panelboard directories to owner as part of Close-out Documentation.

1.5 COORDINATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes and standards. Use consistent designations throughout Project.
- B. All identifications shall be consistent with the owner's standard practices, especially within existing facilities, unless otherwise require by codes. Where the requirements herein are in conflict, the contractor shall notify the engineer in writing prior to ordering any material.
- C. All room names and/or numbers for labeling or programming shall use the Owner's approved room name and numbering scheme, not names and numbers indicated on floor plans. All reprogramming shall be included as required to accommodate construction phasing.
- D. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- E. Coordinate installation of identifying devices with location of access panels and doors.
- F. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT SIGNS AND NAMEPLATES

- A. Engraved Plastic Signs and Nameplates.
 - 1. 3-layer melamine plastic laminate
 - 2. Weather and UV-resistant for Wet and Damp Locations.
 - Thickness:
 - a. For signs up to 20 sq. in., minimum 1/16 inchthick.
 - b. For signs larger than 20 sq. in. or 8 inchesin length, 1/8 inchthick.
 - c. Punched or drilled for mechanical fasteners with 1/4-inch grommets in corners for mounting.
 - d. Framed with mitered melamine molding and arranged for attachment at applicable equipment.
 - 4. Color: Comply with color legend.

2.2 RACEWAY AND CONDUCTOR LABELS

- A. Raceway Labels: Pre-printed, self-adhesive, polyester, suitable for indoor or outdoor use, resistant to abrasion, humidity, and weather.
 - 1. Color: Black Letters on an orange field.
 - 2. Size: For each raceway size, comply with ANSI/ASME A13.1 for recommended letter height and field length.
- B. Wire and Cable Labels: Machine printed, self-adhesive, polyester, self-laminating, suitable for indoor or outdoor use on flexible cables, resistant to abrasion, humidity, and weather.

2.3 SAFETY SIGNS AND LABELS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. All field-applied hazard markings shall warn of hazards using effective words, colors, symbols, or any combination thereof as recommended by ANSI Z535.4-2011. This applies to all instances where caution, warning, or danger signs are required per the NEC and applicable OSHA standards.
- C. Self-Adhesive Safety Labels: Polyester, Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for intended use and suitable for installed environment.
- D. Provide UV overlaminating film for outdoor locations.

2.4 INSTRUCTION SIGNS

A. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.

B. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

2.5 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Floor Marking Tape: 2-inch wide, 5-mil pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.
- B. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select paint system suitable for surface material and location (exterior or interior).
- C. Fasteners for Labels and Signs:
 - 1. Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.
 - 2. Pop-Rivets.
 - 3. Two-Part Epoxy Adhesive
- D. Cable Ties: Self-extinguishing, one-piece, self-locking, UV-stabilized or plenum rated where required by installed environmental conditions. 3/16-inch minimum width.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Verify identity of each item before installing identification products.
- B. Before installation of labels, clean all surfaces using materials and methods recommended by manufacturer of identification device.
- C. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- D. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- E. Install all labels in a neat manner, plumb and parallel to equipment lines.
- F. Attach plastic signs and labels to equipment with mechanical fasteners appropriate to the location and substrate. Where screws cannot or should not penetrate substrate use two-part epoxy adhesive listed for use with intended substrate and environmental conditions.
- G. Handwritten, non-permanent, or stenciled labels are not permitted unless noted otherwise.
- H. For surfaces that require finish work, apply identification devices to surfaces after completing finish work.
- I. Identification shall consist of all UPPER-CASE LETTERS.

IDENTIFICATION FOR ELECTRICAL SYSTEMS 26 0553 - 5 04/24/2025

J. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.

3.2 EQUIPMENT IDENTIFICATION

- A. Provide all new and modified equipment with a nameplate consisting of 1/2" letters for equipment designation and 1/4" letters for voltage, source, and feeder information. This includes but is not limited to panelboards, switchboards, switchgear, disconnect switches, transformers, power transfer equipment, generators, motor starters, variable frequency drives, lighting control panels, contactors, cabinets, push button stations, and auxiliary system control panels.
- B. Distribution equipment labels shall indicate the following:
 - 1. Equipment designation.
 - Voltage system.
 - 3. Equipment ampacity.
 - 4. Source equipment designation and location.
 - Feeder size.
- C. Transformer labels shall indicate the following:
 - 1. Equipment designation.
 - 2. Primary voltage system and primary feeder ampacity.
 - 3. Source equipment designation and location.
 - 4. Primary feeder size.
 - 5. Secondary voltage system and load equipment designation
- D. Equipment disconnect labels shall indicate the following:
 - 1. Equipment designation.
 - 2. Voltage system and feeder ampacity
 - 3. Source equipment designation and location.
- E. Locate equipment nameplates at center of top of trim for branch circuit panels, switchgear, and centered at side for branch circuit switches.
- F. Where equipment is provided with a factory installed disconnecting means or motor controller, install label on factory provided unit.
- G. For equipment with multiple power sources, such as transfer switches and control panels, identify each source and its function.
- H. Color Legend
 - 1. Normal Power Systems: Black field with white letters
 - 2. Emergency Power Systems (As defined by NEC Article 700): Red field with white letters.
- I. Where electrical distribution equipment, including panelboards, switchboards, and switchgear, are connected to an emergency source, the nameplate shall incorporate the word "EMERGENCY" into the legend. In health care applications, the NEC designated branch of the essential electrical system (life

safety, critical or equipment branch) shall also be incorporated into the legend, all in 1/4" letters. Refer to drawings for further details.

- J. Where the premise wiring system has feeders and/or branch circuits supplied from more than one nominal voltage system, provide sign at each switchgear, switchboard, and panelboard displaying color coded identification method for each ungrounded, grounded, and equipment grounding conductor.
- K. Service Equipment and Building Feeder, Branch Circuit Disconnects.
 - 1. Provide label for service disconnecting means to permanently identify it as the "SERVICE DISCONNECT".
 - 2. Where a building or structure has any combination of feeders, branch circuits, or services passing through it or supplying it, provide a permanent sign at each disconnect location identifying all other feeders, branch circuits, or services and the area served by each.

3.3 IDENTIFICATION OF CONDUCTORS

- A. Service, Feeder, and Branch-Circuit Conductors: Refer to Section 26 0519, "Low Voltage Electrical Power Conductors and Cables" for conductor and cable color coding requirements.
- B. Indicate source and circuit number of conductors to be extended in the future.
- C. Auxiliary Systems Alarm, Signal, and Control Wire Identification: At termination points, identify each conductor by its system, designation, and function.

3.4 IDENTIFICATION OF RACEWAYS AND BOXES

- A. Identify all junction, outlet, device, and pull boxes with wiring system, voltage, and circuit designations of conductors.
 - 1. In concealed locations above accessible ceilings and in exposed unfinished areas such as data, mechanical, or electrical rooms, provide designations on outside of box covers.
 - 2. For exposed boxes in finished areas, provide designations on inside of box covers.
 - 3. System Legend shall be as follows:
 - a. Power
 - b. Emergency
 - c. UPS
- B. The inside of all junction and backboxes shall be marked with panel and circuit number in permanent marker.
- C. For Essential Electrical Systems, all junction boxes utilized for life-safety branch emergency power circuits, connections, devices, etc. shall have the cover painted blue. Mark over paint with panel and circuit number.
- D. All empty conduit runs and conduit with conductors for future use shall be identified for use and shall indicate where they terminate.

3.5 IDENTIFICATION OF WIRING DEVICES

- A. All new and existing receptacle cover plates in area of work shall be marked with their panel and circuit number(s) with clear, machine printed adhesive labels with black lettering.
- B. All essential electrical system device cover plates in patient care areas shall be permanently engraved with panel and circuit number(s). All device cover plates which are not engraved shall be marked with their panel and circuit number with clear, machine printed adhesive labels with black lettering.

3.6 PANELBOARD CIRCUIT DIRECTORIES

- A. For Distribution Panelboards, Switchboards, and Switchgear, provide nameplates at each switch or circuit breaker to indicate load designation.
- B. Provide clearly legible typewritten directories in each electrical panel indicating the area, item of equipment, etc. controlled by each switch, breaker, fuse, etc. These directories are to be inserted into plastic cardholders on back door in each panel. Descriptions shall identify each circuit as to its clear, evident, and specific purpose or use. The identification shall include an approved degree of detail that allows each circuit to be distinguished from all others. Spaces and Spare positions shall be described accordingly.
 - 1. At a minimum, provide the following panel information for each panel directory:
 - a. Panel name
 - b. Panel bus rating
 - c. Voltage System
 - d. Mains Configuration and Rating
 - e. Short Circuit Current Rating
 - 2. Circuit Designation Examples:
 - a. LIGHTS, ROOM 100
 - b. FLOOR RECEPTACLES, ROOM 200
 - c. ERV-1 RECEPTACLE. ROOF
- C. Panel Schedules and circuit numbers on Record Drawings shall match.

3.7 SAFETY SIGNS

- A. Install Warning, Caution, and Danger signs in accordance with NFPA 70 and OSHA requirements to ensure safe operation of electrical equipment and the items to which they connect.
- B. Comply with 29 CFR 1910.145 and ANSI Z535.4.
- C. Apply to exterior of door, cover, or other access point.
- D. Labels and signs shall include, but are not limited to, the following legends:
 - 1. Identify system voltage with black letters on an orange background.
 - 2. Multiple Power Source Warning: "DANGER ELECTRICAL SHOCK HAZARD EQUIPMENT HAS MULTIPLE POWER SOURCES."

PROJECT NO. 24-179.000 Harrison REMC - Addition and Renovation Harrison REMC

IDENTIFICATION FOR ELECTRICAL SYSTEMS 26 0553 - 8 04/24/2025

- 3. Workspace Clearance Warning: "WARNING OSHA REGULATION AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES"
- 4. Where series combination ratings are allowed: "CAUTION SERIES COMBINATION SYSTEM RATED ____ AMPERES. IDENTIFIED REPLACEMENT COMPONENTS REQUIRED."

3.8 INSTRUCTION SIGNS

A. Operating Instruction Signs: Install instruction signs with minimum 3/8-inch letters to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation, power transfer, and load shedding.

3.9 WORKSPACE INDICATION

A. Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install flush-mounted panelboards and similar equipment in finished spaces.

END OF SECTION 26 0553

SECTION 26 0573 - POWER SYSTEM STUDIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General, Special and Supplementary Conditions, Division 01 Specification Sections, and Section 26 0010 "General Requirements for Electrical Systems" apply to this Section.

1.2 SUMMARY

- A. Section includes the following computer-based studies:
 - 1. Fault-current study to determine the minimum interrupting capacity of circuit protective devices.
 - 2. Overcurrent protective device coordination studies to determine overcurrent protective devices and to determine overcurrent protective device settings for selective tripping.
 - 3. Arc-flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.

B. Related Requirements

1. Refer to Section 26 0553, "Identification for Electrical Systems" for label material and performance requirements.

1.3 REFERENCES

A. Abbreviations

1. SCCR: Short-circuit current rating.

B. Definitions

- 1. Emergency Electrical Systems: Those systems legally required and classed as emergency by NFPA 70 Article 700, municipal, state, other codes, or by any government agency having jurisdiction.
- Essential Electrical Systems: Those systems designed to ensure continuity of electrical power to designated areas and functions of a healthcare facility during disruption of normal power sources, and to minimize disruption within the internal wiring system as defined by NFPA 70 Article 517 and NFPA 99.
- 3. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed and salvaged, or removed and reinstalled. Existing to remain items shall remain functional throughout the construction period.
- 4. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- 5. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.
- 6. Power Systems Analysis Specialist: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located.

- 7. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion of the circuit from the system.
- 8. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.
- 9. Single-Line Diagram: See "One-Line Diagram."
- C. Reference Standards: The following publications are referred to in the text by the basic designation only. The edition/revision of the referenced publications shall be the latest version as of the date of the Contract Documents, unless otherwise specified.
 - 1. Institute of Electrical and Electronics Engineers (IEEE)
 - IEEE 141 Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems
 - b. IEEE 241 Recommended Practice for Electric Power Systems in Commercial Buildings
 - c. IEEE 242 Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
 - d. IEEE 399 Recommended Practice for Industrial and Commercial Power System Analysis
 - e. IEEE 551 Recommended Practice for Calculating AC Short-Circuit Currents in Industrial and Commercial Power Systems
 - f. IEEE 1015 Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems
 - g. IEEE 1584 Guide for Performing Arc-Flash Hazard Calculations
 - h. IEEE 3002.3 IEEE Recommended Practice for Conducting Short-Circuit Studies and Analysis of Industrial and Commercial Power Systems
 - 2. American National Standards Institute (ANSI)
 - ANSI C57.12.00 Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
 - b. ANSI C37.13 Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures
 - c. ANSI C37.010 Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis
 - d. ANSI C 37.41 Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories
 - 3. The National Fire Protection Association (NFPA)
 - a. NFPA 70E Standard for Electrical Safety in the Workplace

1.4 SEQUENCING

- A. The short-circuit and protective device coordination studies shall be submitted for review prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment drawings for manufacturing.
- B. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.

1.5 SUBMITTALS

- A. Product Data: For computer software program to be used for studies.
- B. Initial Study Report: The study shall provide sufficient data to ensure that selection of equipment and devices will have adequate ratings and the protective device trip characteristics will be satisfactory. Include the following:
 - 1. Study input data, including completed computer program input data sheets including assumptions on worst case project conditions.
 - 2. Study and equipment evaluation report; signed, dated, and sealed by a qualified professional engineer.
- C. Final Study and Report: Submit final study at the end of the construction when all circuits are installed and all equipment is on site and installed such that complete and accurate data can be obtained.

D. Closeout Submittals

- 1. In addition to items specified in Division 01 and Section 26 0010 "General Requirements for Electrical Systems", include the following:
 - Provide five (5) bound copies of the complete final report. Additional copies shall be provided on CD or USB in PDF format.
 - b. Certification Document to confirm system settings have been implemented.
 - c. Provide the study project files in electronic format including all project files and libraries to allow the owner to update and print additional copies, labels, etc. This includes copies of the actual models from the power system analysis software and all associated files required to support the model(s).

1.6 QUALITY ASSURANCE

- A. Study shall be performed using commercially developed and distributed software designed specifically for power system analysis.
- B. Software algorithms shall comply with requirements of standards and guides specified in this Section.
- C. Manual calculations are not acceptable.
- D. Power Systems Analysis Specialist Qualifications: Professional engineer licensed in the state where Project is located and skilled in performing and interpreting the power system studies. All elements of the study shall be performed under the direct supervision and control of this professional engineer.
 - 1. Engineer shall be a full-time employee of the electrical equipment manufacturer.
 - 2. The engineer shall have a minimum of five (5) years' experience performing power system studies.
- E. Power System Study Certification: Report shall be signed and sealed by Power Systems Analysis Specialist.
- F. Field Adjusting Personnel Qualifications:
 - 1. Technician shall be a full-time employee of the electrical equipment manufacturer.
 - 2. Technician responsible for all field adjusting of the Work shall have a minimum NICET Electrical Power Testing Level III certification or equivalent.

PART 2 - PRODUCTS

2.1 POWER SYSTEM ANALYSIS SOFTWARE

- A. Perform studies using the latest version of one of the following:
 - Power Tools for Windows by SKM Systems Analysts.
 - 2. ETAP by Operation Technology, Inc.
 - 3. EasyPower by Easypower, LLC
- B. Comply with IEEE 242, IEEE 399, IEEE 551, IEEE 1584, IEEE 3002.3, and NFPA 70E.
- C. Analytical features of power systems analysis software program shall have capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- D. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.

2.2 POWER SYSTEM STUDY REPORT CONTENTS

- A. Executive summary of study findings.
- B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.
- C. One-line diagram of modeled power system, showing the following:
 - 1. Protective device designations and ampere ratings.
 - 2. Conductor types, sizes, and lengths.
 - 3. Transformer kilovolt ampere (kVA) and voltage ratings.
 - 4. Motor and generator designations and kVA ratings.
 - 5. Switchgear, switchboard, motor-control center, and panelboard designations and ratings.
 - 6. Derating factors and environmental conditions.
 - 7. Any revisions to electrical equipment required by the study.

D. Study Input Data

- 1. Available Power source data.
- 2. Manufacturer, model, and interrupting rating of protective devices.
- 3. Conductors.
- 4. Transformer data.
- E. Comments and recommendations for system improvements or revisions in a written document, separate from one-line diagram.

F. Protective Device Evaluation:

- 1. Evaluate equipment and protective devices and compare to available short-circuit currents. Verify that equipment SCCR ratings exceed available short-circuit current at equipment installation locations.
- 2. Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties
- 3. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
- 4. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in standards to 1/2-cycle symmetrical fault current.
- Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy
 of equipment grounding conductors and grounding electrode conductors at maximum ground-fault
 currents. Ensure that SCCR ratings are equal to or higher than calculated 1/2-cycle symmetrical fault
 current.

G. Short-Circuit Study Output Reports:

- 1. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
 - a. Voltage.
 - b. Calculated fault-current magnitude and angle.
 - c. Fault-point X/R ratio.
 - d. Equivalent impedance.
- 2. Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
 - a. Voltage.
 - b. Calculated symmetrical fault-current magnitude and angle.
 - c. Fault-point X/R ratio.
 - d. Calculated asymmetrical fault currents:
 - 1) Based on fault-point X/R ratio.
 - 2) Based on calculated symmetrical value multiplied by 1.6.
 - 3) Based on calculated symmetrical value multiplied by 2.7.
- 3. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
 - a. Voltage.
 - b. Calculated symmetrical fault-current magnitude and angle.
 - c. Fault-point X/R ratio.
 - d. No AC Decrement (NACD) ratio.
 - e. Equivalent impedance.
 - f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
 - g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

- H. Protective Device Coordination Study:
 - 1. Report recommended settings of protective devices, ready to be applied in the field. Use manufacturer's data sheets for recording the recommended setting of overcurrent protective devices when available.
 - a. Phase and Ground Relays:
 - 1) Device tag.
 - 2) Relay current transformer ratio and tap, time dial, and instantaneous pickup value.
 - 3) Recommendations on improved relaying systems, if applicable.
 - b. Circuit Breakers:
 - 1) Adjustable pickups and time delays (long time, short time, and ground).
 - 2) Adjustable time-current characteristic.
 - 3) Adjustable instantaneous pickup.
 - 4) Recommendations on improved trip systems, if applicable.
 - 2. Fuses: Show current rating, voltage, and class.
- I. Time-Current Coordination Curves: Determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:
 - 1. Device tag and title, one-line diagram with legend identifying the portion of the system covered.
 - 2. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
 - 3. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
 - 4. Plot the following listed characteristic curves, as applicable:
 - a. Power utility's overcurrent protective device.
 - b. Medium-voltage equipment overcurrent relays.
 - c. Medium- and low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
 - d. Low-voltage equipment circuit-breaker trip devices, including manufacturer's tolerance
 - e. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.
 - f. Cables and conductors damage curves.
 - g. Ground-fault protective devices.
 - h. Motor-starting characteristics and motor damage points.
 - i. Generator short-circuit decrement curve and generator damage point.
 - j. The largest feeder circuit breaker in each motor-control center and panelboard.
 - 5. Maintain selectivity for tripping currents caused by overloads.
 - 6. Maintain maximum achievable selectivity for tripping currents caused by overloads on series-rated devices.

- 7. Provide adequate time margins between device characteristics such that selective operation is achieved.
- 8. Comments and recommendations for system improvements.
- J. Arc-Flash Study Output Reports:
 - 1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each equipment location included in the report:
 - a. Voltage.
 - b. Calculated symmetrical fault-current magnitude and angle.
 - c. Fault-point X/R ratio.
 - d. No AC Decrement (NACD) ratio.
 - e. Equivalent impedance.
 - f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
 - g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.
- K. Incident Energy and Flash Protection Boundary Calculations:
 - 1. Arcing fault magnitude.
 - 2. Protective device clearing time.
 - 3. Duration of arc.
 - 4. Arc-flash boundary.
 - 5. Restricted approach boundary.
 - 6. Limited approach boundary.
 - 7. Working distance.
 - 8. Incident energy.
 - 9. Hazard risk category.
 - 10. Recommendations for arc-flash energy reduction.

2.3 ARC-FLASH WARNING AND AVAILABLE FAULT CURRENT LABELS

- A. Comply with requirements in Section 26 0553 "Identification for Electrical Systems" for self-adhesive equipment labels. Produce a 3.5-by-5-inchself-adhesive equipment label for each location indicated in the analysis unless noted otherwise.
- B. Arc Flash Warning Labels shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include all information required by NFPA 70E and the following information taken directly from the arc-flash hazard analysis:
 - 1. Location designation.
 - 2. Engineering report number, revision number, and issue date.
- C. Available Fault Current Labels shall have an orange header with the wording, "WARNING", and shall include the following information taken directly from the short circuit study.
 - 1. Location designation.
 - 2. Maximum available fault current.
 - 3. Calculation date.
 - 4. Engineering report number, revision number, and issue date.

D. Labels shall be machine printed, with no field-applied markings.

PART 3 - EXECUTION

3.1 POWER SYSTEM DATA

- A. Obtain all data necessary for conduct of the study.
 - 1. Verify completeness of data supplied on one-line diagram. Call any discrepancies to Engineer's attention.
 - 2. For equipment included as Work of this Project, use characteristics submitted under provisions of action submittals and information submittals for this Project.
 - 3. For relocated equipment and that which is existing to remain, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers. Qualifications of technicians and engineers shall be as defined by NFPA 70E.
- B. Electrical Survey Data: Gather and tabulate the required input data to support the short-circuit study. Comply with requirements in Section 01 7839 "Project Record Documents" for recording circuit protective device characteristics. Record data on a Record Document copy of one-line diagram. Comply with recommendations in IEEE 551 as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under direct supervision and control of the engineer in charge of performing the study. Data includes, but is not limited to, the following:
 - Product Data for Project's overcurrent protective devices involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
 - 2. Electrical power utility impedance and available short circuit current at the service.
 - 3. Power sources and ties.
 - 4. Short-circuit current at each system bus (three phase and line to ground).
 - 5. Full-load current of all loads.
 - 6. Voltage level at each bus.
 - 7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
 - 8. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
 - 9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.
 - 10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
 - 11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
 - 12. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
 - 13. Motor horsepower and NEMA MG 1 code letter designation.
 - 14. Conductor sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
 - 15. Derating factors.

- 16. Data sheets to supplement electrical distribution system one-line diagram, cross-referenced with tag numbers on diagram, showing the following:
 - a. Special load considerations, including starting inrush currents and frequent starting and stopping.
 - b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
 - c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
 - d. Generator thermal-damage curve.
 - e. Ratings, types, and settings of utility company's overcurrent protective devices.
 - f. Special overcurrent protective device settings or types stipulated by utility company.
 - g. Time-current-characteristic curves of devices indicated to be coordinated.
 - h. Manufacturer, frame size, interrupting rating in amperes root mean square (rms) symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
 - i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
 - j. Switchgear, switchboards, motor-control centers, and panelboards ampacity, and SCCR in amperes rms symmetrical.
 - k. Identify series-rated interrupting devices for a condition where the available fault current is greater than the interrupting rating of downstream equipment. Obtain device data details to allow verification that series application of these devices complies with NFPA 70 and UL 489 requirements.

3.2 POWER SYSTEMS STUDY

- A. Perform study following the general study procedures contained in IEEE 399.
- B. Base study on device characteristics supplied by device manufacturer.
- C. Gather all necessary data from the existing facility as needed to perform the study.
- D. The Contractor shall be responsible for modifying settings on existing equipment only at over-current protection devices upstream of new equipment unless noted otherwise.
- E. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.
- F. Include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and apply to low- and medium-voltage, three-phase ac systems. Also account for the fault-current dc decrement to address asymmetrical requirements of interrupting equipment.
- G. Identify in the report any protective device applied outside its capacity.
- H. Short Circuit Study
 - 1. Calculate short-circuit currents according to IEEE 551.

- 2. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and a single line-to-ground fault at each equipment indicated on one-line diagram.
 - a. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.
- 3. Evaluate equipment and protective devices and compare to short-circuit ratings.

I. Coordination Study

- 1. Comply with IEEE 242 for calculating short-circuit currents and determining coordination time intervals.
- 2. Transformer Primary Overcurrent Protective Devices:
 - a. Device shall not operate in response to the following:
 - 1) Inrush current when first energized.
 - 2) Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
 - 3) Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
 - b. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

3. Motor Protection:

- a. Select protection for low-voltage motors according to IEEE 242 and NFPA 70.
- b. Select protection for motors served at voltages more than 600 V according to IEEE 620.
- 4. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and protection recommendations in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.
- 5. Generator Protection: Select protection according to manufacturer's written instructions and to IEEE 242.

J. Arc Flash Hazard Analysis

- 1. Comply with NFPA 70E and its Annex D for hazard analysis study.
- 2. Preparatory Studies: Perform the Short-Circuit and Protective Device Coordination studies prior to starting the Arc-Flash Hazard Analysis.
- 3. Calculate maximum and minimum contributions of fault-current size.
 - a. Maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.
 - b. Calculate arc-flash energy at 85 percent of maximum short-circuit current according to IEEE 1584 recommendations.
- 4. Calculate the arc-flash protection boundary and incident energy at locations in electrical distribution system where personnel could perform work on energized parts.
- 5. Include medium- and low-voltage equipment locations, except equipment rated 240 V ac or less fed from transformers less than 125 kVA.
- 6. Calculate the limited and restricted approach boundaries for each location.

- 7. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:
 - a. Fault contribution from induction motors shall not be considered beyond three to five cycles.
 - b. Fault contribution from synchronous motors and generators shall be decayed to match the actual decrement of each as closely as possible (for example, contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).
- 8. Arc-flash energy shall generally be reported for the maximum of line or load side of a circuit breaker. However, arc-flash computation shall be performed and reported for both line and load side of a circuit breaker as follows:
 - a. When the circuit breaker is in a separate enclosure.
 - b. When the line terminals of the circuit breaker are separate from the work location.
- 9. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

3.3 LABELING

- A. All labels will be based on recommended overcurrent device settings and will be provided to owner after the results of the analysis have been presented and after any system changes, upgrades, or modifications have been incorporated in the system.
- B. Arc Flash Labeling:
 - Provide and install an arc-flash label for each piece of electrical equipment listed below and each piece of equipment that is likely to require examination, adjustment, servicing, or maintenance while energized:
 - a. Motor-control centers.
 - b. Switchboards.
 - c. Switchgears.
 - d. Meter Enclosures.
 - e. Medium voltage and low voltage transformers
 - f. Panelboards.
 - g. Equipment Control panels.
 - h. Motor Controllers.
 - i. Disconnect Switches.
 - 2. Apply arc-flash label on the front cover of each section of the equipment and on side or rear covers with accessible live parts and hinged doors or removable plates for each equipment included in the study. Base arc-flash label data on highest values calculated at each location.
- C. Available Fault Current Labeling
 - Provide and install an available fault current label for each piece of electrical equipment listed below:
 - a. Service equipment.
 - b. Elevator Control Panel.

- D. Install warning labels under the direction of the Power System Analysis Specialist.
- E. Provide new labels for any existing equipment to remain with updated values based on the results of the analysis.

3.4 FIELD ADJUSTING

- A. Adjust relay and protective device settings according to recommended settings provided by the coordination study. Field adjustments shall be completed by a qualified technician from the engineering service division of the equipment manufacturer.
- B. Make modifications to equipment as required to accomplish compliance with short-circuit and protective device coordination studies.
- C. Notify Architect and Engineer in writing of any required major modifications.
- D. Equipment shall not be energized until all breakers or protective relays are set either to the recommended values indicated by the studies or to minimum trip settings.
- E. Certification: Prior to project Substantial Completion, submit four signed copies of a document certifying that the settings and selection scope has been completed as specified.

3.5 DEMONSTRATION

- A. Acquaint personnel in fundamentals of operating the power system in normal and emergency modes.
- B. Hand-out and explain the power system study objectives, study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpreting time-current coordination curves.

END OF SECTION 26 0573

SECTION 26 0923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General, Special and Supplementary Conditions, Division 01 Specification Sections, and Section 26 0010 "General Requirements for Electrical Systems" apply to this Section.

1.2 SUMMARY

A. Description:

- 1. Section includes requirements for the provision of Lighting Controls including manufacturing, fabrication, configuration, and installation as required for the complete performance of the Work, as shown on the Drawings, as specified herein.
- 2. This work consists of providing all labor, materials, accessories, mounting hardware and equipment necessary for an operationally and aesthetically complete installation of all lighting controls.
- 3. Specifications and drawings are intended to convey all salient features, functions and characteristics of the lighting control devices only, and do not undertake to illustrate or set forth every item or detail necessary for the work. Minor details, not usually indicated on the drawings nor specified, but that are necessary for proper execution and completion of the lighting controls shall be included, the same as if they were herein specified or indicated on the drawings.

B. Section Includes:

- 1. General lighting control devices
- 2. Digital lighting control devices
- 3. Lighting Control Relay panels
- 4. Lighting Control Panelboards
- 5. Lighting Contactor Cabinets
- 6. Electronic Digital Time Switches
- 7. Outdoor Photoelectric Switches
- 8. Emergency lighting control devices

C. Related Requirements:

- 1. Refer to Section 26 0500, "Common Work Results for Electrical Systems" for requirements related to equipment supports.
- 2. Refer to Section 26 2726, "Wiring Devices" for requirements related to lighting snap switches and wall plates.

1.3 REFERENCES

A. Abbreviations and Acronyms

- 1. BAS: Building Automation System.
- 2. DDC: Direct Digital Controller/Direct Digital Control.
- 3. IP: Internet protocol.

- 4. NRTL: Nationally Recognized Testing Laboratory
- 5. SPD: Surge Protection Device

B. Definitions

- 1. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE 100 and ANSI/IES LS-1.
- 2. Scene: The lighting effect created by adjusting several zones of lighting to the desired intensity.
- 3. Zone: A light fixture or group of light fixtures controlled simultaneously as a single dimmer/relay/entity.
- 4. Occupancy Sensor: Motion sensing device programmed as automatic on and automatic off.
- 5. Vacancy Sensor: Motion sensing device programmed as manual on and automatic off.
- C. Reference Standards: The following publications are referred to in the text by the basic designation only. The edition/revision of the referenced publications shall be the latest version as of the date of the Contract Documents, unless otherwise specified.
 - 1. National Electrical Contractors Association (NECA):
 - NECA NEIS 130, "Standard for Installing and Maintaining Wiring Devices"
 - 2. Underwriters Laboratories, Inc. (UL):
 - a. UL 508, "Standard for Industrial Control Equipment."
 - b. UL 773, "Plug-in, Locking Photocontrols for Use with Area Lighting."
 - c. UL 773A, "Nonindustrial Photoelectric Switches for Lighting Control."
 - d. UL 916, "Standard for Energy Management Equipment Systems."
 - e. UL 917, "Clock Operated Switches."
 - f. UL 924, "Emergency Lighting and Power Equipment."
 - g. UL 1008, "Transfer Switch Equipment."
 - h. UL 1449, "Transient Voltage Surge Suppressors."
 - i. UL 2108, "Low-Voltage Lighting Systems."

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated including physical data and electrical performance. Include data on features, accessories, finishes, and the following:
 - 1. Physical description, including dimensions.
 - 2. All available finishes and colors for each device and wall/cover plate shall be submitted to the Architect for selection during review.
 - 3. Control type: 0-10V, DMX, bi-level, etc.
 - 4. Sample Warranty.
- B. Shop Drawings: Show installation details for occupancy, vacancy, light-level sensors, and digital control devices.
 - 1. Lighting floor plan showing location, orientation, and coverage area of each wall and ceiling mounted sensor.
 - 2. Interconnection diagrams showing field-installed wiring.
 - 3. Riser diagrams indicating device network and cabling types.
 - 4. Include systems descriptions, set points, and controls settings and adjustment.
- C. Manufacturer's Installation Instructions: Include for manufactured components.
- D. Qualification Data: For Start-Up Field Technician

E. Closeout Submittals

- 1. Operation and Maintenance Data: For each type of product to include in operation and maintenance manuals. In addition to items specified in Division 01 and Section 26 0010 "General Requirements for Electrical Systems", include the following:
 - a. Description of operation and servicing procedures.
 - b. Technical support contact
 - c. List of components.
 - d. Recommended spare parts.
 - e. Programming instructions and system operation procedures.
 - f. Include interconnection wiring diagrams complete field installed system with identified and numbered, system components and devices.
 - g. Include operation and maintenance manuals for equipment and devices, including sensors, power supplies, and other equipment furnished.
 - h. Provide detailed set-up information for furnished equipment, indicating required initial configuration switch settings, jumper positions, to facilitate equipment replacement.
 - i. Include device calibration settings after system programming and start-up with manufacturer's representative.
- 2. Software and Firmware Operational Documentation:
 - Software operating and upgrade manuals.
 - b. Program Software Backup: On USB media. Provide names, versions, and website addresses for locations of installed software.
 - c. Device address list.
 - d. Printout of software application and graphic screens.

1.5 MAINTENANCE MATERIAL

- A. Extra Stock Material: Provide one (1) of each type of sensor, switch, dimmer, power pack, and emergency lighting control device installed. Package with protective covering for storage and identified with labels describing contents.
- B. Keys and Special Tools: Provide one extra set for access to locked or tamperproof enclosures.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 - Manufacturer must maintain an authorized service organization within 100 miles of the project location that stocks a full complement of parts for all equipment specified in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.
 - 2. Provide toll free technical telephone support.
- B. Installer Qualifications:
 - 1. An employer of workers qualified and trained in electrical safety as required by NFPA 70E.
- C. Start-Up Field Technician Qualifications:
 - 1. Minimum experience of 2 years training in the electrical/electronic field.
 - 2. Certified by the manufacturer on the system installed.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer instructions for storage of equipment and devices to prevent damage from dirt, moisture, or other environmental concerns.

1.8 COORDINATION

- A. Preinstallation Conference: Arrange a pre-installation conference between all applicable subcontractors and architect/engineer prior to the installation of rough ins for the lighting controls.
- B. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, speakers, fire alarm, HVAC equipment, fire-suppression system, and partition assemblies.
- C. Coordinate protocol and interface points of lighting control devices with temperature controls (BAS/DDC) specified in Division 23.
- D. Product procurement and coordination:
 - 1. Order products according to application.
 - 2. Confirm the proper and complete catalog number with distributor and agent.
 - 3. Provide additional parts and pieces required to complete the installation in the location and manner intended by the design.
 - 4. Confirm voltages.
- E. Contractor shall coordinate with Vendors and other trades, in advance of installation work, to define all infrastructure and installation requirements. Contractor shall coordinate all infrastructure requirements with all approved lighting control devices prior to infrastructure installation. This includes, but not limited to, appropriately sized, positioned, and located junction boxes, structural supports, feeds, power conduits, control conduits, and remote code-compliant power-supply enclosures.

1.9 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace lighting controls, finishes, wiring, cabling and all of its components that fail in materials or workmanship within 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL 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. Comply with NFPA 70, as well as applicable ANSI, IEC standards, and FCC regulations.
- C. Comply with CFR Title 47, Part 15, Subparts A and B, for Class A digital devices.
- D. Devices shall be in accordance with NFPA 70, NEMA, and UL listed and labeled.
- E. RoHS compliant.

- F. Devices located in above ceilings shall be plenum rated.
- G. Power failure: Incorporate non-volatile memory. Should power be interrupted and subsequently restored, settings and parameters saved in protected memory shall not be lost and should restore system to its last operating state without requiring user input.
- H. Failsafe operation: If automatic switching device loses power, device will latch to closed "ON" position.
- I. Components shall be designed and tested to withstand discharges without impairment of performance when subjected to discharges of 15,000 volts per IEC 801-2.
- J. Products tested in identical manner, complaint to NEMA WD 7 -2011 Occupancy Motion Sensors Standards.
- K. Voltage: 120/277VAC unless noted otherwise
- L. Line-Voltage Surge Protection: Include in all 120- and 277-V solid-state equipment. Comply with UL 1449 and with ANSI C62.41 for Category A locations.
- M. Refer to Section 26 2726 "Wiring Devices" for device and faceplate colors.
- N. Standard Operating Range: 32 to 120 deg F, up to 90 percent relative humidity, non-condensing, unless noted otherwise.
- O. Minimum load rating: 800W at 120VAC and 1200W at 277VAC.
- P. Provide all control devices with LED status indicator.
- Q. Minimum Occupancy and Vacancy Sensor Coverage Radius:
 - 1. Wall Switch: 35 ft for large motion, 20 ft for small motion.
 - 2. Ceiling, 360 deg, Standard Range: 12 ft radius for small motion.
 - 3. Ceiling, 360 deg, Extended Range: 28 ft radius for large motion.
 - 4. Corner, 120 deg: 40 ft for large motion.
 - 5. Hallway: 100 ft for large motion.
 - 6. High Bay, 360 deg: 20 ft radius at 15 ft mounting height for large motion

2.2 GENERAL LIGHTING CONTROL DEVICES

- A. Basis of Design: Subject to compliance with requirements, provide products indicated on Drawings or equivalent by one of the following:
 - 1. Acuity Sensorswitch
 - 2. Hubbell
 - 3. Leviton
 - 4. Lutron
 - Wattstopper
- B. General Requirements:
- C. Wall Switch Occupancy and Vacancy Sensors: Decora style sensor with on/off switch(es) for mounting in a single gang switchbox.
 - 1. Programmable Automatic On and Manual On Operating Modes.

- 2. Time Delay for Automatic Off: Adjustable up to 20 minutes.
- 3. Programmable sensitivity settings.
- 4. Sensing Technology: Dual technology, PIR and Ultrasonic or Microphonics unless noted otherwise.
- 5. Noise filtering to eliminate false triggers.
- 6. Vandal resistant lens
- 7. Multi-Way: Multi-way: Capable of operation in 3-way application where indicated.
- 8. Dimming: Provide 0-10V dimming output where indicated.
- 9. Dual Relay: Where independent control of two loads is required, provide unit with two isolated relays and override switches, capable of independent operating modes and time delays.
- D. Line Voltage Occupancy Sensors: Self-contained occupancy sensor with integral power supply and relay suitable for mounting to a standard outlet box in ceiling and wall mounted applications
 - 1. Automatic On operation.
 - 2. Time delay for Automatic Off: Adjustable up to 20 minutes.
 - 3. Sensing Technology: Dual technology, PIR and Ultrasonic or Microphonics unless noted otherwise.
 - 4. Dual Relay: Where independent control of two loads is required, provide unit with two isolated relays and override switches, capable of independent operating modes and time delays.
- E. Low Voltage Occupancy, Vacancy Sensors, Daylight Sensors, Power Packs, and Low Voltage Wall Stations
 - 1. Programmable Automatic On and Manual On Operating Modes.
 - 2. Time Delay for Automatic Off: Adjustable up to 20 minutes.
 - 3. Sensing Technology: Dual technology, PIR and Ultrasonic unless noted otherwise.
 - 4. Noise filtering to eliminate false triggers.
 - 5. Isolated Relay: Low voltage relay with N.O. and N.C. outputs to indicate occupancy status for HVAC interface with BAS/DDC system.
 - 6. Power Packs/Load Controllers: Self-contained power supply with relay module capable of switching 20-amp load.
 - a. Class 2, 24VDC output for powering low voltage sensors.
 - b. UL 2043 Plenum Rated.
 - c. Threaded 1/2-inch nipple, suitable for mounting inside or outside a junction box.
 - 7. Wall stations: Low voltage, decorator style, with single or multiple pushbuttons for interface with power packs and sensors.
 - a. Multi-way: Capable of operation in 3-way application.
 - b. Manual Dimming: Provide 0-10V dimming output where indicated.
 - 8. Low Voltage Indoor Daylight Sensors: Low voltage, ceiling mounted photosensor that detects changes in light levels.
 - a. Suitable for interface with an occupancy/vacancy sensor, power pack, or another field device.
 - b. Closed loop device: measures both daylight contribution and controlled electric light contribution.
 - c. Open Loop device: measures only daylight contribution.
 - d. Desired task level illuminance: Auto calibrating, programmable, with daytime and nighttime on/off setpoints and a dead band to prevent light from cycling.
 - e. Auto Dimming: Provide 0-10V dimming output for automatic dimming control of luminaires.

- F. Interval Timer Light Switch: Combination countdown timer and conventional switch lighting control unit, switchbox mounted, decorator style.
 - 1. On/Off Switch with Status LED.
 - 2. Adjustable preset intervals.
 - 3. Warning: Audible and/or flash timeout warning.
- G. Wallbox Dimmer Switches
 - 1. Single gang decorator style, suitable for full range continuous variable control of luminaire light intensity.
 - 2. Comply with UL 1472.
 - 3. Preset slide style dimming control with a mechanical air-gap switch to totally disconnect power from the load when in the off position.
 - 4. Compatible with luminaire ballast or driver.

2.3 DIGITAL LIGHTING CONTROL DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products indicated on drawings or equivalent by one of the following:
 - 1. Acuity nLight
 - 2. Crestron Zum
 - 3. Hubbell NX
 - 4. Wattstopper DLM
- B. Description: Intelligent control devices capable of operating in standalone control zones or in a networked configuration for remote, time-based, and global operation with inputs from digital signal sources and remote configuration and monitoring through a software interface.
- C. System Architecture:
 - 1. Free topology plug-in wiring with Cat 5e network cabling for power and data between control devices, switches, and sensors.
 - 2. Self-configuring, digitally addressable control devices.
 - 3. Any combination of inputs shall be programmable to any number of control devices.
 - 4. Automatic configuration and connection of room loads to the connected control devices in the space without commissioning or the use of any tools.
 - 5. Units shall not have any dip switches or potentiometers for field settings.
- D. Sensors, power packs, and wall stations shall be interconnected through RJ-45 ports and comply with General Requirements section specified herein.
- E. System Accessories: Provide the following accessories as required for implementation of the control intent illustrated on the drawings.
 - 1. Daylight Sensors: Shall be digital and comply with General Requirements section specified herein.

- a. Daylight sensor groupings: The set of zones that are controlled by a given daylight sensor shall be configurable through associated lighting relay room controller and shall not require manual wiring to modify.
- b. Daylight sensor settings: Settings associated with a given daylight sensor shall be adjustable through associated lighting relay room controller and shall not require any physical adjustment to the sensor itself.
- 2. I/O Module: Input / Output device. 24VDC relay with normally open, normally closed, and common outputs to indicate occupancy or lighting status to third party systems such as a BAS or nurse call systems. Four input terminals for maintained or momentary switch closure inputs.
- 3. Relay Panels: Mechanically latching relays with individual manual override in steel enclosure. Digital integration with other system devices. Relay quantity, poles, and voltages per drawings.
- 4. BACnet Appliance: Provides BACnet MS/TP digital networked communication between rooms, panels, Gateway, or BAS and automatically creates BACnet objects representative of connected devices.
- F. Sequence Control and Override: Networked systems utilizing astronomical or time of day controls shall comply with the following.
 - 1. Override control must allow any relay connected to it to be switched on or off by a manual switch or by an automatic switch, such as a sensor. Provide 2-hour override unless otherwise noted.
 - 2. Override control "blink warning" must warn occupants approximately five minutes before actuating the off sequence. Does not apply to exterior lighting.
 - 3. Activity log, storing previous relay operation, including the time and cause of the change of status.

G. Emergency Modes:

Lighting relay room controllers and/or ELCD's shall comply with UL 924 requirements. Upon loss of
power to a lighting relay room controller or ELCD, lighting relays shall operate in the closed ('on')
position and associated LED drivers shall operate in a full light output state. Once normal or backup
power is restored, lighting relays shall remain in the closed ('on') position and LED drivers shall
remain in a full light output state until a new command is initiated.

2.4 LIGHTING CONTROL RELAY PANELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Douglas Lighting Controls
 - 2. Leviton Greenmax
 - 3. Lighting Controls & Design (LC&D)
 - 4. Lyntec
 - 5. Wattstopper Lighting Integrator
- B. Description: Lighting control panel using mechanically latched relays to control lighting and appliances based on inputs from sensors, switches, or other sources along with zone based timed overrides and blink warnings. Capable of operation in a standalone application or interconnected with digital communications to operate multiple panels as a single system.
 - 1. Pre-assembled steel enclosure with incoming lighting branch circuits, control circuits, switching relays, and on-board timing and control unit. Comply with UL 508.

- 2. A vertical barrier separating branch circuits from control wiring.
- 3. Suitable for surface or flush mounting with a hinged locking door assembly.
- 4. Relay capacity and configuration as required to accommodate switched zones shown on drawings plus 20 percent spare capacity.
- 5. Surge Protective Device: Factory installed as an integral part of control components or field-mounted surge suppressors complying with UL 1449, SPD Type 2.

C. Relays

- 1. Electrically operated, mechanically held, minimum 20 A rating at 120/277 VAC for single pole switches and 208/240/480VAC for double pole switches.
- 2. Integral manual ON/OFF switch with visual display of switch state.
- 3. Suitable for control of incandescent, fluorescent, LED, and HID loads.
- 4. Short-circuit current rating must not be less than available fault current as indicated in power system study.
- 5. UL924 listed for use on emergency circuits, relays must close upon loss of system power.
- D. Integral Power Supply: NFPA 70, Class 2, sized for connected equipment, plus 20 percent spare capacity. Powered from a dedicated branch circuit of the panelboard that supplies power to the line side of the relays, sized to provide control power for the local panel-mounted relays, bus system, control-voltage inputs, and any field-installed sensors.
- E. Push-Button and Key Operated Wall Station Switches: Modular, momentary contact or digital, for operating one or more relays and to override automatic controls.
- F. Sensors and photocells: Powered from the lighting control relay panel, and signal compatible with the relay panel control unit. Comply with General Requirements section specified herein.

2.5 OUTDOOR PHOTOELECTRIC SWITCHES

- A. Manufacturer: Subject to compliance with requirements, provide product by one of the following:
 - 1. Intermatic
 - 2. Tork
 - 3. Precision
- B. Description: Solid state, 120-277VAC, with SPST dry contacts rated for 1800-VA, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.
 - 1. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of the photocell to prevent fixed light sources from causing turn-off.
 - 2. Time Delay: Fifteen second minimum, to prevent false operation.
 - 3. Surge Protection: Metal-oxide varistor.
 - 4. Mounting: Base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.
 - 5. Enclosure: Outdoor weathertight housing, resistant to high temperatures, equipped with sun-glare shield, ice preventer, and directional lens to prevent fixed light sources from causing turn-off.
 - 6. Failure Mode: Luminaire stays ON.

2.6 EMERGENCY LIGHTING CONTROL DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Bodine
 - 2. Dual-Lite
 - 3. LVS
 - 4. Wattstopper

B. Automatic Load Control Relays (ALCR)

- 1. Operation: Automatically switch emergency lighting on and off as normal lighting is switched. When normal power is not available, the unit shall force and hold emergency lighting on regardless of the state of any external control device until normal power is restored.
- 2. UL 924 listed device with relay switching circuitry, test switch, normal power indicator light, and an alternate power indicator light in a single enclosure.
- 3. Universal Input Voltage: 120-277V, 60Hz
- 4. Load Rating: 20A
- 5. Suitable for indoor or damp locations.

C. Branch Circuit Emergency Lighting Transfer Switches (BCELTS)

- 1. Operation: Automatically switch a lighting load from a normal source to a designated emergency source when normal power is lost.
- 2. UL 1008 listed device with relay switching circuitry, test switch, normal power indicator light, and an alternate power indicator light in a single enclosure.
- 3. Universal Input Voltage: 120-277V, 60Hz
- 4. Load Rating: 20A
- 5. Suitable for indoor or damp locations.

2.7 CONDUCTORS AND CABLES

- A. Wiring to supply side of remote-control power sources: Not smaller than No. 12 AWG. Comply with requirements in Section 26 0519, Low-Voltage Electrical Power Conductors and Cables
- B. Low-voltage control cable for 0-10VDC dimming: Manufacturer's standard multi-conductor cable with stranded-copper conductors not smaller than No. 18 AWG, plenum rated unless otherwise recommended by the manufacturer.
- C. Class 1 and 2 Control Cables: Multi-conductor cable with copper conductors not smaller than No. 14 AWG, plenum rated unless otherwise recommended by the manufacturer.
- D. UTP cabling: Unshielded, plenum rated, Cat5e twisted-pair cable. Comply with lighting control system manufacturer's recommendations.

2.8 SOURCE QUALITY CONTROL

- A. Factory Tests and Inspections: Perform full-function testing on 100 percent of all system components and panel assemblies at the factory prior to delivery.
- B. System control components shall be certified by the manufacturer to have been designed, manufactured and tested for interoperability.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine lighting control devices and equipment before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.
- B. Examine walls, ceilings, and other mounting surfaces for suitable conditions where lighting control devices and equipment will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install lighting controls and equipment in accordance with manufacturer's written instructions, applicable requirements of NEC, and NECA 500 and 501.
- B. Electrical installations shall conform to and meet IEEE C2, NFPA 70, and to the requirements specified herein.
- C. Devices and Equipment shall be installed and programmed to meet the control intent.

D. Device Installation:

- 1. Comply with Section 26 2726 "Wiring Devices" for wall mounted device and faceplate installation requirements.
- 2. Install in a single box and provide a single cover plate where two or more devices are shown adjacent on plans. Provide voltage barrier where required.
- 3. Verify door swings with door frame installed prior to rough-in for switches and sensors. Locate switches on latch side of door.
- 4. Device Orientation: Install switches and dimmers with the "OFF" position down.

E. Panels and Cabinets:

- 1. Install panels and cabinets in accordance with NECA 407.
- 2. Mount top of trim no greater than 90-inches above finished floor unless otherwise indicated.
- 3. Mount panel cabinet plumb and rigid without distortion of box.
- 4. Install filler plates in unused spaces.

F. Conductors/Wiring:

- 1. Wiring Methods: Comply with Section 26 0519, Low-Voltage Electrical Power Conductors and Cables.
- 2. Size conductors in accordance with lighting control device manufacturer's instructions unless otherwise indicated.
- 3. Voltage Drop: Adjust conductors and conduit sizes accordingly based on actual field installed conditions.
- 4. Where the total conductor length for 0-10VDC dimming applications exceeds the values below, adjust conductor size as noted.
 - a. Conductor lengths up to 300 feet: #18 AWG minimum.
 - b. Conductor lengths between 300 feet and 430 feet: #16 AWG minimum.
 - c. Conductor lengths between 430 feet and 690 feet: #14 AWG minimum.

- d. Conductor lengths between 690 feet and 1100 feet: #12 AWG minimum.
- e. Conductor lengths between 1100 feet and 1750 feet: #10 AWG minimum.
- 5. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- 6. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.
- 7. Provide plenum-rated cable, where installed exposed or in open cable tray, within environmental airspaces, including plenum ceilings.

G. Lighting Controllers/Power Packs:

- 1. Room controllers shall be surface mounted in accessible ceiling space above entry door. Install no higher than 6" above accessible ceiling.
- 2. Install controllers/power packs on the unswitched line side of local switches to keep sensors powered at all times.
- 3. Provide controllers/power packs(s) for each room/area/control zone for a working system.
- Note all power pack locations and branch circuiting on as-built record drawings.

H. Lighting Contactors

- 1. Install lighting contactors as indicated on plan. Install at accessible locations.
- 2. Mount contactors in a manner to eliminate structure-borne vibration

I. Occupancy and Vacancy Sensors

- 1. Provide quantity of sensors indicated as a minimum. Provide additional units to give full coverage over controlled area. Provide full coverage for hand and arm motion detection in office, classroom, and administration type areas and walking motion for storage rooms and hallways.
- 2. Install wallbox sensors at switch height indicated on drawings.
- 3. Install wall sensors without manual switches at 8 ft above finished floor unless otherwise noted on drawings.
- 4. Install ceiling mounted sensors at locations indicated on manufacturer's shop drawings. Sensor manufacturer shall provide quantity of sensors as required to provide complete coverage for rooms.
- 5. Locate sensors such that motion through open doors will not falsely activate sensors.
- 6. Do not locate ultrasonic sensors within six feet of supply air diffusers.
- 7. Locate infrared sensors to avoid obstructions.

3.3 IDENTIFICATION

- A. Comply with Section 26 0553 "Identification for Electrical Systems."
 - 1. Identify all components and power and control wiring.
 - 2. Label time switches and contactors with a unique designation.
 - Provide directories inside relay panels and contactor cabinets that identify each relay and the associated control zone.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to perform system startup, functional testing, and inspection of components, assemblies, and equipment installations, including connections.
- B. Visual and Mechanical Inspections:
 - 1. Upon completion of installation, verify that equipment is properly installed, connected, and adjusted.
 - 2. Inspect control components for defects and physical damage, testing laboratory labeling, and nameplate compliance with the Contract Documents.

C. System Start-up:

- 1. Complete installation and startup checks according to manufacturer's written instructions.
- 2. Confirm layout and location of sensors with manufacturer's recommendations to achieve proper coverage of indicated areas. Provide additional sensors and control units as required to achieve complete minor motion coverage of the space indicated. Provide customizable sensor masks to block off unwanted viewing areas.
- 3. Confirm control schedules with owner including operating hours for each day of the week and holiday schedules. Submit to design team for approval.
- D. System Functional Tests: After installing all control devices, automatic time switches, and sensors, and after electrical circuitry has been energized, test systems for compliance with approved sequences in accordance with energy code requirements.
 - 1. Adjust time delays, trim settings, dead bands, and scene settings.
 - 2. Owner and architect/engineer shall be present during adjustment of scene settings. Exterior scenes shall be adjusted during non-daylit hours.
 - 3. Set and operate devices to demonstrate their functions and capabilities in a methodical sequence that cues and reproduces actual operating functions.
 - 4. Include testing of devices under conditions that simulate actual operational conditions including occupied and unoccupied states.
 - 5. Verify all emergency lighting functions upon loss of power.
 - 6. Record all control settings, operations, cues, and functional observations.

E. Nonconforming Work:

- 1. Lighting control devices and equipment will be considered defective if it does not pass tests and inspections.
- 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace defective units and retest.
- 3. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- F. Prepare test and inspection reports.

3.5 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide onsite assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to site outside normal occupancy hours for this purpose.

- B. The lighting and lighting controls systems shall be synchronized and fully operable to address the lighting operation in a complete and code-compliant manner.
- C. All ladders, scaffolds, lifts, gloves, cleaning cloths, access/adjustment tools, etc. required for aiming and adjusting lighting controls shall be furnished by the Contractor.

3.6 PROTECTION

- A. Install lighting control devices after all wall preparation, including painting, is complete.
- B. Replace all devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
- C. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
- D. Do not remove surface protection, such as plastic film and smudge covers, until final cleaning has been completed.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's facility management and maintenance personnel, and selected Owner representatives. as specified below:
 - 1. Train Owner's maintenance personnel on troubleshooting, servicing, adjusting, and preventive maintenance. Provide a minimum of four (4) hours training.
 - 2. Training Aid: Use the approved final version of maintenance manuals as a training aid.
 - 3. Training shall include, but not be limited to, overview, adjustment, operation, use, maintenance, and demonstration of the lighting control system.

END OF SECTION 26 0923

SECTION 26 2200 - LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General, Special and Supplementary Conditions, Division 01 Specification Sections, and Section 26 0010 "General Requirements for Electrical Systems" apply to this Section.

1.2 SUMMARY

- A. Description: Section includes requirements for the provision of Low-Voltage, dry type distribution transformers including manufacturing, fabrication, configuration and installation as required for the complete performance of the Work, as shown on the Drawings, as specified herein.
- B. Section includes distribution, energy efficient, dry-type transformers with a nominal primary and secondary rating of 600 V and less.
- C. Related Requirements:
 - 1. Refer to Section 26 0500 "Common Work Results for Electrical Systems" for requirements related to equipment bases, supports, and vibration pads.

1.3 REFERENCES

- A. Abbreviations
 - 1. DOE: Department of Energy
 - 2. FCAN: Full Capacity Above Normal
 - 3. FCBN: Full Capacity Below Normal
 - 4. XFMR: Transformer
- B. Reference Standards: The following publications are referred to in the text by the basic designation only. The edition/revision of the referenced publications shall be the latest version as of the date of the Contract Documents, unless otherwise specified.
 - 1. National Electrical Contractors Association (NECA)
 - a. NECA 409, "Standard for Installing and Maintaining Dry-Type Transformers".
 - 2. National Electrical Manufacturers Association (NEMA)
 - a. NEMA ST20, "Dry Type Transformers for General Applications".
 - 3. Underwriters Laboratories Inc (UL)
 - a. UL 1561, "Dry-Type General Purpose and Power Transformers".
 - 4. Federal Regulations and Policies
 - a. DOE 10 CFR Part 429, "Certification, Compliance, and Enforcement for Consumer Products and Commercial and Industrial Equipment".

b. DOE 10 CFR Part 431, "Energy Efficient Program for Certain Commercial and Industrial Equipment".

1.4 SEQUENCING

A. Submit the preliminary power system study prior to receiving final approval of equipment and system protective devices submittals and prior to release of equipment drawings for manufacturing. Adjust equipment sizes, frame sizes, and trip units as necessary to achieve performance requirements outlined in Section 26 0573, "Power Systems Studies".

1.5 SUBMITTALS

- A. Product Data: For each type of product. Include the following:
 - Basic Performance characteristics including insulation class, temperature rise, core and coil materials, impedances & audible noise level, unit weight, and inrush data expressed in either Amperes RMS or Times Rated input current.
 - 2. Efficiency Data per NEMA ST20 and 10 CFR Part 431 at 35% loading point.
 - 3. No load and full load losses calculated per NEMA ST20 test methods.
 - 4. Efficiency levels at 25%, 50%, 75%, and 100% load points.
- B. Shop Drawings: For each product type.
 - 1. Enclosure dimensions and clearances
 - 2. Wiring Diagrams: Power, signal, and control wiring.
 - 3. Wire Bending Dimensions
 - 4. Location for Ground Lug Provisions
 - 5. Factory provided mounting brackets
 - 6. Field installed accessories.
- C. Field quality-control test reports.
- D. Closeout Submittals
 - 1. Provide Operation and Maintenance Data for transformers to include in operation and maintenance manuals.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Remove and replace access fencing, doors, lift-out panels, and structures as required to provide pathway for moving transformers into place.
- B. Comply with manufacturer instructions for storage of electrical equipment to prevent damage from condensation or other environmental concerns.

1.7 COORDINATION

Coordinate size and location of concrete bases with dimensions of transformer provided.

- B. Coordinate installation of wall and ceiling mounting hardware and structural supports with transformer provided.
- C. Distribution equipment sizes and equipment layouts shall be considered basis of design. Equipment sizes vary by manufacturer. If proposed equipment is larger than the sizes illustrated, the burden shall be on the Contractor to provide equipment which fits in the space allotted while maintaining all code-required and manufacturer-recommended clearances.
- D. Drawings indicate space available for electrical equipment, including clearances between equipment and adjacent surfaces and other items. Equipment installed must comply with all clearance, access and replacement working space requirements of the NEC and Owner.
- E. Conduct and submit results of power system studies before submitting Product Data and Shop Drawings for electrical equipment.
- F. Coordinate inrush current values of transformer provided with overcurrent protection device settings as described in Section 26 0573, "Power System Studies". Adjust overcurrent protection device size, settings, and feeder size to eliminate nuisance operation in response to the actual transformer inrush current.

1.8 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace transformers, finishes, controls, wiring, and all of its components that fail in materials or workmanship within 12 months 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:
 - ABB/General Electric.
 - 2. Eaton.
 - 3. Siemens.
 - 4. Square D.
- B. Source Limitations: Obtain transformers and all other electrical distribution equipment through one source from a single manufacturer.

2.2 GENERAL TRANSFORMER REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70, NEMA ST 20, and list and label as complying with UL 1561.

- C. Comply with (DOE) 10 CFR 431 for minimum energy efficiency levels. Transformers shall bear the UL Energy Efficiency Verification Mark to confirm that the unit meets minimum efficiency levels.
- D. Provide transformers that are constructed to withstand seismic forces specified in Section 26 0548.16 "Seismic Controls for Electrical Systems."
- E. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.
- F. Phase, kVA Ratings, and Primary and Secondary Voltages: as indicated on drawings.
- G. Cores: Grain-oriented, non-aging silicon steel with high permeability and low hysteresis and eddy current losses. Magnetic flux densities are to be kept well below the saturation point to prevent core overheating.
 - 1. One leg per phase.
 - 2. Core volume shall allow efficient transformer operation at 10 percent above the nominal tap voltage.
 - 3. Visibly grounded to the enclosure by means of a flexible grounding conductor sized in accordance with applicable UL and NEC standards.
 - 4. Cores shall be clamped with structural angles and bolted to the enclosure to prevent damage during shipment or rough handling.
- H. Coils: Continuous windings without splices except for taps. Coils shall have a final wrap of electrical insulating material designed to prevent injury to the coil wire.
 - 1. Coil Material: Copper
 - 2. Internal Coil Connections: Brazed or pressure type.
 - 3. Terminal Connections: Welded.
- I. Insulation Class: Minimum 220 deg C, UL-component-recognized insulation system.
 - 1. Temperature Rise: 115 deg C unless noted otherwise.
 - 2. All insulation materials shall be flame-retardant and shall not support combustion as defined in ASTM Standard Test Method D635
 - 3. Wire left bare will not be accepted, all conductors must have insulation material.
- J. Enclosure: Ventilated
 - 1. NEMA 250, Type 2 unless otherwise required by environmental conditions. Provide weathershield for ventilation openings where located outdoors.
 - 2. Heavy gauge steel construction.
 - 3. The core and coil unit shall be completely isolated from the enclosure by means of a vibration isolating system and shall be so designed as to provide for continual securement of the core and coil unit to the enclosure.
 - 4. Core and coil shall be encapsulated within non-hygroscopic thermosetting varnish, sealing out moisture and air.
 - 5. Wiring Compartment: Sized for conduit entry and wiring installation.
 - 6. Minimum clearances from ventilated openings to obstructions shall be indicated on the nameplate and not exceed 6-inches.
 - 7. The maximum top of case temperature shall not exceed 35 deg C above 40 deg C ambient.
 - 8. Finish: Gray weather resistant baked enamel, complying with NEMA 250.

K. Taps:

- 1. Three-phase transformers rated 15 kVA and larger shall be provided with six 2-1/2% full capacity taps, two above and four below rated primary voltage.
- 2. Three-phase transformers rated below 15kVA shall be provided with two 5% full capacity taps below rated primary voltage.
- L. Grounding: Provide ground bar installed on the inside of the transformer enclosure.
- M. Wall and Ceiling Brackets: Manufacturer's standard brackets.
- N. Low-Sound-Level Requirements: Minimum of 3 dBA less than NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91.
- O. Terminations: Mechanical Lugs listed to accept specified wiring method, conductor size, and temperature rating.

2.3 SOURCE QUALITY CONTROL

- A. Test and inspect transformers according to IEEE C57.12.91 and IEEE C57.12.91.
 - 1. Ratio tests at the rated voltage connection and at all tap connections.
 - 2. Polarity and phase relation tests on the rated voltage connection
 - 3. Applied potential tests
 - 4. Induced potential test
 - 5. No-load and excitation current at rated voltage on the rated voltage connection
- B. Factory Sound-Level Tests: Conduct prototype sound-level tests on equipment for this Project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.
- B. Verify that field measurements are as needed to maintain working clearances and equipment operation required by NFPA 70 and manufacturer's written instructions.
- Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

- D. Verify that ground connections are in place and requirements in Section 26 0526 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install transformers level and plumb with vibration dampening supports.
 - 1. Provide wall and ceiling mounted transformers with brackets fabricated by transformer manufacturer.
 - 2. Coordinate installation of structural steel supports with actual transformer provided.
- B. Construct concrete bases and anchor floor-mounted transformers according to manufacturer's written instructions.
- C. Secure covers to enclosure and tighten all bolts to manufacturer-recommended torques to reduce noise generation.
- D. Remove shipping bolts, blocking, and wedges.

3.3 CONNECTIONS

- A. Ground equipment according to Section 26 0526 "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Provide flexible connections at all conduit and conductor terminations and supports according to Section 26 0533, "Raceways and Boxes for Electrical Systems" and Section 26 0500, "Common Work Results for Electrical Systems" to eliminate sound and vibration transmission to the building structure.
- D. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- E. Where a tightening torque is indicated as a numeric value on equipment or in installation instructions provided by the manufacturer, use a calibrated torque tool to achieve that indicated torque value, unless the equipment manufacturer has provided installation instructions for an alternative method of achieving the required torque.

3.4 IDENTIFICATION

- A. Comply with requirements in Section 26 0553, "Identification for Electrical Systems".
 - Where primary disconnecting means is not provided within sight of transformer, identify transformer with equipment designation and location of remote lockable disconnecting means by permanent nameplate.

- 2. All distribution equipment shall be shipped from the manufacturer with factory-applied warning labels affixed to the outside front of the equipment (as it will be installed per the plans). All labeling shall be in compliance with NFPA 70 requirements.
- 3. Labels affixed to equipment by the equipment manufacturer shall comply with drawing and specification labeling requirements or shall be omitted by the manufacturer and field-installed by the Contractor. Labels which are factory-installed and not in compliance shall be removed and replaced and equipment enclosures refinished or replaced by the manufacturer to repair finish.

3.5 FIELD QUALITY CONTROL

- A. Tests and Inspections: Perform the following tests and inspections. Certify compliance with test parameters.
 - 1. Visual and Mechanical Inspection
 - a. Document equipment nameplate data on the test report. Verify that transformer nameplate ratings are in accordance with drawings.
 - b. Inspect the physical and mechanical condition of the equipment.
 - c. Inspect anchorage, alignment, and grounding.
 - d. Verify that resilient mounts are free and that any shipping brackets have been removed.
 - e. Inspect bolted electrical connections for high resistance by verifying tightness with calibrated torque-wrench method in accordance with manufacturer's published data.

2. Electrical Tests

- Perform insulation-resistance tests. Measurements shall be made from winding-to-winding and each winding-to-ground. Test voltages and minimum resistance shall be in accordance with manufacturer's published data.
- b. Verify correct secondary voltage phase-to-phase and phase-to-neutral after energization and prior to loading.
- B. Test and Inspection Reports: Prepare a written report to certify compliance with test parameters and record the following:
 - 1. Test procedures used.
 - 2. Results that comply with requirements.
 - 3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- C. Products will be considered defective if they do not pass tests and inspections. Remove and replace malfunctioning units and retest as specified above.
- D. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.6 CLEANING:

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 26 2200

SECTION 26 2416 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General, Special and Supplementary Conditions, Division 01 Specification Sections, and Section 26 0010 "General Requirements for Electrical Systems" apply to this Section.

1.2 SUMMARY

A. Description: Section includes requirements for the provision of Panelboards including manufacturing, fabrication, configuration and installation as required for the complete performance of the Work, as shown on the Drawings, as specified herein.

B. Section Includes:

- 1. Distribution panelboards
- 2. Lighting and appliance branch-circuit panelboards
- 3. Disconnecting and overcurrent protective devices.

C. Related Requirements:

1. Refer to Section 26 0500, "Common Work Results for Electrical Systems" for requirements related to equipment supports.

1.3 REFERENCES

A. Abbreviations

- 1. AFCI: Arc-fault circuit interrupter.
- 2. GFCI: Ground-fault circuit interrupter.
- 3. GFPE: Ground-fault protection of equipment.
- 4. MCCB: Molded Case Circuit Breaker
- 5. SWD: Switching Duty
- 6. VPR: Voltage protection rating.

B. Definitions

1. Panelboard: A single panel or group of panel units designed for assembly in the form of a single panel, including buses and automatic overcurrent devices, and equipped with or without switches for the control of light, heat, or power circuits; designed to be placed in a cabinet or cutout box placed in or against a wall, partition, or other support; and accessible only from the front.

- C. Reference Standards: The following publications are referred to in the text by the basic designation only. The edition/revision of the referenced publications shall be the latest version as of the date of the Contract Documents, unless otherwise specified.
 - 1. National Electrical Contractors Association (NECA):
 - a. NECA 407, "Standard for Installing and Maintaining Panelboards"
 - 2. National Electrical Manufacturers Association (NEMA):
 - a. NEMA AB 1, "Molded Case Circuit Breakers and Molded Case Switches."
 - b. NEMA PB 1, "Panelboards."
 - c. NEMA PB 1.1, "General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less."
 - 3. Underwriter Laboratories (UL):
 - a. UL 50, "Enclosures for Electrical Equipment, Non-Environmental Considerations."
 - b. UL 67, "Standard for Panelboards."
 - c. UL 489, "Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures."

1.4 SEQUENCING

A. Submit the preliminary power system study prior to receiving final approval of equipment and system protective devices submittals and prior to release of equipment drawings for manufacturing. Adjust equipment sizes, frame sizes, and trip units as necessary to achieve performance requirements outlined in Section 26 0573, "Power Systems Studies".

1.5 SUBMITTALS

- A. Product Data: For each type of panelboard,
 - 1. Include materials, switching and overcurrent protective device, accessories, and component indicated.
 - 2. Include manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 6. Include wiring diagrams for power, signal, and control wiring.

C. Closeout Submittals

- 1. Operation and Maintenance Data: For Panelboards and components to include in operation and maintenance manuals.
- 2. In addition to items specified in Division 01 and Section 26 0010 "General Requirements for Electrical Systems", include the following:
 - a. Routine maintenance requirements for panelboards and all installed components.
 - b. Manufacturer's written instructions for testing and adjusting overcurrent protective devices
 - c. Time-current coordination curves for each type and rating of overcurrent protective device included in Panelboards.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An employer of qualified workers as defined in NEMA PB 1.1 and trained in electrical safety as required by NFPA 70E.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Handle and prepare panelboards for installation according to NECA 407 and NEMA PB 1. Handle carefully to avoid damage to internal components, enclosure, and finish.
- B. Comply with manufacturer instructions for storage of electrical equipment to prevent damage from condensation or other environmental concerns.

1.8 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Distribution equipment sizes and equipment layouts shown on drawings shall be considered the basis of design. Equipment sizes vary by manufacturer. If the proposed equipment is physically larger than the sizes illustrated, the burden shall be on the Contractor to provide equipment which fits in the space allotted while maintaining all code-required and manufacturer-recommended clearances.
- C. Drawings indicate space available for electrical equipment, including clearances between equipment and adjacent surfaces and other items. Equipment installed must comply with all clearance, access, and working space requirements of the NEC and Owner.

1.9 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards, circuit breakers, finishes, controls, components, and accessories that fail in materials or workmanship within 12 months 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. ABB.
 - 2. Eaton.
 - Siemens.
 - 4. Square D.
- B. Source Limitations: Obtain panelboards, overcurrent protection devices, and all other electrical distribution equipment through one source from a single manufacturer.

2.2 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70 and NEMA PB 1.
- C. Provide panelboards that are constructed to withstand seismic forces specified in Section 26 0548.16 "Seismic Controls for Electrical Systems."
- D. Provide circuit breaker type panelboards unless noted otherwise.
- E. Enclosures: Flush- or surface-mounted, dead-front cabinets as indicated on drawings.
 - 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - b. Outdoor and Wet Locations: NEMA 250, Type 3R.
 - 2. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover
 - 3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box and keep tight to wall with no gaps allowing access to live parts. Oversize trims will not be acceptable
 - 4. Interior trim shall be of dead-front construction to shield user from all energized parts.
 - 5. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
 - 6. Materials and Finishes:
 - a. Panel Fronts and Trim: Galvanized Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Galvanized steel. Unpainted galvannealed steel is not acceptable.
 - 7. Boxes shall have removable end walls. End walls shall not be provided with concentric knockouts. Boxes shall have welded interior mounting studs. Interior mounting brackets are not required.
 - 8. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover.
 - 9. All lock assemblies shall be keyed alike.

F. Incoming Mains:

- 1. Circuit breaker or Lugs only as indicated on drawings
- 2. Location: Top or bottom to match feeder conduit entry.
- 3. Feeders routed through the side gutters to reach the top or bottom main breakers from the opposite end of the panel are not acceptable.
- 4. Main lugs or main breakers shall have barriers on five sides.

G. Phase, Neutral, and Ground Busses:

- 1. Material: Hard-drawn copper, 98 percent conductivity.
 - a. Bus shall be fully rated the entire length, with one continuous bus bar per phase.
- 2. Phase bussing shall be pre-drilled to accommodate field installable options.
- 3. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
- 4. Equipment Ground Bus: Extend full length of panelboard and adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
- 5. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.

H. Conductor Connectors: Suitable for use with conductor material and sizes.

- 1. Material: Tin-plated aluminum.
- 2. Terminations shall allow use of 75 deg C rated conductors without derating.
- 3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
- 4. Main and Neutral Lugs: Mechanical type.
- 5. Ground Lugs and Bus-Configured Terminators: Mechanical type.
- 6. Feed-Through Lugs: Where indicated provide mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device. Provide where indicated on drawings.
- 7. Subfeed (Double) Lugs: Where indicated provide mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
- 8. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus where indicated.
- I. Service Entrance: Where panelboards are used as service equipment with one or more main service disconnecting and overcurrent protective devices, provide marking by an NRTL acceptable to authority having jurisdiction indicating panelboard is suitable for use as service equipment. Coordinate with utility company for any additional requirements.
- J. Future Devices: Provide mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices. Where panelboards are noted to have "space" or "space only", this shall be prepared space with all bussing, lugs, etc. as required to accept future installation of overcurrent devices.
- K. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Panelboard and overcurrent protective device short circuit ratings shall be at least 110 percent of the actual available fault current.
 - 1. Panelboards rated 240V or less: minimum 10,000 A.

2. Panelboards rated above 240V: minimum 14,000 A.

2.3 DISTRIBUTION PANELBOARDS

- A. Panelboards: NEMA PB 1, power and feeder distribution type.
- B. Provide bolt-on circuit breakers for overcurrent protective devices.
- C. Doors: Secured with three point vault-type latch with tumbler lock; keyed alike. For doors more than 48 inches high, provide two latches.
- D. All panelboards shall be capable of accepting 225 amp 3 pole branch breakers as a minimum unless otherwise noted.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- B. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- C. Doors: Door-in-door construction with concealed hinges; secured with multipoint latch with tumbler lock; keyed alike. Outer door shall permit full access to the panel interior. Inner door shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed.
- D. All panelboards shall have space to accept forty-two 20 amp single pole circuit breakers unless otherwise noted.

2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers:
 - a. Inverse time-current element for low-level overloads.
 - b. Instantaneous magnetic trip element for short circuits.
 - c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. Adjustable Instantaneous-Trip Circuit Breakers:
 - a. Magnetic trip element with front-mounted, field-adjustable trip setting.
 - 3. Electronic trip circuit breakers:
 - a. RMS sensing.
 - b. Field-replaceable rating plug or field-replicable electronic trip.
 - c. Digital display of settings, trip targets, and indicated metering displays.
 - d. Multi-button keypad to access programmable functions and monitored data.
 - e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.

- f. Integral test jack for connection to portable test set or laptop computer.
- g. Field-adjustable Instantaneous, Long- and short-time pickup, and Ground-fault pickup settings.
- 4. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
- 5. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
- 6. AFCI Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
- 7. MCCB features and accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Breaker handle indicates tripped status.
 - c. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - e. Shunt Trip: 120 V or 24V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
 - f. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.
 - g. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
 - h. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
- B. Provide Ground Fault protection for circuit breakers rated 1000 A and higher on solidly grounded wye systems more than 150V to ground.
- C. Provide Arc Flash energy reducing maintenance switch with local status indicator for circuit breakers rated 1200A and higher or where circuit breaker trip setting can be adjusted to 1200A or greater.

2.6 METERING

- A. Where indicated comply with requirements in Section 26 0913, "Electrical Power Monitoring."
- B. Overcurrent Protective Device Communication Capability: Where indicated provide electronic trip circuit breakers and integral communication module with functions and features compatible with power monitoring and control system specified in Section 26 0913, "Electrical Power Monitoring".

2.7 SURGE PROTECTION DEVICES

A. Where panelboards are indicated with integral SPD, comply with requirements in Section 26 4300, "Surge Protective Devices". Factory install SPDs prior to shipment.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.
- B. Receive, inspect, handle, and store panelboards according to NECA 407 and NEMA PB 1.1.
- C. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work. Ensure area to receive panelboard has adequate clearance for panelboard installation.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Install panelboards and accessories according to NECA 407 and NEMA PB 1.1.
- C. Temporary Lifting Provisions: Remove any temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- D. Mount top of trim 90 inches above finished floor unless otherwise indicated or where required to maintain center of trip handle on overcurrent protection devices below 79-inches. Where mounted in groups, align top of trim or tub for all panels in an area.
- E. Mount panelboard cabinet plumb and rigid without distortion of box.
- F. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- G. Provide steel slotted support structures where required for freestanding equipment or where building mounting surface is unsuitable.
- H. Install overcurrent protective devices and controllers not already factory installed. Set field-adjustable, circuit-breaker trip ranges.
- I. Install filler plates in unused spaces.
- J. Stub four (4) 1-inch and two (2) 1-1/4-inch empty conduits from recessed panelboard into accessible ceiling space or space designated to be ceiling space in the future. Provide suitable closures for spare conduits and identify with a suitable label.

- K. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
- L. Comply with NECA 1.

3.3 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B. Where a tightening torque is indicated as a numeric value on equipment or in installation instructions provided by the manufacturer, use a calibrated torque tool to achieve that indicated torque value, unless the equipment manufacturer has provided installation instructions for an alternative method of achieving the required torque.

3.4 IDENTIFICATION

- A. Comply with requirements in Section 26 0553, "Identification for Electrical Systems" and as noted below:
 - 1. Provide a directory card inside each door, covered with a plastic non-yellowing shield. Directory Card to indicate installed circuit loads after balancing panelboard loads. Obtain approval before installing. Use a computer to create directory in Microsoft Excel; handwritten directories are not acceptable. Digital versions to be provided to Owner.
 - 2. The room numbers used to fill out the panel directories shall match the actual final name and numbering scheme selected by the Owner. They shall not be filled out per the construction drawing numbering scheme, unless the Contractor is directed to do so by the Architect or Engineer.
 - 3. Provide nameplate for each panelboard.
 - 4. For distribution panelboards, provide nameplate for each branch circuit device.
 - 5. All distribution equipment shall be shipped from the manufacturer with factory-applied warning labels affixed to the outside front of the equipment (as it will be installed per the plans). All labeling shall be in compliance with NFPA 70 requirements.
 - 6. Labels affixed to equipment by the equipment manufacturer shall comply with drawing and specification labeling requirements or shall be omitted by the manufacturer and field-installed by the Contractor. Labels which are factory-installed and not in compliance shall be removed and replaced and equipment enclosures refinished or replaced by the manufacturer to repair finish.

3.5 FIELD QUALITY CONTROL

- A. Perform the following Tests and Inspections:
 - 1. Visual and Mechanical Inspection:
 - a. Examine equipment nameplate data and confirm proper identification.
 - b. Inspect the physical, electrical, and mechanical condition of the equipment and all components in accordance with the manufacturers' instructions.
 - c. Inspect anchorage, alignment, and grounding.
 - d. Inspect bolted electrical connections and terminations for high resistance by verifying tightness with calibrated torque-wrench method in accordance with manufacturer's published data.
 - e. Exercise all active components.

- f. Inspect all mechanical indicating devices for correct operation.
- g. Physically test key interlock systems to check for proper functionality prior to energizing.

2. Electrical Acceptance Testing:

- a. Perform insulation resistance test for one minute on each panelboard bus, component, connecting supply, feeder, and control circuit. Open control and metering circuits within the panelboard, and remove neutral connection to surge protection and other electronic devices prior to insulation test. Reconnect after test. Test voltages and minimum resistance shall be in accordance with manufacturer's published data.
- 3. Circuit Breaker Testing: For all circuit breakers with electronic trip units, determine minimum pickup current, long-time and short-time pickup and delay, and instantaneous pickup by secondary current injection. Certify compliance with test parameters and ensure settings match recommendations from final approved power system study.
- 4. Test ground-fault protection of equipment for service equipment per NFPA 70.
- 5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- C. Panelboards will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 CLEANING

A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

3.7 ADJUSTING

- A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Section 26 0573, "Power System Studies".
- C. All circuit breakers identified as spares shall be left in the OFF position.

END OF SECTION 26 2416

SECTION 26 2726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General, Special and Supplementary Conditions, Division 01 Specification Sections, and Section 26 0010 "General Requirements for Electrical Systems" apply to this Section.

1.2 SUMMARY

A. This section of the specifications covers all wiring devices and cover plates, standard, weatherproof and dust-tight.

B. Section Includes:

- 1. Straight Blade receptacles.
- 2. GFCI receptacles.
- 3. AFCI receptacles.
- 4. USB receptacles.
- 5. SPD receptacles.
- 6. Twist-locking receptacles.
- 7. Controlled receptacles.
- 8. General use snap switches.
- 9. Manual Motor Control switches.
- 10. Wall Plates.
- 11. Cord and plug sets.
- 12. Floor service fittings.
- 13. Poke-through assemblies.
- 14. Prefabricated multioutlet assemblies.
- 15. Service poles.
- 16. Cord Reels.

1.3 REFERENCES

A. Abbreviations

- 1. AFCI: Arc-fault circuit interrupter.
- 2. CR: Corrosion Resistant
- 3. EMI: Electromagnetic interference.
- 4. GFCI: Ground-fault circuit interrupter.
- 5. IG: Isolated Ground
- 6. SPD: Surge Protective Device
- 7. TR: Tamper Resistant.
- 8. USB: Universal Serial Bus.
- 9. WR: Weather Resistant.

B. Definitions

- 1. Emergency Electrical Systems: Those systems legally required and classed as emergency by NFPA 70 Article 700, municipal, state, other codes, or by any government agency having jurisdiction.
- Essential Electrical Systems: Those systems designed to ensure continuity of electrical power to designated areas and functions of a healthcare facility during disruption of normal power sources, and also to minimize disruption within the internal wiring system as defined by NFPA 70 Article 517 and NFPA 99
- 3. Outlet: A point on the wiring system at which current is taken to supply utilization equipment.
- 4. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- 5. Receptacle. A receptacle is a contact device installed at the outlet for the connection of an attachment plug. A single receptacle is a single contact device with no other contact device on the same yoke. A multiple receptacle is two or more contact devices on the same yoke.
- C. Reference Standards: The following publications are referred to in the text by the basic designation only. The edition/revision of the referenced publications shall be the latest version as of the date of the Contract Documents, unless otherwise specified.
 - 1. National Electrical Contractors Association (NECA):
 - a. NECA 130, "Standard for Installing and Maintaining Wiring Devices"
 - 2. National Electrical Manufacturers Association (NEMA)
 - NEMA WD 1, "General Color Requirements for Wiring Devices"
 - b. NEMA WD 6, "Wiring Devices—Dimensional Specifications"

1.4 SUBMITTALS

- A. Product Data: For each type of product.
- B. Schedules: List of legends and description of materials and process used for pre-marking wall plates.
- C. Samples: Where requested by architect or engineer, one for each type of device and wall plate, in each color specified.

D. Closeout Submittals

- 1. Operation and Maintenance Data: For Wiring Devices to include in operation and maintenance manuals.
- 2. In addition to items specified in Division 01 and Section 26 0010 "General Requirements for Electrical Systems", include the following:
 - a. Manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide product indicated or equal from one of the following:
 - 1. Eaton/Arrow Hart
 - 2. Hubbell
 - 3. Leviton
 - 4. Pass & Seymour/Legrand
- B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.
- C. RoHS compliant.
- D. Devices for Fixtures, Furnishings, and Equipment:
 - 1. Receptacles: Match plug configurations.
 - 2. Cord and Plug Sets: Match equipment requirements.
- E. All terminations shall be side-wired clamping type. "Backstab" terminations or modular connectors are not permitted.

F. Device Color:

- 1. Wiring devices in finished spaces connected to normal power system: Ivory, to be confirmed with architect unless otherwise indicated or required by NFPA 70 or device listing.
- 2. Wiring Devices in unfinished spaces connected to normal power system: Ivory unless otherwise indicated or required by NFPA 70 or device listing.
- 3. Wiring Devices Connected to Emergency or Essential Electrical System: Red.
- 4. SPD Devices: Blue.
- Isolated-Ground Receptacles: Orange or as specified above with orange triangle on face.

G. Wall Plate Color:

- 1. For plastic covers, match device color unless noted otherwise.
- 2. Where normal and essential system devices are ganged under a common wall plate, the plate shall be the color of normal power plates.

2.3 SPECIFICATION GRADE STRAIGHT-BLADE RECEPTACLES

A. Specification Grade Receptacle, Comply with NEMA WD 6, UL 498, FS W-C-596.

		T	T
TYPE	RATING	CONFIGURATION	BASIS OF DESIGN
Duplex	20A, 125V	NEMA 5-20R	Hubbell 5362
Single	20A, 125V	NEMA 5-20R	Hubbell 5361
Duplex-TR	20A, 125V	NEMA 5-20R	Hubbell 5362TR
Duplex-IG	20A, 125V	NEMA 5-20R	Hubbell IG5362
Duplex-WR	20A, 125V	NEMA 5-20R	Hubbell 5362WR
Duplex-CR	20A, 125V	NEMA 5-20R	Hubbell HBL53CM62
Single	30A, 250V	NEMA 6-30R	Hubbell HBL9330
Single	50A, 250V	NEMA 6-50R	Hubbell HBL9367
Single	20A, 250V	NEMA 10-20R	Hubbell HBL9326

2.4 SPECIFICATION GRADE GFCI RECEPTACLES

- A. Specification Grade GFCI Receptacles, Comply with UL 498, FS W-C-596, and UL 943 Class A.
- B. Non-feed through type unless otherwise required, Integral self-testing GFCI with "Test" and "Reset" buttons and LED indicator light that is lighted when the unit is tripped. If critical components are damaged and ground fault protection is lost, power to receptacle shall be discontinued.

TYPE	RATING	CONFIGURATION	BASIS OF DESIGN
Duplex GFCI	20A, 125V	NEMA 5-20R	Hubbell GFRST20
Duplex GFCI with Alarm	20A, 125V	NEMA 5-20R	Hubbell GFRST20A
Duplex GFCI - TR	20A, 125V	NEMA 5-20R	Hubbell GFTRST20
Duplex GFCI - WR	20A, 125V	NEMA 5-20R	Hubbell GFTWRST20
Duplex GFCI - CR	20A, 125V	NEMA 5-20R	Hubbell GFRST52M
GFCI Blank Face	20A, 125V		Hubbell GFBFST20

2.5 SPECIFICATION GRADE AFCI RECEPTACLES

- A. Specification Grade AFCI Receptacles, Comply with UL 498, FS W-C-596, and UL 1699A.
- B. Non-feed through type unless otherwise required, Integral self-testing AFCI with "Test" and "Reset" buttons and LED indicator light that is lighted when the unit is tripped. If critical components are damaged and ground fault protection is lost, power to receptacle shall be discontinued.

TYPE	RATING	CONFIGURATION	BASIS OF DESIGN
Duplex AFCI - TR	20A, 125V	NEMA 5-20R	Hubbell AFR20TR
Duplex AFCI/GFCI -TR	20A, 125V	NEMA 5-20R	Hubbell AFGF20TR
AFCI Blank Face	20A, 125V		Hubbell AFR20BF

2.6 USB RECEPTACLES

- A. USB Charging Receptacle and Outlet, Comply with UL 1310 and USB 3.0 devices.
- B. Dual port, combination USB Type A and C, 5 V dc, and 5 A per receptacle (minimum).

TYPE	RATING	CONFIGURATION	BASIS OF DESIGN
Duplex USB - TR	20A, 125V	NEMA 5-20R	Hubbell USB20AC5
Duplex USB - WR	20A, 125V	NEMA 5-20R	Hubbell USB20AC5WR

2.7 SPECIFICATION GRADE SPD RECEPTACLES

- A. Specification Grade SPD Receptacles, Comply with UL 498, FS W-C-596, and UL 1449, Type 3:
- B. Self-grounding. Integral SPD in line to ground, line to neutral, and neutral to ground. Visual and audible SPD indication, with LED indicator light visible in face of device to indicate device is "active" or "no longer in service.".
- C. SPD Components: Multiple metal-oxide varistors; with a nominal clamp-level rating of 500 V and minimum single transient pulse energy dissipation of 340 J in each mode, according to IEEE C62.41.2 and IEEE C62.45.

TYPE	RATING	CONFIGURATION	BASIS OF DESIGN
Duplex SPD	20A, 125V	NEMA 5-20R	Hubbell HBL5362SA

2.8 HOSPITAL-GRADE RECEPTACLES

- A. Hospital-Grade Receptacles, Comply with requirements above and UL 498 Supplement SD:
- B. Marking: Listed and labeled as complying with NFPA 70, Article 517 "Health Care Facilities".

TYPE	RATING	CONFIGURATION	BASIS OF DESIGN
Duplex	20A, 125V	NEMA 5-20R	Hubbell HBL8300H
Single	20A, 125V	NEMA 5-20R	Hubbell HBL8310
Duplex - TR	20A, 125V	NEMA 5-20R	Hubbell 8300TRA
Duplex - IG	20A, 125V	NEMA 5-20R	Hubbell IG8300
Duplex GFCI	20A, 125V	NEMA 5-20R	Hubbell GFRST83
Duplex GFCI - TR	20A, 125V	NEMA 5-20R	Hubbell GFTRST83
Duplex USB	20A, 125V	NEMA 5-20R	Hubbell USB8300AC5
Duplex SPD	20A, 125V	NEMA 5-20R	Hubbell 8362

2.9 TWIST-LOCKING RECEPTACLES

A. Twist-Lock, Single Receptacles, with matching plug as required by equipment. Comply with NEMA WD 6, UL 498, FS W-C-596.

TYPE	RATING	CONFIGURATION	BASIS OF DESIGN
Single	20A, 125V	NEMA L5-20R	Hubbell HBL2310
Single	20A, 250V	NEMA L6-20R	Hubbell HBL2320
Single	20A, 277V	NEMA L7-20R	Hubbell HBL2330
	,		

2.10 CONTROLLED RECEPTACLES

A. Specification Grade Receptacle, Permanently marked and suitable for use with automatic switching means. Comply with NEMA WD 6, UL 498B, FS W-C-596.

TYPE	RATING	CONFIGURATION	BASIS OF DESIGN
Duplex Single Face Control	20A, 125V	NEMA 5-20R	Hubbell 5362C1TR
Duplex Two Face Control	20A, 125V	NEMA 5-20R	Hubbell 5361C2TR

2.11 GENERAL USE SNAP SWITCHES

A. Switches, 120/277 V, Comply with UL 20 and FS W-S-896.

TYPE	RATING	CONFIGURATION	BASIS OF DESIGN
Single Pole	20A, 120/277V		Hubbell 1221
Double Pole	20A, 120/277V		Hubbell 1222
Three Way	20A, 120/277V		Hubbell 1223
Four Way	20A, 120/277V		Hubbell 1224

B. Pilot-Light Switches, illuminated when switch is ON:

TYPE	RATING	CONFIGURATION	BASIS OF DESIGN
Single Pole	20A, 120/277V		Hubbell 1221PL

C. Illuminated Switches, illuminated when switch is OFF:

TYPE	RATING	CONFIGURATION	BASIS OF DESIGN
Single Pole	20A, 120/277V		Hubbell 1221IL

D. Key-Operated Switches, Factory-supplied key in lieu of switch handle:

TYPE	RATING	CONFIGURATION	BASIS OF DESIGN
Single Pole	20A, 120/277V		Hubbell 1221L
Three Way	20A, 120/277V		Hubbell 1223L
Four Way	20A, 120/277V		Hubbell 1224L

E. Double-Throw, Momentary-Contact, Center-off Switches.

TYPE	RATING	CONFIGURATION	BASIS OF DESIGN
Single Pole	20A, 120/277V		Hubbell 1557
Low Voltage	5A, 24VDC		Hubbell 1557LV

2.12 MANUAL MOTOR CONTROL SWITCHES

- A. Motor-Starting Switches (MSS): "Quick-make, quick-break" toggle type for manual control of single or three phase motors up to 3/4 HP where overload protection is not required or is provided separately, marked to indicate whether unit is on or off.
 - 1. Standard: Comply with NEMA ICS 2, general purpose, Class A.
- B. Fractional Horsepower Manual Controllers (FHPMC): "Quick-make, quick-break" toggle type with integral overload protection for use with single phase motors up to 1HP; marked to show whether unit is off, on, or tripped.
 - 1. Configuration: Non-reversing unless noted otherwise on drawings.
 - 2. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters matched to nameplate full-load current of actual protected motor and ambient temperature; external reset push button; melting alloy type.
 - 3. Red pilot light where indicated on drawings.
 - 4. HOA selector switch with dry contact inputs where indicated on drawings.
- C. Provide with NEMA 1, NEMA 3R or other enclosure suitable for the location and atmosphere.
- D. All manual starters located in finished areas shall be in flush-mounted enclosures.

2.13 PENDANT CORD-CONNECTOR DEVICES

A. Description: Matching, locking-type plug and receptacle body connector, heavy-duty grade.

- B. Body: Nylon, with screw-open, cable-gripping jaws and provision for attaching external cable grip.
- C. External Cable Grip: Woven wire-mesh type made of high-strength, galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.14 CORD AND PLUG SETS

- A. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
- B. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.
- C. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.15 WALL PLATES

- A. Single and combination types shall match corresponding wiring devices.
 - 1. Plate-Securing Screws: Metal with head color to match plate finish.
 - 2. Material for Finished Spaces: Smooth, 0.060-inch high-impact thermoplastic.
 - 3. Material for Unfinished Spaces: type 430 stainless steel.
 - 4. Material for rough service or corrosive locations including gymnasiums, kitchens, mechanical rooms, material management, and food service areas: satin-finished, Type 304 stainless steel.
 - a. For kitchen and food service areas, provide foam gasket behind plate to help prevent water infiltration.
- B. Material for Interior Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.
- C. Wet-location, Weatherproof, in-use cover plates: extra duty, suitable for use with and decorator style devices, die-cast aluminum lockable cover, self-closing, gasketed, standard box mounting.
 - 1. Vertical mounting Hubbell WP26E or equal.
 - 2. Horizontal mounting Hubbell WP26EH or equal.
- D. Cover plates for lighting control devices exposed to severe physical damage: Low profile, flip-up clear polycarbonate cover. STI Stopper or equal.

2.16 FLOOR BOXES AND POKE-THROUGH ASSEMBLIES

- A. Description: Single or multi-service, recess activated, multi-gang floor outlet with devices capable of supplying combinations of power, data, voice, and AV services in a single assembly.
- B. Manufacturers: Subject to compliance with requirements, provide product indicated on drawings or approved equal by one of the following:
 - 1. FSR

- 2. Hubbell
- 3. Legrand (Wiremold)

C. Floor Boxes and Poke-Thru Assemblies

- 1. Comply with UL514A.
- 2. Material: Cast metal or sheet metal with finished interior
- 3. Type: Fully adjustable before and after floor installation.
- 4. Shape: Rectangular or Round
- 5. Designed for use with industry standard wall plates, devices, and modular inserts.
- 6. Painted with corrosion resistant fusion-bonded epoxy, where used in on-grade floor applications.
- 7. Classified for fire resistance up to 2 hours, where used in rated floors.
- 8. Evaluated by UL to meet U.S. safety standards for scrub water exclusion.
- 9. Provide separate paths for management of telecommunications and power cables in compliance with NFPA 76.
- 10. Cover: ADA-compliant, with less than 0.15-inch rise to cover flange, hinged for 180-degree opening, Gasketed, Die-cast powder coated aluminum suitable for multiple floor surfaces.
 - a. Surface style for carpet and VCT floor finishes.
 - b. Flush style for wood, tile, finished concrete, and terrazzo floor finishes.

2.17 PREFABRICATED MULTIOUTLET ASSEMBLIES

- A. Description: Two-piece surface metal raceway, with factory-wired multioutlet harness.
- B. Components shall be products from single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.
- C. Raceway Material: Metal, with manufacturer's standard finish.
- D. Multioutlet Harness:
 - 1. Receptacles: 20-A, 125-V.
 - 2. Receptacle Spacing: 18 inches unless noted otherwise.
 - 3. Wiring: No. 12 AWG solid, Type THHN copper.

2.18 SERVICE POLES

A. Dual-Channel Service Poles

- 1. Description: Factory-assembled and -wired units to route power and communications cabling from connections above ceiling to outlets below ceiling.
- 2. Listed and labeled in accordance with UL 5 for exposed power raceway and fittings, and UL 2024 for communications raceway and fittings.

- 3. Poles: Minimum 2.5-inch-square cross-section, with height adequate to extend from floor to at least 6 inchesabove ceiling, and with separate channels for power wiring and voice and data communication cabling.
- 4. Mounting: Ceiling trim flange with concealed bracing arranged for positive connection to ceiling supports; with pole foot and carpet pad attachment.
- 5. Material: Aluminum.
- 6. Finishes: Manufacturer's standard painted finish and trim combination.
- 7. Wiring: Sized for minimum of five No. 12 AWG power and ground conductors and a minimum of four, balanced twisted pair data communication cables.

2.19 CORD REELS

- A. Description: Reel equipped with, or intended for use with, length of flexible cord, providing means for cord to be unwound by user as desired, providing spring take-up mechanism to rewind cord on reel, and providing latch to restrain action of spring take-up mechanism while cord reel is in use.
- B. Comply with UL 355.
- C. Spring Driven, suitable for industrial and commercial use, No. 12 AWG conductors, 20A rating, Black aluminum housing, Ball stop, pivot base, 40ft spool capacity with double 20A duplex receptacles unless noted otherwise.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Provide receptacles and cover plates listed for the installed environment.
 - 1. Provide corrosion resistant devices where exposed to corrosive environment such as pools and natatoriums.
- B. Outdoor receptacles and receptacles located in wet locations shall be weather resistant, GFCI type, with weather proof enclosure.
- C. Provide GFCI receptacles where required by the NEC in addition to the locations noted on the drawings.
- D. Provide weather-resistant rating for GFCI receptacles installed in wet locations.
- E. Where GFCI receptacles are located in areas that are not readily accessible, provide GFCI blank face device in readily accessible location approved by Architect.
- F. Provide GFCI receptacles with audible alarm for refrigeration and vending applications.
- G. Provide tamper resistant receptacles where required by the NEC in addition to the locations noted on the drawings.
- H. Provide hospital grade wiring devices in all areas, whether in patient care areas or not.

3.2 INSTALLATION

- A. Unless more stringent requirements are specified in Contract Documents or manufacturers' instructions, comply with installation instructions in NECA 130.
- B. Mounting Heights: Unless otherwise indicated in Contract Documents, comply with mounting heights recommended in NECA NEIS 1.
- C. Devices that have been installed before painting shall be masked. No plates or covers shall be installed until all finishing and cleaning has been completed. Replace stained or improperly painted wiring devices and coverplates.
- D. Install non-feed-through GFCI receptacles where protection of downstream receptacles is not required. Where GFCI receptacles share a single circuit with other devices, a ground fault on any GFCI receptacle shall not interrupt power to downstream devices.
- E. Coordination for all receptacles: Confirm receptacle configuration of all special purpose receptacles with approved submittals prior to installation and provide devices to match equipment plugs. Contractor shall replace any incompatible receptacle discovered during owner move-in.

F. Coordination with Other Trades:

- 1. Adjust locations of outlets to suit arrangement of partitions and furnishings. Locate outlets to avoid blocking by supports, furnishings, and other architectural fixtures.
- 2. Adjust locations of floor boxes and poke-throughs to coordinate with locations of structural members, concealed piping, and concealed conduit.
- 3. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
- 4. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
- 5. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
- 6. Install wiring devices after all wall preparation, including painting, is complete.

G. Conductors:

- 1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
- 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
- 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
- 4. Where re-using existing conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - Pigtailing existing conductors is permitted, provided the outlet box is large enough.

H. Device Installation:

- 1. Replace all devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
- 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.

- 3. Do not remove surface protection, such as plastic film and smudge covers, until all finish work is complete.
- 4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
- 5. Use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
- 6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
- 7. When conductors larger than #12 AWG are installed on 15- or 20-A circuits, splice #12 AWG pigtails for device connections.
- 8. Tighten unused terminal screws on the device.
- 9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.
- 10. Install devices and assemblies level, plumb, and square with building lines. Align devices vertically and horizontally. Securely fasten devices into boxes.

I. Device Orientation:

- 1. Install switches with "OFF" position down.
- 2. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the left so the neutral blade is at the top.

J. Device Plates:

- 1. Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
- 2. All outlets not provided with wiring devices shall be closed with a blank plate matching other plates in the area.
- 3. Align coverplate mounting screw slots in the same direction, either vertical or horizontal. Do not overtighten coverplate mounting screws. Overtightening can cause the coverplate to warp, dimple, bend, and in the case of plastic faceplates, crack or break.

3.3 IDENTIFICATION:

- A. Comply with Section 26 0553 "Identification for Electrical Systems."
 - 1. All device wall plates shall be labeled with panel and circuit designation by means of machine printed adhesive tape. Select face plates shall be engraved. Refer to drawings.
 - 2. All device boxes shall have circuit number identified within the box.

3.4 FIELD QUALITY CONTROL

- A. Test Instruments: Use instruments that comply with UL 1436.
- B. Using a test plug, perform the following tests and inspections for receptacles:
 - 1. Insert and remove test plug to verify that devices are securely mounted.
 - 2. Verify correct configuration of hot, neutral, and ground pins.
 - 3. Verify correct operation of ground fault protective devices.
- C. Healthcare Facilities: Test straight-blade receptacles in patient care spaces with receptacle pin tension test instrument in accordance with NFPA 99. Retention force of ground pin must be not less than 4 oz.

- D. Nonconforming Work:
 - 1. Device will be considered defective if it does not pass tests and inspections.
 - 2. Remove and replace defective units and retest.
- E. Prepare test and inspection reports.

END OF SECTION 26 2726

SECTION 26 2813 - FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General, Special and Supplementary Conditions, Division 01 Specification Sections, and Section 26 0010 "General Requirements for Electrical Systems" apply to this Section.

1.2 SUMMARY

A. Description: Provide labor, material, equipment, related services, and supervision required for the installation of cartridge fuses where utilized for overcurrent and/or current limitation applications.

B. Section Includes:

- 1. Cartridge fuses rated 600V-AC and less for use in control circuits, enclosed switches, panelboards, switchboards, and motor controllers.
- 2. Spare fuse cabinet.

1.3 REFERENCES

A. Definitions

- 1. Fuse: A protective device that opens a circuit during specified overcurrent conditions by means of a current responsive element.
- B. Reference Standards: The following publications are referred to in the text by the basic designation only. The edition/revision of the referenced publications shall be the latest version as of the date of the Contract Documents, unless otherwise specified.
 - 1. National Electrical Contractors Association (NECA)
 - a. NECA 420, "Fuse Applications"

1.4 SEQUENCING

A. Submit the preliminary power system study prior to receiving final approval of equipment and system protective devices submittals and prior to release of equipment drawings for manufacturing. Adjust equipment sizes, frame sizes, and trip units as necessary to achieve performance requirements outlined in Section 26 0573, "Power Systems Studies".

1.5 SUBMITTALS

- A. Product Data: For each fuse type indicated:
 - 1. Include let-through current curves for fuses with current-limiting characteristics.
 - 2. Time-current curves, coordination charts and tables, and related data.
- B. Ambient Temperature Adjustment Information: Where ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
 - 1. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
 - 2. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.

C. Closeout Submittals

- Operation and Maintenance Data: For Fuses include in emergency, operation, and maintenance manuals
- 2. In addition to items specified in Division 01 and Section 26 0010 "General Requirements for Electrical Systems", include the following:
 - a. Let-through current curves for fuses with current-limiting characteristics.
 - b. Time-current curves, coordination charts and tables, and related data.
 - c. Ambient temperature adjustment information.

1.6 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels indicated in power system study.

1.7 MAINTENANCE MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fuses: Equal to one spare for every 10 installed units, but not less than 5 units for each size and type.
 - 2. Fuse Pullers: Two for each size and type.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace fuses that fail in materials or workmanship within 12 months from date of Substantial Completion.

1.9 FIELD CONDITIONS

A. Where ambient temperature to which fuses are exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Bussmann, Inc.
 - 2. Littlefuse, Inc.
 - Mersen USA.
- B. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

2.2 GENERAL REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with:
 - 1. NEMA FU 1 Low Voltage Cartridge Fuses.
 - 2. UL 248 Standard for Low Voltage Fuses.
 - 3. UL 512 Fuseholders.

2.3 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, current limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.
 - 1. Type RK-1: 250 or 600-V, zero- to 600-A rating, 200 kAIC minimum, fast acting or time delay.
 - 2. Type RK-5: 250 or 600-V, zero- to 600-A rating, 200 kAIC minimum, fast acting or time delay.
 - 3. Type CC: 600-V, zero- to 30-A rating, 200 kAIC minimum, fast acting or time delay.
 - 4. Type L: 600-V, 601- to 6000-A rating, 200 kAIC minimum, time delay option.
- B. Voltage: Rating suitable for circuit phase-to-phase voltage.
- C. Provide dual element fuses with separate overload and short circuit elements.

2.4 SPARE-FUSE CABINET

- A. Manufacturer: Bussmann #SFC-FUSE-CAB spare fuse cabinet or equal.
- B. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.
 - 1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
 - 2. Finish: Gray, baked enamel.

- 3. Identification: "SPARE FUSES" in 1-1/2 inch high white letters on black lamicoid plate. Mount plate on exterior of door.
- 4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPICATIONS

- A. Service, Feeders, and Branch Circuits (601-6000A): Class L, time delay. Bussmann HI-CAP Fuses KRP-C or equal. Fuses shall hold 500% of rated current for a minimum of 4 seconds.
- B. Feeders and Branch Circuits (0-600A): Class RK1, time delay. Bussmann Low-Peak Dual Element Fuses, LPN-RK (250 volts) or LPS-RK (600 volts) or equal. The fuse shall hold 500% of rated current for a minimum of 10 seconds.
- C. Motor Circuits Class RK1 or Class L, time delay as indicated above.
 - 1. Motor with 1.15 service factor: Size at 125% of motor FLA. For high inrush current applications size 150% to 200% of motor FLA.
 - 2. Motor with 1.0 service factor: Size at 115% of motor FLA.
- D. Control Circuits: Class CC, time delay. Bussmann Low-Peak Fuses LP-CC or equal. Fuses shall hold 200% of rated current for a minimum of 12 seconds.
- E. Adjust fuse type and selection as required to ensure available fault current at equipment controllers indicated in power systems study does not exceed labeled SCCR values.

3.3 INSTALLATION

A. Fuses shall be shipped separately. Any fuses shipped installed in equipment, shall be replaced by the Electrical Contractor with new fuses as specified above prior to energizing at no additional expense to

Owner. All fuses shall be stored in moisture free packaging at job site and shall be installed immediately prior to energizing of the circuit in which it is applied.

- B. No fuses shall be installed in the equipment until the installation is complete, including tests and inspections required prior to being energized. All fuses shall be of the same manufacturer to ensure retention of selective coordination, as designed.
- C. Provide a complete set of fuses for all fusible devices. Arrange fuses so rating information is readable without removing fuse.
- D. Install spare-fuse cabinet(s). Locate in Main Electrical Room.
- E. Upon completion of the building, the Contractor shall provide the Owner with spare fuses in Spare-Fuse Cabinet.

3.4 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Section 26 0553 "Identification for Electrical Systems".
 - 1. Indicate fuse rating and type on the outside door of each fused switch.

END OF SECTION 26 2813

SECTION 26 2816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General, Special and Supplementary Conditions, Division 01 Specification Sections, and Section 26 0010 "General Requirements for Electrical Systems" apply to this Section.

1.2 SUMMARY

A. Description: Section includes requirements for the provision of individually enclosed switches and circuit breakers including manufacturing, fabrication, configuration and installation as required for the complete performance of the Work, as shown on the drawings and specifications

B. Section includes:

- 1. Fusible and Non-Fusible Switches.
- 2. Enclosed Circuit Breakers.
- 3. Elevator Shunt Trip Switches.
- 4. Enclosures.

1.3 REFERENCES

A. Abbreviations

- 1. HD: Heavy Duty
- 2. MCCB: Molded Case Circuit Breaker
- 3. NC: Normally Closed
- 4. NO: Normally Open
- 5. SCCR: Short Circuit Current Rating

B. Definitions

- 1. Disconnect: A switch, device, group of devices, or other means used to disconnect conductors of a circuit from their source of supply.
- 2. Switch (switching device): A device, manually operated, unless otherwise designated, for opening and closing or for changing the connection of a circuit. Also referred to as safety switches or disconnect switches.

1.4 SEQUENCING

A. Submit the preliminary power system study prior to receiving final approval of equipment and system protective devices submittals and prior to release of equipment drawings for manufacturing. Adjust equipment sizes, frame sizes, and trip units as necessary to achieve performance requirements outlined in Section 26 0573, "Power Systems Studies".

1.5 SUBMITTALS

- A. Product Data: For each product type.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Short-circuit current ratings (interrupting and withstand, as appropriate).
 - 3. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
- B. Shop Drawings: For each type of enclosed switch, circuit breaker, accessory, and component indicated.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of overcurrent protective devices.
 - 5. Include evidence of NRTL listing for series rating of installed devices.
 - 6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 7. Include wiring diagrams for power, signal, and control wiring.
 - 8. Cable terminal size and quantity.

C. Closeout Submittals

- 1. Operation and Maintenance Data: For enclosed switches and circuit breakers include in emergency, operation, and maintenance manuals.
- 2. In addition to items specified in Division 01 and Section 26 0010 "General Requirements for Electrical Systems", include the following:
 - a. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.6 COORDINATION

A. Product Selection for Restricted Space: Drawings indicate space available for enclosed switches including clearances between enclosed switches and adjacent surfaces and other items. Furnish and install equipment to comply with NEC clearances.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace devices that fail in materials or workmanship within 12 months 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. ABB/General Electric.
- Eaton Electrical Inc.
- 3. Siemens.
- 4. Square D
- B. Source Limitations: Obtain enclosed switches, overcurrent protection devices, and all other electrical distribution equipment through one source from a single manufacturer unless approved otherwise.

2.2 GENERAL REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.
- C. Service-Rated Switches and Circuit Breakers: Labeled for use as service equipment.
- D. Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Switch and overcurrent protective device short circuit ratings shall be at least 110% of the actual available fault current.

2.3 FUSIBLE AND NON-FUSIBLE SWITCHES

- A. Type HD, Heavy Duty, Single Throw, 250-VAC or 600-VAC, 1200 A and Smaller unless noted otherwise.
- B. Quick-make, quick-break operating handle and switch mechanism integral to box.
- C. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate fuses where indicated.
- D. Externally operable dual interlocked handle to prevent opening front cover with switch in ON position, or closing switch when door is open. Visible load interrupter knife switch blades in the off position with door open.
- E. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- F. All current carrying parts shall be plated by an electrolytic process to resist corrosion and to promote cooling.

G. Accessories:

- 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
- 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
- 3. Lugs: UL Listed, mechanical type, front removeable, and suitable for number, size, and conductor material at 75 deg C.
- 4. Auxiliary Contact Kit: NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating as required for application.

ENCLOSED SWITCHES AND CIRCUIT BREAKERS 26 2816 - 4 04/24/2025

- 5. Electrical Interlock Kit: Pivot arm operated from the switch mechanism, breaking a control circuit before the main switch blades break.
- H. For receptacle switches provide interlocking linkage between the receptacle and switch mechanism to prevent inserting or removing plug while switch is in the on position, inserting any plug other than specified, and turning switch on if an incorrect plug is inserted or correct plug has not been fully inserted into the receptacle.

2.4 ENCLOSED MOLDED-CASE CIRCUIT BREAKERS

- A. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.
- B. Circuit breakers shall be constructed using glass-reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.
- C. Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over center, be trip free, and reside in a tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit-breaker tripping mechanism for maintenance and testing purposes.
- D. MCCBs shall be equipped with a device for locking in the open position.
- E. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- F. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
 - 1. Long-time, Short-time, and Instantaneous trip unless noted otherwise on drawings.
- G. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.
- H. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single-, two-pole, and three-pole configurations with Class A ground-fault protection (6-mA trip).
- I. Ground-Fault Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).
- J. Features and Accessories:
 - 1. Standard frame sizes, trip ratings, and number of poles.

- 2. Lugs: UL Listed, mechanical type, suitable for number, size, trip ratings, and conductor material at 75 deg C.
- Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-totest feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
- 4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact. Coordinate coil voltage and provide control circuits as required for application.

2.5 ELEVATOR SHUNT TRIP SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Bussmann
 - 2. Eaton
 - 3. Littlefuse
 - 4. Mersen
- B. General Requirements: Comply with ASME A17.1, UL 50, and UL 98, with Class J fuse block and 200-kA interrupting and short-circuit current rating.
- C. Type HD, Heavy-Duty, Three Pole, Single-Throw Fusible Switch; UL 98 and NEMA KS 1; integral shunt trip mechanism; horsepower rated, with clips or bolt pads to accommodate fuses; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
- D. Control Circuit: 120-V ac; obtained from integral control power transformer, with primary and secondary fuses.

E. Accessories:

- 1. Key switch for key-to-test function.
- 2. Red ON pilot light.
- 3. Isolated neutral lug.
- 4. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.
- 5. Form C alarm contacts that change state when switch is tripped.
- 6. Three-pole, double-throw, fire-safety and alarm relay; 24-V dc coil voltage.
- F. Three-pole, double-throw, fire-alarm voltage monitoring relay complying with NFPA 72.

2.6 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
 - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 - 2. Outdoor and Wet Locations: NEMA 250, Type 3R.
 - 3. Kitchen and Wash-Down Areas: NEMA 250, Type 3R, stainless steel.
- B. Enclosure Finish: The enclosure shall be finished with the standard manufacturer gray finish.

C. Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- C. Securely fasten each switch and circuit breaker to the supporting structure or wall, utilizing a minimum of four (4) 1/4-inch bolts. Do not mount in an inaccessible location or where the passageway to the switch may become obstructed.
- D. After equipment has been installed, inspected, and is ready to be energized, install fuses in fusible devices in accordance with equipment nameplates and Section 26 2816, "Fuses".
- E. Comply with NFPA 70 and NECA 1.
- F. Provide electrical interlock kit and low voltage wiring where utilized on the line side of VFD controller to shut down VFD prior to disconnection of power. Coordinate control wire termination with Division 25.
- G. Provide electronic trip breakers where required to achieve performance requirements outlined in Section 26 0573, "Power Systems Studies".
- H. Provide fusible switches with current limiting fuses or current limiting circuit breaker for equipment disconnecting means where equipment short circuit current rating is insufficient for available fault current.
- I. Where battery lowering devices are specified with Elevators, provide connection between an auxiliary contact at the elevator disconnect and the battery lowering device.
- J. Where enclosed breakers or switched are provided on the load side of a VFD, provide connection between and auxiliary contact at the disconnect and the VFD that will trigger a freewheel stop on the VFD before the disconnect contacts open.

3.3 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B. Where a tightening torque is indicated as a numeric value on equipment or in installation instructions provided by the manufacturer, use a calibrated torque tool to achieve that indicated torque value, unless the equipment manufacturer has provided installation instructions for an alternative method of achieving the required torque.

3.4 IDENTIFICATION

- A. Comply with requirements in Section 26 0553, "Identification for Electrical Systems"
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with nameplate.

3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Visual and Mechanical Inspection:
 - a. Examine equipment nameplate data and confirm proper identification.
 - b. Verify and record fuses sizes and types are in accordance with nameplates and power systems study.
 - c. Inspect the physical, electrical, and mechanical condition of the equipment and all components in accordance with the manufacturers' instructions.
 - d. Inspect anchorage, alignment, and grounding.
 - e. Inspect bolted electrical connections and terminations for high resistance by verifying tightness with calibrated torque-wrench method in accordance with manufacturer's published data.
 - f. Exercise all active components to ensure proper mechanical operation.
 - g. Check all interlocking systems for correct operation.
 - Circuit Breaker Testing: For all circuit breakers with electronic trip units, determine minimum pickup current, long-time and short-time pickup and delay, and instantaneous pickup by secondary current injection. Certify compliance with test parameters and ensure settings match recommendations from final approved power system study.
 - 3. Test ground-fault protection of equipment for service equipment per NFPA 70.
 - 4. Test all auxiliary devices/system interfaces and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Switches and Circuit Breakers will be considered defective if they do not pass tests and inspections.
- C. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Prepare test and inspection reports, including a certified report that identifies switches and circuit breakers included and that describes results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Section 26 0573 "Power System Studies".

END OF SECTION 26 2816

SECTION 26 2900 - MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General, Special and Supplementary Conditions, Division 01 Specification Sections, and Section 26 0010 "General Requirements for Electrical Systems" apply to this Section.

1.2 SUMMARY:

- A. Extent of motor starter work is indicated by drawings and schedules.
- B. Section includes:
 - 1. Combination full voltage, non-reversing Motor Controllers.
 - 2. Combination Soft Start Motor Controllers
- C. Related Requirements:
 - 1. Refer to Section 26 0500 "Common Work Results for Electrical Systems" for additional requirements related to motors connections.
 - 2. Refer to Section 26 2726 "Wiring Devices" for information on manual motor controllers.
 - 3. Refer to Division 25 for coordinating requirements related to control system interface points.

1.3 REFERENCES

A. Abbreviations

- 1. FVNR: Full Voltage Non Reversing
- 2. MCP: Motor Circuit Protector
- 3. OCPD: Overcurrent protective device
- 4. SCCR: Short Circuit Current Rating
- 5. SCPD: Short-circuit protective device
- SCR: Silicon Controlled Rectifier

B. Definitions

1. Soft Starter: Solid state reduced voltage non-reversing motor controller

1.4 SEQUENCING

A. Submit the preliminary power system study prior to receiving final approval of equipment and system protective devices submittals and prior to release of equipment drawings for manufacturing. Adjust equipment sizes, frame sizes, and trip units as necessary to achieve performance requirements outlined in Section 26 0573, "Power Systems Studies".

1.5 SUBMITTALS:

- A. Product Data: For each type of product.
- B. Shop Drawings: For each type of product.
 - Include wiring diagrams for signal and control wiring. Clearly identify manufacturer-installed and field installed wiring.
 - 2. Include features and factory settings of individual protective devices and auxiliary components.

C. Closeout Submittal:

- 1. Operation and Maintenance Data: For motor controllers to include in operation and maintenance manuals.
- 2. In addition to items specified in Division 01 and Section 26 0010 "General Requirements for Electrical Systems", include the following:
 - a. Routine maintenance requirements for magnetic controllers and installed components.
 - b. Manufacturer's written instructions for testing and adjusting circuit breaker and motor circuit protector trip settings.
 - c. Manufacturer's written instructions for setting field-adjustable overload relays.
 - d. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor-running overload protection suit actual motors to be protected.

1.6 MAINTENANCE MATERIAL

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fuses: Equal to one spare for every 10 installed units, but not less than 5 units for each size and type.
 - 2. Overloads: Equal to one spare for every 9 installed units, but not less than 3 units for each size and type.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace enclosures, starters, overcurrent protective devices, accessories, and factory installed interconnection wiring that fail in materials or workmanship within 12 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS:

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

- B. UL Compliance and Labeling: Fabricate and label motor controllers to comply with UL 508.
- C. NEC Compliance: Comply with NEC as applicable to wiring methods, construction and installation of motor starters.
- D. NEMA Compliance: Comply with applicable portions of NEMA standards pertaining to motor controllers/starters and enclosures.

2.2 MANUFACTURERS:

- A. Manufacturer: Subject to compliance with requirements, provide products from one of the following:
 - 1. ABB/General Electric
 - 2. Allen Bradley Co.
 - 3. Eaton
 - 4. Siemens.
 - 5. Square D. Co.

2.3 MANUAL MOTOR CONTROLLERS

A. Refer to Section 26 2726 "Wiring Devices" for manual motor controller requirements.

2.4 COMBINATION FULL VOLTAGE MOTOR CONTROLLER

- A. Description: Factory-assembled, combination full-voltage, non-reversing magnetic motor controller consisting of the controller, indicated disconnecting means, SCPD, OCPD, pushbuttons, selector switch(es), and indicator lights in a single enclosure.
- B. All combination starter/disconnect switches shall have low-voltage protection, solid state overloads, start / stop pushbuttons, Hand-Off-Auto selector switch and Red and Green pilot lights.
- C. All combination starter/disconnect switches shall be Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- D. Combination motor starters shall be rated in accordance with NEMA sizes and horsepower ratings. No starter shall be listed as a fractional size. Contactor contacts shall be silver alloy, double break, and shall allow for inspection on NEMA Sizes 00 through 4 without the use of tools. Size 5 and larger shall allow for inspection utilizing standard tools. They shall be replaceable without removing the line, load, or control wiring from the starter, and replaceable without removing the starter from the enclosure.
- E. Contactor coils shall be the encapsulated type, and shall be replaceable on NEMA Sizes 00 through 4 without the use of tools. Size 5 and larger shall be replaceable with standard tools. They shall be replaceable without removing the line, load, or control wiring from the starter, and replaceable without removing the starter from the enclosure.
- F. Overload protection shall be provided by solid state electronic overload relay. Single-phase starters shall provide one- or two-leg overload protection; three-phase starters shall provide three-leg overload

protection. Overload protection shall be class 10/20 selectable, have visible trip indicator, and manual or remote reset function.

- G. Starter shall include phase failure relay with under-voltage protection.
- H. Starter shall have integral controls transformer with primary and secondary fusing.
- I. Starter to have two normally closed and two normally open auxiliary contacts.
- J. Combination starter shall be suitable for straight through wiring.
- K. Fusible Disconnecting Means: Heavy Duty, quick-make, quick-break, load break rated, such that during normal operation of the switch, the operation of the contacts shall not be capable of being restrained by the operating handle after the closing and opening action of the contacts has started. The handle and mechanism shall be an integral part of the box (not cover) with facilities for pad locking in the open or closed position with up to three padlocks. Switch doors shall be interlocked with switch handle so that the door can only be opened when the switch is in the "OFF" (open) position.
- L. All safety switches shall have a factory installed neutral lug, when a neutral is necessary.
- M. All current carrying parts shall be plated by an electrolytic process to resist corrosion and to promote cooling.
- N. Provide the following Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 3. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.5 COMBINATION SOFT START MOTOR CONTROLLER

- A. Description: Factory Assembled, Solid state, reduced voltage, non-reversing motor controller consisting of controller, disconnecting means, protection devices, microprocessor with digital keypad in a single enclosure.
- B. Enclosure shall include a door mounted digital keypad for adjusting the soft starter parameters and viewing process values and viewing the motor and soft starter status without opening the enclosure door. Provisions shall be available for padlocking the enclosure door.
- C. The enclosed product shall be provided with molded case disconnect switch and in-line fuse block for Class J power fuses from 10 to 600A or Class L power fuses from 601 to 1600A for Type 1 short circuit protection.
- D. The motor must be automatically protected from solid state component failure by an isolation contactor that opens when the motor is stopped or when the controller detects a fault condition including a shorted SCR.

- E. The soft starter shall utilize an SCR bridge consisting of at least two SCRs per phase to control the starting and stopping of industry standard motors.
- F. The soft start shall provide torque control for linear acceleration independent of motor load or application type without external feedback. The gating of the SCRs will be controlled in such a manner to ensure stable and linear acceleration ramp.
- G. The soft starter shall be controlled by a microprocessor that continuously monitors the current and controls the phasing of the SCRs. Analog control algorithms shall not be allowed.
- H. A shorting contactor shall be standard on soft starters in all enclosure configurations. Protective features and deceleration control options integral to the soft starter shall be available even when the shorting contactor is engaged.
- I. The SCRs shall have a minimum P.I.V. rating of 1800 Vac. Lower rated SCRs with MOV protection are not acceptable.
- J. All programming/configuration devices, display units, and field control wiring terminals shall be accessible on the front of the control module. Exposure to control circuit boards or electrical power devices during routine adjustments is prohibited.
- K. Digital indication shall provide, as a minimum, the following conditions:
 - 1. Soft starter status ready, starting/stopping, run.
 - 2. Motor status current, torque, thermal state, power factor, operating time, power in kW.
 - 3. Fault status Motor thermal overload, soft starter thermal fault, loss of line or motor phase, line frequency fault, low line voltage fault, locked rotor fault, motor underload, maximum start time exceeded, external fault, serial communication fault, line phase reversal fault, motor overcurrent fault.
- L. The soft starter must be preset to the following for adjustment-free operation in most applications:
 - 1. Linear (torque-controlled) acceleration ramp of 15 seconds.
 - 2. Current limitation to 400% of the motor full load current rating.
 - 3. Class 10 overload protection.
 - 4. Motor current preset per NEC / NFPA 70 table 430.150 for standard hp motors.
- M. A digital keypad shall be utilized to configure operating and controller parameters such as FLA, acceleration ramp, torque, braking type, thermal overload Class, reset functions, etc.
- N. Provide output relays to provide the following status indications:
 - 1. One Form A (N.O.) minimum for indication of fault.
 - 2. One Form A (N.O.) for indication that acceleration ramp is complete and current is below 130% motor FLA (end of start).
 - 3. One Form A (N.O.) assignable to one of the following functions: motor thermal alarm, motor current level alarm, and motor underload alarm.

- O. A microprocessor-based thermal protection system shall be included which continuously calculates the temperature-rise of the motor and soft starter and provides:
 - 1. A motor overload pre-alarm that indicates by relay contact or logic output that the motor windings have exceeded 130% of its rated temperature rise. This function shall be for alarm only.
 - 2. A motor overload fault will stop the motor if the windings have exceeded 140% of temperature-rise.
 - 3. An electronic circuit with a time-constant adjustable to the motor's thermal cooling time-constant ensuring the memorization of the thermal state even if power is removed from the soft starter.
 - 4. The soft starter shall provide line and motor phase loss, phase reversal, underload, stall, and jam protection.
 - 5. The integral protective features shall be active even when the shorting contactor is used to bypass the SCRs during steady state operation.
 - 6. The soft starter control circuit shall be fed from the line supply and be completely independent of the power circuit and separate from the control logic.
- P. The peripheral soft starter control circuitry shall be operated at 120 Vac 60 Hz from a control power transformer included within the enclosure.
- Q. Operator devices shall be door mounted and shall be:
 - 1. Red STOP and black START push buttons.
 - 2. Three position H-O-A switch which provides for manual (HAND) start or remote signal (AUTO) start from user-supplied relay contacts.
 - 3. Three position FWD-OFF-REV switch provides forward, off and reverse selector switch mounted on the door (available with reversing starter only).
 - 4. Red RUN pilot light illuminated whenever the soft starter is provided a run command and no fault condition is present.
 - 5. Green OFF pilot light illuminated whenever the soft starter is supplied with control power and no run command is present.
 - 6. All operator devices shall be remote-mounted using supplied 120 Vac control logic. Clearly labeled terminals shall be provided for field installation.
- R. Provide a shorting contactor that shall close, shorting the SCRs after the acceleration ramp is compete and motor current is below 130% of motor FLA, and open on a stop command to allow a deceleration ramp. Overload protection integral to the soft starter shall continue to protect the motor when shorting is engaged. A microprocessor shall control the operation of the shorting contactor via an output relay.
- S. Provide full voltage bypass starter with overload protection to provide motor operation in the event of soft starter failure. Provide "NORM/BYPASS" selector switch on enclosure door.

PART 3 - EXECUTION

3.1 MOTOR CONTROLLER APPLICATION

A. FVNR and Soft Starter type motor controllers shall be combination type starter and disconnect switch unless noted otherwise on plans.

- B. Starters smaller than 10HP shall be full voltage non-reversing type (FVNR). Starters 10HP and larger shall be soft starters.
- C. SCCR ratings shall exceed the available fault current calculated by the power system study as required by Section 26 0573, "Power System Studies".
- D. The starter shall be designed to operate in the environment in which installed including ambient temperature, humidity, and elevation.

E. Enclosure:

- 1. Type of each starter to comply with environmental conditions at installed location:
 - a. Indoor, Dry and Clean Locations: NEMA 250, Type 1
 - b. Outdoor Locations: NEMA 250, Type 3R.
 - c. Kitchen and Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
- 2. Provide provisions for padlocking the enclosure door.

3.2 EXAMINATION

- A. Examine elements and surfaces to receive motor starters for compliance with installation tolerances, relationship to motors, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION OF MOTOR CONTROLLERS:

- A. Install motor starters as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA, and NECA standards, and in compliance with recognized industry practices to ensure that products fulfill requirements.
- B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- C. Securely fasten each switch, circuit breaker and combination starter to the supporting structure or wall, utilizing a minimum of four (4) 1/4 inch bolts.
- D. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and NEC. Do not mount in an inaccessible location or where the passageway to the switch may become obstructed.
- E. Install fuses in fusible devices in accordance with Section 26 2813, "Fuses".
- F. Select and set overloads on the basis of full-load current rating as shown on motor nameplate.
- G. Verify that overcurrent and overload protection devices are properly matched to actual motor nameplate data and service class.

- H. Provide conductor reducers, taps and splices, as required, for proper termination of all branch circuits and feeders at disconnect switches, panelboards, motor starters, VFDs, etc. This shall include where conductors have been oversized to accommodate voltage drop, motor circuit conductor protection, and all instances where conductors are unable to terminate at factory lugs.
- I. Final 18 inch of power wiring to motor shall be in liquid tight flexible conduit.

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B. Where a tightening torque is indicated as a numeric value on equipment or in installation instructions provided by the manufacturer, use a calibrated torque tool to achieve that indicated torque value, unless the equipment manufacturer has provided installation instructions for an alternative method of achieving the required torque.

3.5 IDENTIFICATION

- A. Comply with requirements in Section 26 0553, "Identification for Electrical Systems"
 - 1. Identify field-installed conductors, interconnecting wiring, and components.
 - 2. Provide Warning Signs.
 - 3. Label each enclosure with nameplate.

3.6 FIELD QUALITY CONTROL:

- A. Perform Test and Inspections:
 - 1. Visual and Mechanical Inspection:
 - a. Compare equipment nameplate data with drawings and specifications.
 - b. Inspect physical and mechanical condition.
 - c. Inspect anchorage, alignment, and grounding.
 - d. Verify the unit is clean.
 - e. Inspect contactors:
 - 1) Verify mechanical operation.
 - 2) Verify contact gap, wipe, alignment, and pressure are according to manufacturer's published data.
 - f. Motor Protection:
 - 1) Verify overload element rating is correct for its application.
 - 2) If motor-running protection is provided by fuses, verify correct fuse rating.
 - g. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench or low resistance ohmmeter. Bolt-torque levels and/or bolted connection resistance values shall be according to manufacturer's published data.
 - h. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
 - Electrical Tests:

- a. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Insulation-resistance values shall be according to manufacturer's published data.
- b. Test motor protection devices according to manufacturer's published data.
- c. Verify voltages at the controller locations are within plus or minus 10 percent of the motor nameplate rated voltages. If outside the range for any motor, notify the design team before starting the motor.
- d. Perform operational tests by initiating control devices.
- e. Test all auxiliary devices/system interfaces and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Motor controller will be considered defective if it does not pass tests and inspections.
- C. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance, otherwise replace with new units and retest.
- D. Prepare test and inspection reports, including a certified report that identifies motor controllers included and that describes results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION 26 2900

SECTION 26 4100 - FACILITY LIGHTNING PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General, Special and Supplementary Conditions, Division 01 Specification Sections, and Section 26 0010 "General Requirements for Electrical Systems" apply to this Section.

1.2 SUMMARY

- A. Section includes requirements for providing a complete UL master labeled traditional lightning protection system for ordinary structures.
- B. Related Requirements:
 - 1. Refer to Section 26 0526, "Grounding and Bonding for Electrical Systems" for additional requirements related to grounding electrodes and connections.
 - 2. Refer to Section 26 4300, "Surge Protection Devices" for additional requirements related to surge suppression.

1.3 REFERENCES

A. Abbreviations

- 1. LPI: Lightning Protection Institute
- 2. LPS: Lightning Protection System

B. Definitions

- 1. Grounding: Establishing a direct or indirect connection to Earth or some conducting body that serves in place of Earth.
- 2. Bonding: Method by which all non-energized conductive materials are effectively interconnected to create a low impedance path.
- C. Reference Standards: The following publications are referred to in the text by the basic designation only. The edition/revision of the referenced publications shall be the latest version as of the date of the Contract Documents, unless otherwise specified.
 - 1. National Fire Protection Association (NFPA)
 - a. NFPA 780, Standard for the Installation of Lightning Protection Systems
 - 2. Underwriters' Laboratories (UL)
 - a. UL 96, Standard for Lightning Protection Components

1.4 COORDINATION

A. Coordinate system scope and layout requirements, attachment methods, and envelope penetrations with architectural roof plans, elevations, and sections.

1.5 PREINSTALLATION MEETINGS

- A. Schedule preconstruction conference with Architect, Owner, and all affected trades. Agenda topics should include, but are not limited to, the following:
 - 1. System Installation Schedule.
 - 2. Planned down conductor routing.
 - 3. Planned building enclosure penetrations.
 - 4. Building material compatibility.
 - 5. Cutting and patching requirements.
 - 6. Surge protection requirements.

1.6 SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Indicate compliance with performance requirements and design criteria, including analysis data signed and sealed by qualified professional responsible for their preparation.
 - 1. Include layouts of the lightning protection system, with details of the components to be used in the installation.
 - 2. Include raceway locations needed for the installation of conductors.
 - 3. Details of air terminals, ground rods, ground rings, conductor supports, splices, and terminations, including concealment requirements.
 - 4. Include roof attachment and penetration details, coordinated with roof installation warranty.
 - 5. Calculations required by NFPA 780 for bonding of metal bodies.
- C. Delegated Design: For system layout, in addition to submittals listed above, indicate compliance with performance requirements and design criteria, including analysis data signed and sealed by qualified professional responsible for their preparation.
- D. Qualification Data: For Installer.
- E. Product Certificates: For each type of roof adhesive for attaching the roof-mounted air terminal assemblies, approved by the roofing-material manufacturer.
- F. Sample Warranty.
- G. Closeout Submittals
 - 1. Operation and Maintenance Data: For lightning protection system to include in maintenance manuals.

- 2. In addition to items specified in Division 01 and Section 26 0010 "General Requirements for Electrical Systems" include the following:
 - a. A system testing and inspection record, listing the results of inspections and ground resistance tests, as recommended by NFPA 780, Annex D.
- 3. As-Built Data: Dimensioned site plan showing dimensioned route of the grounding electrodes.

H. Completion Certificate:

1. UL Master Label Certificate suitable for fastening to building for display.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Regularly engaged in manufacturer of lightning protection equipment, of types, sizes and ratings required, whose products have been satisfactorily used in similar service for not less than 5 years. The firm shall be a member of and certified by the Lighting Protection Institute.
- B. Installer Qualifications: A firm with at least 3 years of successful installation experience on projects with lightning protection work similar to that required for project
 - 1. The System Design shall be completed and the shop drawing stamped by an LPI Certified Master Installer Designer of Lightning Protection Systems.
 - 2. The installing contractor shall be listed with the Lightning Protection Institute, and Underwriters' Laboratories, Inc.
 - 3. The installation contractor shall have personnel on staff Certified by the LPI as a Master Installer Designer of lightning protection systems.
 - 4. LPI qualified staff, Journeyman or higher, shall provide on-site supervision of the installation.

1.8 WARRANTY

A. Furnish a 10-year adhesion warranty for all adhesives.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products from one of the following:
 - 1. East Coast Lightning Protection
 - 2. Harger
 - 3. nVent Erico
 - 4. Thompson Lightning Protection
 - 5. VFC/Lyncole
- B. Source Limitations: Obtain components through one source from a single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. NFPA Lightning Protection Standard: Comply with NFPA 780 requirements for Class I materials on structures not exceeding 75ft and Class II materials on structures or portions of structures exceeding 75ft.
- B. Lightning Protection Components, Devices, and Accessories: Listed and labeled by a qualified testing agency suitable to the Authority Having Jurisdiction as complying with UL 96, and marked for intended location and application.
- C. Surge Suppression products for the electrical service entrance and communication services shall comply with NFPA 780 and UL 1449

2.3 MATERIALS

- Comply with minimum Class I and Class II material requirements as listed in NFPA 780.
- B. Air Terminals:
 - 1. Aluminum unless otherwise required due to adjacent materials or existing conditions.
 - Safety tip
 - 3. Threaded base support: Adhesive type for membrane roof, non-penetrating clamp for standing seam metal roof.
- C. Main and Secondary Conductors:
 - 1. Aluminum unless otherwise required due to adjacent materials or existing conditions.
 - 2. Smooth weave cable for Class I materials and Concentric or Ropelay for Class II materials
 - 3. Cable Fastener: Adhesive type for membrane roof, non-penetrating clamp for standing seam metal roof.
- D. Underground Conductors: Tinned copper.
- E. Ground Rods:
 - 1. Material: Copper-clad steel.
 - 2. Diameter: 3/4 inch.
 - 3. Rods: not less than 120 incheslong.
- F. Conductor Splices and Connectors for aboveground applications:
 - 1. Suitable configuration and class type for the intended application and of the same material as the conductors or of electrolytically compatible materials
- G. Adhesives: High performance, solvent free, UV resistant, for durable bond with substrate. All adhesives must be compatible with the roofing material and approved by the roofing system manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install lightning protection components and systems according to NFPA 780.
- B. Install conductors with direct paths from air terminals to ground connections without excessive splices. Maintain a horizontal or downward route along the entire path to ground. Avoid bends less than 90 degrees and 8 inches in radius and narrow loops.
- C. Rigidly fasten exposed conductors at intervals not exceeding 3 feet.
- D. Conceal conductors within normal view from exterior locations at grade within 200 feetof building. Comply with requirements for concealed systems in NFPA 780.
 - Roof penetrations required for down conductors and connections to structural-steel framework shall be made using listed through-roof fitting and connector assemblies with solid bars and appropriate roof flashings. Use materials approved by the roofing manufacturer for the purpose. Conform to the methods and materials required at roofing penetrations of the lightning protection components to ensure compatibility with the roofing specifications and warranty.
 - 2. Install conduit where necessary to comply with conductor concealment requirements.
 - 3. Structural elements and design features shall be used whenever possible to minimize the visual impact of exposed conductors.
 - 4. Coordinate sequence of installation with other trades to avoid coring, cutting, and patching.
 - 5. Do not install conductors in gutters, downspouts, or on surfaces where water is retained.
- E. Where conductors are exposed to potential damage or environmental hazards at grade level, provide guards to protect the conductors to a point 10 feet above grade. Bond down conductors to guards or conduit at both ends.
- F. Air Terminals on Single-Ply Membrane Roofing: Comply with adhesive manufacturer's written instructions.
- G. Provide Ground Ring Electrode for structures exceeding 60 feet. The conductor shall not be less than the main-size lightning conductor.
- H. Where local conditions such as soil material, earth resistivity, or limited project boundary require the use of other grounding electrode configurations, refer to grounding electrode requirements in Section 26 0526, "Grounding and Bonding for Electrical Systems".
- I. Provide bonding between the LPS grounding electrode system and the Building grounding electrode system in accordance with NEC and NFPA 780 requirements.
- J. Install surge suppression at all power service entrances and at all entrances of conductive communications systems.
- K. Provide cutting and patch as necessary for installation of work in existing structures. Refer to Section 26 0500, "Common Work Results for Electrical Systems".

3.2 CONNECTIONS

- A. All connections to down conductors and connections in earth or concrete: Exothermic weld.
- B. Aboveground concealed connections: Exothermic welds or high-compression fittings listed for the purpose.
- C. Aboveground exposed connections shall be done using the following types of connectors, listed and labeled for the purpose: bolted connectors, exothermic weld, high compression, or crimp type.
- D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
- E. Follow manufacturer's temperature and substrate requirements for installation of adhesives.

3.3 CORROSION PROTECTION

- A. Coordinate lightning protection materials with building materials to assure compatibility.
- B. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.
- Use conductors with protective coatings where conditions would cause deterioration or corrosion of conductors.
- D. Provide bimetallic connectors and fittings for splicing or bonding dissimilar metals.
- E. Do not install aluminum materials in the following locations:
 - 1. Embedded in or in direct contact with concrete, masonry, limestone, plaster, or mortar.
 - 2. On copper surfaces or in locations exposed to direct water run-off from copper surfaces.
 - 3. On a building surface coated with alkaline based paint.
 - 4. In direct contact with earth or within 18-inches of the point where a conductor comes into contact with the earth.
- F. Do not install copper materials in the following locations:
 - 1. On aluminum surfaces or on exterior sheet metal surfaces.

3.4 FIELD QUALITY CONTROL

A. Testing: Upon completion of installation of lightning protection system, test resistance-to-ground with resistance tester. Where tests show resistance-to-ground is over 25 ohms, take appropriate action to reduce resistance to 25 ohms, or less, by driving additional ground rods.

- B. Engage a third-party inspector to perform inspections required to obtain a UL Master Label for the system.
- C. Prepare detailed test and inspection reports with corresponding test results and photos.

END OF SECTION 26 4100

SECTION 26 4300 - SURGE PROTECTION DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General, Special and Supplementary Conditions, Division 01 Specification Sections, and Section 26 0010 "General Requirements for Electrical Systems" apply to this Section.

1.2 SUMMARY

A. Description: The Contractor shall provide the necessary labor, materials, wiring and services necessary to provide the complete electrical surge protection systems as specified herein. This work shall include, but is not necessarily limited to provision of Surge Suppression Units at certain points in the power distribution network and proper installation in accordance with manufacturer's instructions.

B. Section includes:

1. Requirements for both field-mounted SPDs (externally mounted), and integrated SPDs (installed from the factory) for low voltage power distribution and control equipment.

1.3 REFERENCES

A. Abbreviations

- 1. MCOV: Maximum continuous operating voltage.
- 2. OCPD: Overcurrent protective device.
- 3. SCCR: Short-circuit current rating.
- 4. SPD: Surge protective device.
- 5. VPR: Voltage protection rating.

B. Definitions

- 1. Inominal: Nominal discharge current.
- 2. Mode(s), also Modes of Protection: The pair of electrical connections where the VPR applies.
- 3. MOV: Metal-oxide varistor; an electronic component with a significant non-ohmic current-voltage characteristic.
- 4. Type 1 SPDs: Permanently connected SPDs intended for installation between the secondary of the service transformer and the line side of the service disconnect overcurrent device.
- 5. Type 2 SPDs: Permanently connected SPDs intended for installation on the load side of the service disconnect overcurrent device, including SPDs located at the branch panel.
- 6. Type 3 SPDs: Point of utilization SPDs.
- C. Reference Standards: The following publications are referred to in the text by the basic designation only. The edition/revision of the referenced publications shall be the latest date as of the date of the Contract Documents, unless otherwise specified.

- 1. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - a. ANSI/IEEE C62.41.1, "Guide on the Surges Environment in Low Voltage (1000 V and Less) AC Power Circuits."
 - b. ANSI/IEEE C62.41.2, "Recommended Practice on Characterization of Surges in Low Voltage (1000 V and Less) AC Power Circuits."
 - c. ANSI/IEEE Standard C62.45, "Guide on Surge Testing for Equipment Connected to Low-Voltage Ac Power Circuits"
- 2. Underwriters Laboratories, Inc. (UL)
 - a. UL 1283, "Standard for Safety for Electromagnetic Interference Filters."
 - b. UL 1449, "Standard for Surge Protective Devices."

1.4 SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Indicate all capacity ratings, clamp times, maximum capacities, physical characteristics and listing agency approvals.
 - 2. Copy of UL certification, as a minimum, listing the tested values for VPRs, Inominal ratings, MCOVs, type designations, OCPD requirements, model numbers, system voltages, and modes of protection.
 - 3. Wiring diagram showing all manufacturer installed wiring including wire size, type, routing, and exact length of conductors.
- B. Product Schedule: Indicate where each type of SPD is installed.
- C. Closeout Submittal
 - 1. Operation and Maintenance Data: For surge protection devices and components to include in emergency, operation, and maintenance manuals.

1.5 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to replace or replace SPDs that fail in materials or workmanship within a period of ten years from the 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. ABB/General Electric Company.
 - 2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 3. Siemens.
 - 4. Square D; a brand of Schneider Electric.

B. Source Limitations: SPDs installed internal to the distribution system shall be of the same manufacturer as the equipment. The equipment shall be fully tested and certified in accordance with UL standards.

2.2 GENERAL SPD REQUIREMENTS

- A. SPD with Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
- B. SPDs: Comply with UL 1449
 - 1. Provide Type 1 SPDs installed on the line side of the service entrance OCPD and Type 2 SPDs installed on the load side of the service entrance OCPD.
- C. Electrical Noise Filter: Comply with UL 1283 for Type 2 SPDs.
 - 1. Each Type 2 unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be up to 50 dB from 10 kHz to 100 MHz
- D. Unit Operating Voltage: Refer to drawings.
- E. MCOV of the SPD shall not be less than 115% of the nominal system voltage.
- F. The suppression system shall incorporate thermally protected MOVs as the core surge suppression component for all distribution levels. Each MOV shall be individually fuse-protected to avoid cascading faults. The thermal protection assembly shall disconnect the MOV(s) from the system in a fail-safe manner should a condition occur that would cause them to enter a thermal runaway condition.
- G. SPDs shall be provided with the following features and accessories:
 - 1. Integral disconnect switch for externally mounted SPDs. SPDs integrated into factory supplied equipment shall have an input disconnect switch or circuit breaker unless indicated on the equipment drawings/data sheets.
 - 2. Internal fusing that disconnects the SPD before damaging internal suppressor components.
 - 3. Indicator light display (Red and Green) for power and protection status with push-to-test capabilities.
 - 4. Audible alarm with silencing switch. Alarm shall activate when any one of the surge current modules has faulted or reached an end-of-life condition.
 - 5. Form-C contacts, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device.
 - 6. Surge counter with LCD display, reset switch, non-volatile memory, and battery backup to retain memory upon loss of AC power.
- H. All SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C, B, and A environments.
- I. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than the following values. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.
 - 1. Category C, Service Entrance larger than 1200A: 400 kA/phase.

- 2. Category C, Service Entrance 1200A and below: 240 kA/phase.
- 3. Category B, Distribution larger than 1200A: 300 kA/phase.
- 4. Category B, Distribution 1200A and below: 160 kA/phase.
- 5. Category B, Branch: 120kA/phase.
- J. Protection modes and UL 1449 VPR for grounded wye circuits shall not exceed the following:
 - 1. Line to Neutral: 1200 V for 480Y/277 V and 700 V for 208Y/120 V.
 - 2. Line to Ground: 1200 V for 480Y/277 V and 700 V for 208Y/120 V.
 - 3. Neutral to Ground: 1200 V for 480Y/277V and 700 V for 208Y/120 V.
 - 4. Line to Line: 2000 V for 480Y/277 V and 1200 V for 208Y/120 V.
- K. SCCR: The short circuit current rating of the SPD shall be a minimum of 200kA and equal to or greater than the available short circuit current at the point on the system where installed.
- L. Minimum Inominal Rating: 20 kA

2.3 SURGE SUPPRESSORS FOR OTHER SYSTEMS

A. Refer to specific specification sections for additional information on surge suppressors related to other building systems.

2.4 ENCLOSURES

- A. Enclosure shall meet or exceed the ratings for the environment to be installed as indicated on drawings.
 - 1. Indoor locations: NEMA 250, Type 1.
 - 2. Outdoor or wet locations: NEMA 250, Type 3R.
 - 3. Corrosive Environments: NEMA 250, Type 4X.

2.5 CONDUCTORS AND CABLES

A. Power Wiring: Provide sizes to match SPD leads, complying with Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Factory install integral SPDs as part of the distribution equipment and connect through a disconnect.
 - 1. SPDs shall be installed immediately following the load side of the main breaker. SPDs installed in main lug only panelboards shall be installed immediately following the incoming main lugs.

- C. Provide a OCPD as required to comply with the UL listing of the SPD and selected to comply with power system study.
- D. Install SPDs with properly rated conductors between suppressor and points of attachment as short and straight as possible with no sharp bends, and adjust circuit-breaker positions to achieve shortest and straightest leads.
- E. Do not splice and extend SPD leads unless specifically permitted by manufacturer.
- F. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
- G. Twist input conductors together to reduce the input inductance.
- H. Use crimped connectors and splices only. Wire nuts are not acceptable.

3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Compare equipment nameplate data for compliance with Drawings and Specifications.
 - 2. Inspect anchorage, alignment, grounding, and clearances.
 - 3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.
- B. An SPD will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.3 STARTUP SERVICE

- A. Complete startup checks according to manufacturer's written instructions.
- B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests, and reconnect them immediately after the testing is over.
- C. Energize SPDs after power system has been energized, stabilized, and tested.

3.4 DEMONSTRATION

A. Train Owner's maintenance personnel to operate and maintain SPDs.

END OF SECTION 26 4300

SECTION 26 5000 - LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General, Special and Supplementary Conditions, Division 01 Specification Sections, and Section 26 0010 "General Requirements for Electrical Systems" apply to this Section.

1.2 SUMMARY

A. This section is intended to specify in conjunction with the Light Fixture Schedule, the luminaires, supports, accessories, specialties and related items necessary to complete the work as shown on the drawings.

B. Section Includes:

- 1. Interior light fixture
- 2. Exterior light fixtures including building mounted
- 3. Exit signs
- 4. Emergency lighting units
- 5. LEDs and drivers
- 6. Light fixture supports and accessories
- 7. Light fixture poles and bases

1.3 COORDINATION

- A. This work consists of providing all labor, materials, accessories, mounting hardware and equipment necessary for an operationally and aesthetically complete installation of all luminaires, including power wiring, control wiring and accessories, in accordance with the contract documents.
- B. Contractor shall provide all luminaires, as herein specified, complete with lamps, drivers, power supplies, ballasts and accessories for safe and effective operation. All fixtures shall be installed and left in an operable condition with no broken, damaged or soiled parts.
- C. Contractor shall coordinate all infrastructure requirements with all approved lighting equipment prior to infrastructure installation, including, but not limited to appropriately sized, positioned and located junction boxes, structural supports, feeds, power and control conduits, and remote code-compliant power-supply enclosures.
- D. All available finishes and colors, for each luminaire, shall be submitted to the Architect for selection during shop drawing review. Premium finishes, where indicated, shall be provided at no additional cost premium.
- E. Specifications and drawings are intended to convey all salient features, functions and characteristics of the luminaires only, and do not undertake to illustrate or set forth every item or detail necessary for the work. Minor details, not usually indicated on the drawings nor specified, but that are necessary for proper

execution and completion of the luminaries, shall be included, the same as if they were herein specified or indicated on the drawings.

- F. The Owner, Architect and Engineer shall not be held responsible for the omission or absence of any detail, construction feature, etc. which may be required in the production of the light fixtures. The responsibility of accurately fabricating the light fixtures to the fulfillment of the specification rests with the Contractor.
- G. Refer to architectural details, as applicable, for recessed soffit fixtures or wherever fixture installations depend upon work of other trades. Coordinate all installations with other trades. Verify dimensions of spaces for fixtures, and if necessary, adjust lengths to assure proper fit and illumination of diffuser and/or area below.
- H. In accordance with the above and the criteria established herein, the Contractor is responsible for assuring the final design, fabrication and installation which fulfills the requirements of the Contract Documents.

1.4 REFERENCES

- A. Abbreviations and Acronyms
 - 1. CCT: Correlated color temperature
 - 2. CRI: Color-rendering index
 - 3. CU: Coefficient of utilization
 - 4. IECC: International Energy Conservation Code
 - 5. LER: Luminaire efficacy rating, which is calculated according to NEMA LE 5.
 - 6. NRTL: Nationally Recognized Testing Laboratory
 - 7. SPD: Surge Protective Device
 - 8. RCR: Room cavity ratio.
 - 9. UL: Underwriters Laboratory

B. Definitions

- 1. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in the IESNA Lighting Library.
- 2. Light Fixture (Luminaire): Complete lighting unit consisting of a lamp(s) and driver(s)/ballast(s) (when applicable) together with the parts designed to distribute the light, to position and protect the lamp(s), and to connect the lamps to the power supply.
- 3. Lumen: Delivered output of luminaire.
- 4. Total harmonic distortion (THD): The root mean square (RMS) of all the harmonic components divided by the total fundamental current.
- 5. Pole: Luminaire support structure, including tower used for large area illumination.
- 6. Standard: Same definition as "Pole" above.
- C. Reference Standards: The following publications are referred to in the text by the basic designation only. The edition/revision of the referenced publications shall be the latest version (including amendments, addenda, revisions, supplements, and errata) as of the date of the Contract Documents, unless otherwise specified.
 - 1. Illuminating Engineering Society of North America (IESNA)
 - a. IES LS-1-20, Lighting Science: Nomenclature and Definitions for Illuminating Engineering

- 2. National Electrical Manufacturer's Association (NEMA)
 - a. NEMA SSL 1, Electronic Drivers for LED Devices, Arrays or Systems
 - b. NEMA SSL 3, High-Power White LED Binning for General Illumination

1.5 SUBMITTALS

- A. Product Data: For each type and model of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
 - 1. Physical description of lighting fixture including dimensions.
 - 2. Emergency lighting units including battery and charger.
 - 3. All available finishes and colors for each luminaire type shall be submitted to the Architect for selection during review.
 - 4. Life, output (lumens, CCT, and CRI), and energy-efficiency data for light fixtures.
 - 5. Dimensions, effective projected area (EPA), accessories, installation details and construction details.
 - 6. Poles: Include dimensions, materials, wind load determined in accordance with AASHTO, pole deflection, pole class, and other applicable information.
 - 7. Distribution data according to IESNA classification type as defined in IESNA handbook.
 - 8. Anchor bolts.
 - 9. US DOE LED Lighting Facts Label and IESNA L70 rated life.
 - 10. Amount of shielding on luminaires.
 - 11. Control type: 0-10V, DMX, bi-level, etc.
- B. Shop Drawings: Including plans, elevations, sections, details, and attachment to other work.
 - Include detailed equipment assemblies and indicate electrical ratings, dimensions, emergency section, control type, wiring, 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.
 - 3. Anchor-bolt templates keyed to specific poles and certified by manufacturer.
- C. Pole and Support Component Certification Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements in AASHTO LTS and that load imposed by luminaire and attachments has been included in design. The certification shall be based on design calculations by a professional engineer.
- D. Sample Warranty
- E. Closeout Submittals
 - 1. Maintenance Contract
 - 2. Operation and Maintenance Data
 - 3. Warranty Documentation
 - 4. Record Documentation
 - 5. Sustainable Design Closeout Documentation
 - Software

1.6 MAINTENANCE MATERIAL

- A. Furnish the following extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing content:
 - 1. Single Sided Exit Sign: Three total.
 - 2. Double Sided Exit Sign: Three total.
 - 3. LED Drivers: Furnish Five of each type.
 - 4. LED Lamps/Boards: Two of each type.

1.7 QUALITY ASSURANCE

- A. In each of the publications referred to herein, consider the advisory provisions to be mandatory.
- B. Manufacturer Qualifications: Equipment shall be supported by service organizations which are reasonably convenient (less than 100 miles from project site) to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.
- C. Where groups of luminaire types exhibit the same list of acceptable Manufacturers, such as downlights, accents, and wall washers, the intent is to have a final installation with the same Manufacturer's equipment across the groupings as specified for consistency of optics, aesthetics, and similarity of maintenance procedures. Mixing/matching across groups is unacceptable. This also applies to multiphased projects with single or multiple, but related luminaire types exhibiting the same list of acceptable Manufacturers, except where products have subsequently been discontinued or significantly redesigned in size, appearance, lamping, or gear. Lamps shall be from a single manufacturer and batch.

1.8 DELIVERY, STORAGE AND HANDLING:

- A. The Contractor shall provide, receive, unload, uncrate, store, protect and install lamps, luminaires and auxiliary equipment, as specified herein, in accordance with respective manufacturers' project conditions of temperature and humidity and with appropriate protection against dust and dirt. Lamps for miscellaneous equipment shall be provided and installed by the Contractor according to equipment manufacturers' guidelines.
- B. All products shall be stored in manufacturer's unopened packaging until ready for installation.
- C. Luminaire Poles: Do not store poles on ground. Support poles so they are at least one foot above ground level and growing vegetation. Support poles to prevent distortion and arrange to provide free air circulation. Retain factory-applied pole wrappings on poles until right before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.

1.9 COORDINATION

A. Coordinate layout and installation of exterior lighting fixtures with all other construction including all underground utilities and geothermal well fields.

- B. Coordinate layout and installation of lighting fixtures with all other construction that penetrates ceilings or is supported by them, including HVAC equipment, plumbing, fire-suppression system and partition assemblies.
- C. Contractor shall coordinate all infrastructure requirements with all approved lighting equipment prior to infrastructure installation, including, but not limited to appropriately sized, positioned and located junction boxes, structural supports, feeds, power and control conduits, and remote code-compliant power-supply enclosures.
- D. Prior to procurement of light fixtures:
 - 1. Confirm application and required voltage.
 - 2. Confirm the proper and complete catalog number with distributor and agent.
 - 3. Ensure wiring, driver, etc meets the specifications and proper requirements.
 - 4. Provide additional parts and pieces required to complete the installation in the location and manner intended by the design.
- E. Light fixture locations in mechanical and electrical equipment rooms/areas are approximate. Locate light fixtures to avoid equipment, ductwork, and piping. Locate around and between equipment to maximize the available light. Coordinate mounting heights and locations of light fixtures to clear equipment. Request a meeting with the Engineer if uncertain about an installation.
- F. Coordinate between the electrical and ceiling trades to ascertain that approved luminaires are furnished in the proper sizes, with the proper flange details, and installed with the proper devices (hangers, clips, trim frames, flanges), to match the ceiling system being installed.

1.10 WARRANTIES

- A. Manufacturer Warranty: All luminaries, finishes, poles, batteries, supports, accessories and all of its component parts, workmanship, and controls shall have an unconditional five (5) year on-site replacement warranty. Warranty shall include all light fixtures, lamps, drivers, poles, finishes and all components to be free from defects in materials and workmanship for a period of five (5) years from date of Owner's acceptance. On-site replacement includes transportation, removal, and installation of new products. Replacement of luminaries, faulty materials and the cost of labor to make the replacement shall be the responsibility of the Contractor.
 - 1. Luminaires: Five (5) years from date of substantial completion.
 - 2. LED drivers: Ten (10) years from the date of substantial completion. The warranty shall state the malfunctioning LED driver shall be exchanged by the manufacturer and promptly installed by the Contractor. The replacement LED driver shall be identical to, or an improvement upon, the original design of the malfunctioning LED driver.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
- B. Comply with NFPA 70.

2.2 MANUFACTURERS

- A. Subject to compliance with requirements, provide one of the products indicated on Light Fixture Schedule. Refer to Light Fixture Schedule for manufacturers and model numbers. Basis of Design for each light fixture type shall be the first fixture manufacturer and model number for each type listed.
- B. Manufacturer's catalog numbers together with the descriptions on the drawings and these specifications are indicative of required design, appearance, quality and performance. Report any discrepancies between any of these to the Engineer for resolution prior to bid. In absence of such notice to the Engineer, provide the greater requirement as directed by the Engineer, without additional cost.

2.3 EQUAL MANUFACTURERS

- A. Manufacturers listed as "Equal" to the Basis of Design on the light fixture schedule shall submit product cutsheets to the Engineer prior to bid for final written approval. This written approval will only be issued in addendum form. "Equal" fixtures shall be of equal or better quality and performance to the fixture(s) listed with manufacturer's model numbers. Burden of proof shall be on the Contractor, Vendor and manufacturer.
- B. Upon request by Engineer, the Contractor shall submit manufacturer's computerized horizontal illumination levels using AGI32 software in footcandles at workplane (30" above finished floor), taken every 3 feet in every interior room and area. Include average maintained footcandle levels and maximum and minimum ratio.
- C. Upon request by Engineer, the Contractor shall submit manufacturer's computerized horizontal illumination levels using AGI32 software in footcandles, taken every ten (10) feet at grade for the entire exterior site. Include average maintained footcandle levels and maximum and minimum ratio.
- D. Refer to specification Section 26 0010 "General Requirements for Electrical Systems" for additional requirements.

2.4 GENERAL REQUIREMENTS FOR LUMINAIRES AND COMPONENTS

A. Complete luminaires shall be in accordance with NFPA 70, NEMA, and UL 1598 listed and labeled.

- B. Ballasts, drivers, or transformers, unless otherwise specified, shall be field replaceable and shall be serviceable while the fixture is in its normally installed position, and shall not be mounted to removable reflectors or wireway covers unless so specified.
- C. Luminaires shall be entirely factory wired by the luminaire manufacturer in accordance with code and UL requirements and shall be furnished fully compatible with the project electrical wiring and controls system for smooth, continuous, dimming or on/off flicker-free operation.
- D. Exterior building mounted light fixtures shall be UL classified for damp or wet locations as applicable and shall be complete with gaskets, cast aluminum outlet box and grounding. Luminaires shall be suitably gasketed and vented according to manufacturer's instructions. All dissimilar metal materials shall be separated by non-conductive materials to prevent galvanic action.
- E. All luminaires supplied for recessing in suspended ceilings shall be supplied with pre-wired junction boxes, unless otherwise specified.
- F. Metal parts: Free of burrs, sharp corners and sharp edges.
- G. Doors, frames and other internal access: Smooth operating, free of light leakage under operating conditions. Designed to prevent doors, frames, lenses, diffusers and other components from falling accidently during maintenance and when secured during operating position.
- H. Mounting Frames and Rings: If ceiling system and luminaire type requires, each recessed and semi-recessed luminaire shall be furnished with a mounting frame or ring compatible with the ceiling in which they are to be installed as coordinated by Contractor. The frames and rings shall be one piece and of sufficient size and strength to sustain the weight of the luminaire and maintain plumb. Luminaires shall be braced such that the force required to close and/or latch lens or door frame does not lift or shift luminaire.
- I. Pendant Supports: Contractor shall be responsible for coordination with Manufacturer, Architect, Structural Engineer and related trades to ensure that proper and adequate structural reinforcement is provided within ceilings to support pendant mounted lighting equipment for a secure, neat, square, plumb appearance. Pendants shall not sag, droop, snake or otherwise appear out of plumb or alignment in finished installation with lamps, globes, lenses, lens frames or doors etc. in place.
- J. Wall Bracket (Sconce) Supports: Contractor shall be responsible for coordination with Manufacturer, Architect, Structural Engineer and related trades to ensure that proper and adequate structural reinforcement is provided within walls to support wall mounted lighting equipment for a secure, neat, square, plumb appearance. Wall brackets shall not sag, droop, snake or otherwise appear out of plumb or alignment in finished installation with lamps, globes, lenses, lens frames or doors etc. in place.
- K. All lenses or other light diffusing elements shall be removable for access to lamp and electrical and electronic components and luminaire cleaning, however, they must otherwise be positively and securely held in-place, unless otherwise specified.
- L. All lens door or holder trim flanges shall fit plumb and flush with the ceiling or wall surface. There shall be no light leaks around the interface between lens door or holder trim flanges and the ceiling or wall.
- M. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility.

- N. Recessed luminaires mounted in an insulated ceiling shall be listed for use in insulated ceilings, IC-rated, or provisions made to maintain code-compliant 3" air-space around luminaires in accordance with Manufacturers' instructions.
- O. Mechanical Safety: Unless otherwise specified, luminaire closures (lens doors, trim frame, hinged housing, etc.) shall be retained in a secure manner by captive screws, chains, captive hinges or fasteners such that they cannot be accidentally dislodged during normal operation or routine maintenance.
- P. Unless otherwise specified, luminaires with louvers or light transmitting panels shall have hinges, latches and safety catches to facilitate safe, convenient cleaning and re-lamping. Vapor tight luminaires shall have stainless steel pressure clamping devices.
- Q. Yokes, brackets and supplementary supporting members necessary for mounting lighting equipment shall be furnished and installed by the Contractor and approved by the Architect. All materials, accessories, and any other equipment necessary for the complete and proper installation of luminaires, lamps, ballasts/neon transformers included in the contract shall be furnished and installed by the Contractor. All yokes, brackets and supplementary supports shall provide a neat, square, plumb and level appearance, and shall not sag, droop, snake or otherwise appear out of plumb or alignment in finished installation with all lamps, globes, lenses, lens frames or doors etc. in place.
- R. All connections shall be fixed rigid by screws, rivets and/or soldering. Screws and rivets shall not be visible except as necessary for maintenance and/or aesthetic appearance. All connections shall provide a neat, square, plumb and level appearance, and shall not sag, droop, snake or otherwise appear out of plumb or alignment in finished installation with lamps, globes, lenses, lens frames or doors etc. in place.
- S. All housings shall be free from tool marks and dents and shall have accurate angles bent as sharp as compatible with the gauges of the required metal and the luminaire styling. All intersections and joints shall be formed true and of adequate strength and structural rigidity to prevent any distortion after assembly.
- T. For steel and aluminum luminaires, all screws, bolts, nuts and other fastening and latching hardware shall be a cadmium or equivalent plated. For stainless steel luminaires, all hardware shall be stainless steel. For all bronze luminaires, all hardware shall be bronze.
- U. Extruded aluminum frames and trims shall be rigid and manufactured from quality aluminum without blemishes in the installed product. Miter cuts shall be accurate; joints shall be flush and without burrs and cut alignment maintained with the luminaire located in its final position.
- V. Castings shall exactly replicate the approved pattern(s) and shall be free of sand pits, blemishes, scales and rust and shall be smoothly finished, excepted as necessary for an authentic historic appearance and as agreed by Architect. Tolerances shall be provided for any shrinkage in order that the finished castings accurately fit their locations resulting in plumb and level fit and consistently tight-seamed fittings.
- W. Luminaires in Hazardous Areas: Luminaires shall be suitable for installation in flammable atmospheres (Class and Group) as defined in NFPA 70 and shall comply with UL 844.
- X. Each light fixture shall be packaged with complete instructions and illustrations on how to install.
- Y. Each light fixture box, container, etc shall be labeled at the factory with the type designation as indicated on the Light Fixture Schedule.

- Z. Provide factory cut custom stem lengths, as required.
- AA. Exit signs and fixtures that are hatched or where the fixture type contains the suffix "E" for emergency operation, the fixture shall have an integral 90-minute battery inverter if not powered from an emergency generator.
- BB. All battery powered fixtures shall have test switches factory installed integral to the reflector. Remote test switches will not be accepted.

2.5 LUMINAIRE REFLECTORS AND TRIMS

- A. Alzak cones, reflectors, baffles and louvers shall be warranted against discoloration.
- B. All trims, reflectors and canopies shall fit snugly and securely to the ceiling or wall so that no light leak occurs.
- C. Trims shall be self-flanged, unless otherwise specified.
- D. For trimless or flangeless luminaires, Contractor shall coordinate with other Trades to achieve a trimless/flangeless installation acceptable to the Architect. Where ceilings are drywall or plaster, this involves Level 5 finishes or as otherwise directed by the Architect. In drywall, plaster, wood, or stone ceilings, special luminaire collars and exacting coordination are required of Contractor.

2.6 LIGHT EMITTING DIODE (LED) ELECTRONIC DRIVERS

- A. The electronic drivers shall as a minimum meet the following characteristics:
 - 1. LED drivers shall comply with NEMA SSL 1, NFPA 70, and UL 8750 unless otherwise specified.
 - Drivers remote from luminaires shall be housed in NEMA enclosures so rated for the driver and located in code-compliant, sound-isolated, well-ventilated and easily accessible areas. Wire shall be sized according to run length and LED Manufacturer's size and distance-of-run requirements and all in accordance with all code requirements.
 - 3. Driver shall comply with UL 1310 Class 2 requirements for dry and damp locations, NFPA 70 unless specified otherwise. Drives shall be designed for the wattage of the LEDs used in the indicated application. Drivers shall be designed to operate on the voltage system to which they are connected.
 - 4. LED driver shall withstand up to a 1,000-volt surge without impairment of performance as defined by ANSI C62.41 Category A.
 - 5. LED driver shall tolerate ±10 percent supply voltage fluctuation with no adverse effects to driver or LEDs.
 - 6. Drivers for luminaires controlled by dimming devices shall be as specified herein and equipped for dimming and conform to the recommendations of the manufacturer of the associated dimming devices to assure satisfactory operation of the lighting system. Contractor shall coordinate all wiring infrastructure to accommodate final-selected drivers and controls systems for smooth, continuous, and flicker-free operation.
 - 7. Flicker: The flicker shall be less than 5 percent at all frequencies below 1000 Hz and without visible flicker
 - 8. Provide with short circuit, open circuit and overload protection.

- 9. Drivers shall meet or exceed NEMA 410 driver inrush standard.
- 10. Total Harmonic Distortion shall be less than 20 percent.
- 11. Power Factor to be greater than 95%
- 12. Drivers to be reduction of hazardous substances (ROHS) compliant

2.7 LIGHT EMITTING DIODE (LED)

- A. The light emitting diodes shall as a minimum meet the following characteristic:
 - 1. LED lamps shall comply with ANSI C78.1, IESNA LM-79 and IESNA LM-80.
 - 2. Light emitting diodes shall be tested under IES LM-80 standards.
 - 3. Color Rendering Index (CRI) shall be 84 (minimum).
 - 4. Rated lumen maintenance of 90% lumen output at 50,000 hours (minimum).
 - 5. Rated lumen maintenance of 70% lumen output at 100,000 hours (minimum).

2.8 SUSPENDED LUMINAIRES

- A. Provide hangers capable of supporting twice the combined weight of fixtures supported by hangers. Provide with swivel hangers to ensure a plumb installation. Hangers shall be cadmium-plated steel with a swivel-ball tapped for the conduit size indicated. Hangers shall allow fixtures to swing within an angle of 45 degrees. Brace pendants 4 feet or longer to limit swinging. Single-unit suspended fixtures shall have twin-stem hangers. Multiple-unit or continuous row fixtures shall have a tubing or stem for wiring at one point and a tubing or rod suspension provided for each unit length of chassis, including one at each end. Rods shall be a minimum 0.18 inch diameter.
- B. All suspended luminaires with a weight in excess of 50 pounds shall be fitted with safety cable of sufficient strength and length to meet all UL safety cable load-bearing requirements. Cable shall exhibit a finish (but not painted) compatible with that of the metal finish of the stem/chain/suspension-cable assembly or alternatively finished in black as approved by Architect. Shop drawings shall indicate luminaire weight. Contractor shall coordinate structural support/attachment requirements including independent structure for safety cable attachment with Vendor, Architect, and Structural Engineer and all respective trades. Safety cable shall exhibit sufficient length to wrap tightly and entirely around structural member at least twice before attachment subject to Vendor confirmation of UL requirements and pending Structural Engineer review. Contractor shall provide labor necessary for the stem/chain-assembly-wiring-threading and safety-cable-attachment as instructed by Vendor.

2.9 DOWNLIGHT FIXTURES AND COMPONENTS

- A. Downlights shall be listed for thru-branch circuit wiring, recessing in ceilings and damp locations.
- B. Where installed in plaster or drywall or other inaccessible ceiling types, they shall be UL listed for bottom access.
- C. Provide with tool-less hinged junction box access cover and thermal protection accessible from below through reflector opening.
- D. Provide telescoping channel bar hangers that adjust vertically and horizontally.

2.10 EXIT SIGNS

- A. General requirements: Comply with UL 924, NFPA 70, AND NFPA 101.
- B. All exit signs shall be LED type.
- C. Provide single or double face as scheduled, indicated on plans or as required by the local Authority Having Jurisdiction. Adjust installation position if required for clear visibility, in accordance with applicable codes.
- D. Provide directional arrows (chevrons) as indicated on floor plans and to suit the means of egress or as required by the local Authority Having Jurisdiction.
- E. Where emergency backup battery packs are provided with exit lights, they shall have capacities for continuous operation per applicable codes. All exit signs with battery backup shall be provided with self-diagnostics.
- F. Complete unit to be furnished in color/finish as selected by the Architect.

2.11 EMERGENCY DRIVER

- A. Description: Self-contained, modular, battery-inverter unit, factory mounted within luminaire body and compatible with driver. Complying with UL924.
 - 1. Provide a minimum of 90 minutes of battery back-up upon loss of power.
 - 2. Constant Power Output: minimum 10W, uon.
 - 3. Battery: High temperature Nickel Cadmium or Lithium Iron Phosphate, uon.
 - 4. Charger: Fully automatic, solid-state type with sealed transfer relay.
 - 5. Operation: Solid state switching circuit automatically turns light fixture on upon absence of power-supply circuit voltage and switches back to normal operation upon restoration of AC power.
 - 6. Test Push-Button and Indicator Light: Visible and accessible without opening luminaire or entering ceiling space.
 - a. Push-Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - b. Indicator Light: LED indicates normal power on and charger operation.
 - 7. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.12 EMERGENCY INVERTER

- A. Description: Stand alone, modular, modified sine wave output battery-inverter unit, remote mounted from luminaire. Complying with UL924.
 - 1. Provide a minimum of 90 minutes of battery back-up upon loss of power.
 - 2. Power Output: suitable for powering designated emergency light fixtures.
 - 3. Battery: Sealed, maintenance-free, nickel-cadmium or lead-acid type.
 - 4. Charger: Fully automatic, solid-state, constant-current type.

- 5. Operation: Solid state switching circuit automatically turns connected fixtures on upon absence of power-supply circuit voltage and switches back to normal operation upon restoration of AC power.
- 6. Steel Housing: Type 1 enclosure listed for installation inside, on top of, or remote from luminaire.
- 7. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.13 EMERGENCY LIGHTING UNITS

- A. General Requirements for Emergency Lighting Units: Self-contained units complying with UL 924.
 - 1. Provide a minimum of 90 minutes of battery back-up.
 - 2. Battery: Sealed, maintenance-free, lead-acid type, UON.
 - 3. Charger: Fully automatic, solid-state type with sealed transfer relay.
 - 4. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 - 5. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - 6. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 - 7. Wire Guard: Heavy-chrome-plated wire guard protects lamp heads or fixtures. Install wire guards in gymnasiums.
 - 8. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.14 LUMINAIRE SUPPORT HANGERS AND COMPONENTS

- A. Wires: ASTM A641/A641M, Class 3, soft temper, galvanized regular coating, 0.1055 inches in diameter (12 gage).
- B. Straps: Galvanized steel, one by 3/16 inch, conforming to ASTM A653/A653M, with a light commercial zinc coating or ASTM A1008/A1008M with an electrodeposited zinc coating conforming to ASTM B633, Type RS.
- C. Rod Hangers: Threaded steel rods, 3/16 inch diameter, zinc or cadmium coated.

2.15 GENERAL REQUIREMENTS FOR POLES AND SUPPORT COMPONENTS

A. Provide poles designed for site specific wind loading (minimum of 120 miles per hour) determined in accordance with AASHTO LTS while supporting luminaires and all other appurtenances indicated. The effective projected areas of luminaires and appurtenances used in calculations shall be specific for the actual products provided on each pole. Poles shall be anchor-base type designed for use with underground supply conductors. Poles shall have full base metal covers with matching finish to conceal the mounting hardware, pole-base welds and anchor bolts..

- B. Structural Characteristics: Comply with AASHTO LTS
 - 1. Wind-Load Strength of Poles: Adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of speed indicated in "Structural Analysis Criteria for Pole Selection" Article.
 - 2. Strength Analysis: For each pole, multiply the actual equivalent projected area of luminaires and brackets by a factor of 1.3 to obtain the equivalent projected area to be used in pole selection strength analysis.
- C. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners, unless otherwise indicated.
- D. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.
 - 1. Materials: Shall not cause galvanic action at contact points.
 - 2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.
 - 3. Anchor-Bolt Template: Plywood or steel.
- E. Handhole: Oval-shaped, with minimum clear opening of 2-1/2 by 5 inches, with cover secured by stainless-steel captive screws.
- F. Pole Base Concrete Foundations:
 - Cast in place, with anchor bolts to match pole-base flange. Anchor bolts shall be steel rod having minimum yield strength of 50,000 psi and shall be galvanized in accordance with ASTM A153/A153M. Concrete shall be as specified in Division 03 Section, Cast-In-Place Concrete.
 - 2. Use 4000-psi, 28-day compressive-strength concrete unless otherwise noted. Comply with Division 03 Section "Cast-in-Place Concrete" and ACI standards for subbase requirements, concrete materials, reinforcement, placement, and cover requirements.
- G. Breakaway Supports: Provide frangible breakaway supports where noted on plans, tested by an independent testing agency acceptable to authorities having jurisdiction, according to AASHTO LTS.
- H. Brackets and Supports
 - 1. ANSI C136.3, ANSI C136.13, and ANSI C136.21, as applicable. Pole brackets shall be not less than 1-1/4 inch secured to pole. Slip-fitter or pipe-threaded brackets may be used, but brackets shall be coordinated to luminaires provided, and brackets for use with one type of luminaire shall be identical. Brackets for pole-mounted street lights shall correctly position luminaire no lower than mounting height indicated. Mount brackets not less than 24 feet above street. Special mountings or brackets shall be as indicated and shall be of metal which will not promote galvanic reaction with luminaire head. Detachable, cantilever, without underbrace.
- I. Cable Support Grip: Wire-mesh type with rotating attachment eye, sized for diameter of cable and rated for a minimum load equal to weight of supported cable times a 5.0 safety factor.
- J. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding

conductors of type and size listed in that Section, and accessible through handhole. Provide a pole grounding connection designed to prevent electrolysis when used with copper ground wire.

K. Finish: Same as luminaire.

2.16 POLE ACCESSORIES

- A. Duplex Receptacle: Where indicated on plans, provide 120 V, 20 A receptacle in a weatherproof assembly complying with Division 26 Section "Wiring Devices" for a weather resistant, ground-fault circuit-interrupter type. Recessed, 12 inches above pole base. Weatherproof, metal, in-use cover, color to match pole, that when mounted results in NEMA 250, Type 4X enclosure with cord opening and lockable hasp and latch that complies with OSHA lockout and tag-out requirements.
 - 1. Minimum 1800-W transformer, protected by replaceable fuses, mounted behind access cover for poles supplied by voltage other than 120 V.
- B. Base Covers: Provide Manufacturers' standard metal units, arranged to cover pole's mounting bolts and nuts. Finish same as pole.
- C. Fusing: Provide fuse(s) and in-line fuse holder(s) per phase sized per manufacturer's recommendation located in handhole.

2.17 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

- A. Comply with UL 773 or UL 773A.
- B. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc and off at 4.5 to 10 fc with 15-second minimum time delay. Relay shall have directional lens in front of photocell to prevent artificial light sources from causing false turnoff.
 - 1. Relay with locking-type receptacle shall comply with ANSI C136.10.
 - 2. Adjustable window slide for adjusting on-off set points.

2.18 FACTORY APPLIED FINISH

A. Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA 250 corrosion-resistance test.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Architect's reflected ceiling plan (RCP) indicates actual locations of all light fixtures, diffusers and system devices. Report to the Architect/Engineer any conflicts. Do not scale plans for exact location of lighting fixtures.
- B. Coordinate mounting for lighting fixtures on the job before commencing installation and, where applicable, after coordinating with the type, style, and pattern of the ceiling being installed.
- C. Install luminaires in accordance with luminaire manufacturer's written instructions, applicable requirements of NEC, NECA, and NEMA standards.
- D. Installed luminaires shall be provided with protective covering by Contractor until such time as the space(s) is cleaned and ready for occupancy.
- E. Set luminaires plumb, square, and level with ceiling and walls, in alignment with adjacent lighting fixtures, and secured in accordance with manufacturers' directions and approved drawings.
- F. Lighting Fixture Supports:
 - 1. Comply with Section 26 0500, Common Work Results for Electrical Systems.
 - 2. Sized and rated for luminaire weight.
 - 3. Shall maintain the fixture positions after cleaning and re-lamping.
 - 4. Ensure that the luminaires are supported such that there is no resultant bowing or deflection of the ceiling or wall system.
 - 5. Capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.
- G. Recessed, semi-recessed and surface fixtures shall be independently supported from the buildings structure. Do not support any luminaire solely from ceiling grid or ceiling. Ceiling grid clips are not allowed as an alternative to independently supported light fixtures.
- H. Ceiling Grid mounted light fixtures:
 - 1. Lighting fixtures installed in suspended ceilings shall also comply with the requirements of Division 09 Specification Sections for ceilings.
 - 2. Support fixtures with four (4) wires with one (1) at each corner.
 - 3. Hanger wires: Install within 15 degrees of plumb or additional support shall be provided. Wires shall be attached to fixture body and to the building structure (not to the supports of other work or equipment). Where building structure is located such that 15 degrees cannot be maintained, provide "strut" or similar supports secured to structure to meet this requirement.
 - 4. Support Clips: Provide four (4) clips per fixture minimum. Fasten to light fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application. Install clips per manufacturer's requirements. If screws are required, they shall be provided. Installation shall meet applicable seismic codes.

- 5. Where fixtures of sizes less than the ceiling grid are indicated to be centered in the acoustical panel, support such fixtures independently and provide at least two 3/4-inch metal channels spanning, and secured to, the ceiling tees for centering and aligning the fixture.
- 6. Downlights, exit signs and battery pack supported by or attached to ceiling grid or tile shall be provided with one hanger wire at each end. Provide a minimum of two, located at opposite corners
- 7. Round fixtures or fixtures smaller in size than the ceiling grid shall be independently supported from the building structure by a minimum of four wires per fixture spaced approximately equidistant around the fixture. Do not support fixtures by ceiling acoustical panels.

I. Suspended fixtures:

- 1. Hang plumb and shall be located with no obstructions within the 45 degree range in all directions. The stem, cable, canopy and fixture shall be capable of 45 degree swing.
- Suspended fixtures in continuous rows shall have internal wireway systems for end to end wiring
 and shall be properly aligned to provide a straight and continuous row without bends, gaps, light
 leaks or filler pieces. Aligning splines shall be used on extruded aluminum fixtures to assure
 hairline joints. Steel fixtures shall be supported to prevent "oil-canning" effects.
- 3. Pendants shall be finished to match fixtures. Aircraft cable shall be stainless steel.
- 4. Canopies shall be finished to match the ceiling and shall be low profile unless otherwise shown.
- 5. Whenever a luminaire or its hanger canopy is installed directly to a surface mounted junction box, a finishing ring painted to match the ceiling, shall be used to conceal the junction box.

J. Wall mounted fixtures:

- 1. Do not attach light fixtures directly to gypsum board.
- 2. Attach to structural members in walls or backing plate attached to wall structural members.
- K. Rigidly align continuous rows of light fixtures for true in-line appearance.
- L. Exit Signs and Emergency Lighting Units: Wire exit signs ahead of the switch to the un-switched branch circuit located in the same room or area. Connect to emergency system branch circuit where applicable.
- M. Where emergency battery packs are provided with fixtures (if any), they shall be connected to an unswitched power line and wired in accordance with applicable codes and the manufacturer's recommendations.
- N. Light fixture whips shall be independently supported from the building structure. Do not clip to lay-in ceiling support wires. Independent support wires shall be distinguishable by colors, tagging, or other effective means.

O. Exterior Fixtures:

- 1. Exterior building mounted light fixtures shall not be installed until after the building exterior has been rinsed clean of any corrosive cleaning materials. Damaged fixtures shall be replaced by the Contractor at no cost.
- 2. Provide exterior rated weather proof junction boxes for all fixtures and splices.
- Utilize weatherproof silicone filled wire nuts and seal all junction boxes and conduit with potting compound to create waterproof barriers. Inspect all splices and fixtures for continuity prior to potting.
- 4. Lubricate all threaded parts with a high temperature waterproof anti-seize lubricant to prevent seizing and corrosion.

- 5. All low-voltage wiring to be UV resistant, UL approved for use without conduit, stranded low-voltage wire for use in outdoor and underground applications, gauge as appropriate to avoid voltage drop.
- 6. Provide surface mounted fixtures with conduit hub for end of fixture entrance.
- P. Transformers (applies to all transformers including (but not limited to) low voltage, neon, remote ballast, LED power supplies, exterior locations):
 - 1. Electrical Contractor to locate all transformers (including low voltage, neon, remote ballasts, led power supplies, etc.) near fixtures in a well-ventilated and accessible location. Transformers must be installed (per codes) in accessible areas large enough to dissipate the heat of the transformer. Temperatures should not exceed 100°F (38°C) or that required by manufacturer if more stringent.
 - 2. Electrical Contractor to determine wire size according to load and wire length to eliminate voltage drop. If voltage drop is a problem after installation, the Electrical Contractor is responsible for reinstallation (at no additional cost) of transformer and wire to solve problem.
 - 3. Electrical Contractor to label front of transformer/driver. Example: "Large Display Case @ Entry to Main Dining Room."
- Q. Seal all knock-outs, conduit, and wire entrances for all luminaires in wet and damp locations to prevent water wicking.
- R. All reflecting surfaces, glass or plastic lenses, ballast housings, parabolic louvers, downlighting alzak cones and specular reflectors and other decorative elements shall be installed after completion of ceiling tile installation, plastering, painting and general cleanup.
- S. Handle all reflecting surfaces, glass or plastic lenses, ballast housings, parabolic louvers, downlighting alzak cones and specular reflectors and other decorative elements with care during installation or lamping to avoid fingerprints or dirt deposits.
- T. Luminaires installed and used for working light during construction shall be replaced prior to turnover to the Owner if more than 3 percent of their rated life has been used. Fixtures shall be tested for proper operation prior to turn-over and shall be replaced if necessary.

3.3 POLE, LIGHT COLUMN AND BOLLARD INSTALLATION

- A. Alignment: Align foundations, poles light columns and bollards for optimum directional alignment of luminaires and their mounting provisions on the pole.
- B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features unless otherwise indicated on Drawings:
 - 1. Fire Hydrants and Storm Drainage Piping: 60 inches
 - 2. Water, Gas. Electric, Communication, and Sewer Lines: 10 feet
 - 3. Trees: 15 feet from tree trunk.
- C. Excavation: Restrict excavation in size to that which will provide sufficient working space for installation of concrete forms. Should soil conditions at the bottom of the excavation be unsuitable as a foundation, as determined by the Architect, take the excavation down to firm soil and fill to required grade with concrete or satisfactory soil materials as directed.

D. Backfill: Thoroughly compact backfill with compacting arranged to prevent pressure between conductor, jacket, or sheath and the end of conduit ell.

E. Concrete Pole Foundations:

- 1. Concrete materials, installation, and finishing requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- 2. Concrete Pole Foundations shall be cast-in-place concrete, having 4000 psi minimum 28-day compressive strength.
- 3. Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer.
- 4. Formwork: Construct forms of wood, plywood, steel, or other acceptable materials fabricated to conform to the configuration, line, and grade required. Reinforce formwork to prevent deformation while concrete is being placed and consolidated. Wet or coat formwork with a parting agent before placing concrete.
- 5. Cast conduit into concrete pole foundations.
- 6. Prior to concrete pour, install a ground rod and a separate insulated equipment grounding conductor at each pole, light column and bollard in addition to grounding conductor installed with branch-circuit conductors.
- 7. Finish by troweling and rubbing smooth. Round all above-grade concrete edges to approximately 0.25" radius.
- 8. Refer to Pole Base Detail on drawings for additional requirements.

F. Foundation-Mounted Poles:

- 1. Install according to pole manufacturer's instructions using a template supplied by pole manufacturer in accordance with the lighting standard manufacturer's recommendations.
- 2. Use galvanized steel anchor bolts, threaded at the top end and bent 90 degrees at the bottom end, and nuts selected to resist seismic forces defined for the application and approved by manufacturer.
- 3. Grout void between pole base and foundation. Use non-shrink or expanding concrete grout firmly packed to fill space.
- 4. Mount pole with leveling nuts and tighten top nuts to torque level recommended by pole manufacturer. Provide base covers.
- G. Embedded Poles with Tamped Earth Backfill: Set poles to depth below finished grade indicated on Drawings, but not less than one-sixth of pole height.
 - 1. Dig holes large enough to permit use of tampers in the full depth of hole.
 - 2. Backfill in 6-inch layers and thoroughly tamp each layer so compaction of backfill is equal to or greater than that of undisturbed earth.
- H. Embedded Poles with Concrete Backfill: Set poles in augered holes to depth below finished grade indicated on Drawings, but not less than one-sixth of pole height.
 - 1. Make holes 6 inches in diameter larger than pole diameter.
 - 2. Fill augered hole around pole with air-entrained concrete having a minimum compressive strength of 3000 psi at 28 days, and finish in a dome above finished grade.
 - 3. Use a short piece of 1/2-inch diameter pipe to make a drain hole through concrete dome. Arrange to drain condensation from interior of pole.
 - 4. Cure concrete a minimum of 72 hours before performing work on pole.

- I. Poles and Pole Foundations Set in Concrete Paved Areas (Slabs): Install poles with minimum of 6-inch wide, unpaved gap between the pole or pole foundation and the edge of adjacent concrete slab. Fill unpaved ring with pea gravel to a level 1 inch below top of concrete slab.
- J. Raise and set poles using web fabric slings (not chain or cable). Adjust poles as necessary to provide a permanent vertical position with the bracket arm in proper position for luminaire location. Alterations to poles after fabrication will void manufacturer's warranty and shall not be allowed.
- K. Bollard and light column luminaire installation:
 - 1. Install on concrete base with top level with finished grade or surface at luminaire location. Shape base to match shape and diameter of bollard and/or light column base.

3.4 GROUND-MOUNTING LUMINAIRE INSTALLATION

- A. Align units for optimum directional alignment of light distribution.
- B. Install on concrete base with top 4 inches above finished grade or surface at luminaire location.

3.5 IN-GRADE LUMINAIRE INSTALLATION

- A. All in-grade fixtures shall be installed per manufacturer's installation instructions.
- B. Verify design type, Flow Through or Sealed, prior to installation.
- C. Flow Through in-grades fixtures shall have drainage system installed below fixture per manufacturer's requirements. If site has poor drainage soil, a sealed in-grade shall be installed. Coordinate soil type with civil engineer prior to submittals.
- D. Provide all conduit connections to in-grade fixture with seal off compound.

3.6 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

3.7 GROUNDING

- A. Comply with Section 26 0526 "Grounding and Bonding for Electrical Systems"
- B. Bond luminaires and metal accessories to the grounding system per NEC.
- C. Ground noncurrent-carrying parts of equipment including metal poles, luminaires, mounting arms, brackets, and metallic enclosures. Where copper grounding conductor is connected to a metal other than copper, provide specially treated or lined connectors suitable for this purpose.

D. At each light pole, light column, light bollard and support structures, provide a driven ground rod into the earth so that after the installation is complete, the top of the ground rod will be approximately 1 foot below finished grade. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

3.8 IDENTIFICATION

- A. Comply with requirements for identification specified in Section 26 0553 "Identification for Electrical Systems."
 - Light fixtures served from multiple power sources, such as emergency fixtures fed from emergency transfer relay or split wired fixtures, shall have the following label affixed to it: "DANGER -ELECTRICAL SHOCK HAZARD - LIGHT FIXTURE HAS MULTIPLE POWER SOURCES"
- B. Manufacturer's Nameplate: Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.
- C. Factory-Applied Labels: Provide labeled luminaires in accordance with UL 1598 requirements. All light fixtures shall be clearly marked for operation of specific LED's and drivers according to proper type. The following characteristics shall be noted in the format "Use Only _____":
 - 1. LED or lamp type, and nominal wattage
 - 2. Driver or ballast type
 - 3. Correlated color temperature (CCT) and color rendering index (CRI)
 - 4. All markings related to lamp type shall be clear and located to be readily visible to service personnel, but unseen from normal viewing angles when lamps are in place. Drivers and ballasts shall have clear markings indicating multi-level outputs and indicate proper terminals for the various outputs.

3.9 FIELD QUALITY CONTROL:

- A. The lighting and lighting controls systems shall be synchronized and fully operable to address the lighting operation in a complete and code-compliant manner.
- B. Upon completion of installation, verify that equipment is properly installed, connected, and adjusted. Conduct an operating test to show that equipment operates in accordance with requirements of this section. Replace defective light fixtures, controls, lamps, ballasts and drivers at no cost to Owner.
- C. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal and emergency power sources.
- D. Dimming Drivers. Test for full range of dimming capability. Observe for visually detectable flicker over full dimming range. Replace defective light fixtures, controls, lamps, ballasts and drivers at no cost to Owner.
- E. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal. Replace defective light fixtures at no cost to Owner.
- F. Inspect each light fixture for damage. Replace damaged light fixtures at no cost to the Owner.

G. Fixtures showing dirt, dust or fingerprints shall be restored to like new condition or shall be replaced at no cost.

3.10 CLEANING

- A. At completion of each phase and the time of final acceptance by the Owner, all lighting fixtures shall have been thoroughly cleaned with materials and methods recommended by the manufacturer.
- B. All fingerprints, dirt, tar, smudges, drywall mud and dust, etc. shall be removed by the Contractor from the luminaire bodies, reflectors, trims, and lens/louvers prior to final acceptance. Cleaned with solvent recommended by the manufacturer to a like-new condition or replaced. All reflectors shall be free of paint other than factory-applied, if any.

3.11 ADJUSTING

- A. All adjustable luminaires shall be aimed, focused, locked, etc., by the Contractor under the observation of the Architect and Engineer. As aiming and adjusting is completed, locking setscrews and bolts and nuts shall be tightened securely by the Contractor. All aiming and adjusting shall be performed after the entire installation is complete for each phase or area. The Contractor shall be responsible for notifying the Architect of appropriate time for final luminaire adjustment. Where possible, units shall be focused during the normal working day. However, where daylight interferes with seeing lighting effects, aiming shall be accomplished at night at no premium cost.
- B. All ladders, scaffolds, lifts, gloves, cleaning cloths, access/adjustment tools, etc. required for aiming and adjusting luminaires shall be furnished by the Contractor.
- C. Occupancy Adjustments: When requested within 12 months of date of Completion, provide on-site assistance in adjusting aimable luminaires to suit actual occupied conditions. Provide up to two (2) visits to Project during other-than-normal occupancy hours for this purpose. Some of this work may be required after dark.
 - 1. Adjust aimable luminaires in the presence of Architect/Engineer.

END OF SECTION 26 5000

SECTION 27 0526 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

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1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General, Special and Supplementary Conditions, Division 01 Specification Sections, Section 26 0010 "General Requirements for Electrical", and 270010 "Supplemental Requirements for Communications" apply to this Section.

1.2 SUMMARY

A. Description: The telecommunications bonding and grounding system and its interconnections to the electrical system provide an electrically continuous, low impedance path for all connected telecommunications equipment and pathways.

B. Section Includes:

- 1. Bonding conductors.
- 2. Bonding connectors.
- 3. Bonding busbars.

C. Related Requirements:

1. Refer to Section 26 0526 "Grounding and Bonding for Electrical Systems" for requirements associated with Electrical System Grounding, Equipment Grounding System, and Grounding Electrode System.

1.3 REFERENCES

A. Abbreviations

- 1. TBC: Telecommunications Bonding Conductor.
- 2. SBB: Secondary Bonding Busbar (Formerly TGB).
- 3. PBB: Primary Bonding Busbar (Formerly TMGB).
- 4. RBB: Rack Bonding Busbar
- 5. TBB: Telecommunications Bonding Backbone
- 6. BBC: Backbone Bonding Conductor
- 7. TEBC: Telecommunications Equipment Bonding Conductor
- 8. RBC: Rack Bonding Conductor

B. Definitions

- 1. Service Provider: The operator of a service that provides telecommunications transmission delivered over access provider facilities.
- 2. Grounding: Establishing a direct or indirect connection to Earth or some conducting body that serves in place of Earth.

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- 3. Bonding: Method by which all non-energized conductive materials are effectively interconnected to create a low impedance path.
- C. Reference Standards: The following publications are referred to in the text by the basic designation only. The edition/revision of the referenced publications shall be the latest version as of the date of the Contract Documents, unless otherwise specified.
 - 1. Building Industry Consulting Service International (BICSI)
 - a. ANSI/BICSI N3 "Planning and Installation Methods for the Bonding and Grounding of Telecommunication and ICT Systems and Infrastructure"
 - 2. Telecommunications Industry Association (TIA):
 - a. ANSI/TIA-607, "Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises"

1.4 SUBMITTALS

- A. Product Data: For each type of product.
- B. Field Quality Control Reports: Provide test reports for each test specified in the field quality control section. Include certificate of current equipment calibration.
- C. Closeout Submittals:
 - 1. Operation and Maintenance Data: In addition to the items specified in Division 01 and Section 26 0010 "General Requirements for Electrical" include the following:
 - a. Results of the ground-resistance and bonding resistance tests.
 - b. Include recommended testing intervals

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.
- C. Comply with NFPA 70, TIA-607, and ANSI/BICSI N3.

2.2 CONDUCTORS

- A. Insulated Copper Conductors: Comply with Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables".
 - 1. Ground wire for custom-length equipment bonding jumpers: minimum No. 6 AWG.

2.3 CONNECTORS

A. Comply with requirements in 26 0526 "Grounding and Bonding for Electrical Systems".

2.4 TELECOM BONDING BUSBARS

- A. Manufacturers: Subject to compliance with requirements, provide products from one of the following:
 - 1. Harger Lightning and Grounding
 - 2. Panduit Corp.
 - 3. Erico
 - 4. Chatsworth CPI
 - 5. Ortronics
 - 6. Eaton

B. General Requirements:

- 1. Predrilled BICSI/TIA-607 style hole pattern for use with lugs specified in this Section.
- 2. Mounting Hardware: Stand-off brackets that provide a minimum of 4-inch clearance to access the rear of the busbar. Provide stainless steel brackets and bolts.
- Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.
- 4. Busbar length: Size to accommodate initial conductors plus a 50% growth factor.
- C. Primary Bonding Busbar (PBB): Predrilled, wall-mounted, rectangular bars of electro-tin plated copper, 1/4 by 4 inches in cross section, minimum 24 inches in length or as indicated on Drawings. NRTL listed for use as PBB, complying with UL 467 and TIA-607.
- D. Secondary Bonding Busbar (SBB): Predrilled, wall-mounted rectangular bars of electro-tin plated copper, 1/4 by 2 inches in cross section, minimum 12 inches in length or as indicated on Drawings. NRTL listed for use as a SBB, complying with UL 467 and TIA-607.
- E. Rack Bonding Busbar (RBB): Comply with requirements for rack busbars in Section 27 1100 "Communications Equipment Room Fittings".

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the ac grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of the electrical system.
- B. Inspect the test results of the ac grounding system measured at the point of TBC connection.
- C. Prepare written report, endorsed by Installer, listing any conditions detrimental to performance of the Work.

GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS 27 0526 - 4 04/24/2025

D. Proceed with connection of the TBC only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Bonding shall include the ac utility power service entrance, the communications cable entrance, and the grounding electrode system. The bonding of these elements shall form a loop so that each element is connected to at least two others.
- B. Comply with NECA 1, NFPA 70, TIA-607, and ANSI/BICSI N3.

3.3 APPLICATION

- A. Conductors: Install solid conductor for No. 8 AWG and smaller and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
 - 1. The bonding conductors between the PBB/SBB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.
- B. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.

C. Conductor Support:

- 1. Secure grounding and bonding conductors at intervals of not less than 36 inches.
- D. Grounding and Bonding Conductors:
 - 1. Install in the straightest and shortest route between the origination and termination point, and no longer than required. The bend radius shall not be smaller than ten times the diameter of the conductor. No one bend may exceed 90 degrees.
 - 2. Install without splices.
 - 3. Support at not more than 36-inchintervals.
 - 4. Install grounding and bonding conductors in minimum 1-inchPVC conduit where exposed to physical damage or where routed through building walls or footings. Provide EMT conduit for the grounding and bonding conductor pathway where installed in a plenum.
 - a. If a grounding and bonding conductor is installed in ferrous metallic conduit bond the conductor to the conduit at both ends using a grounding bushing that complies with requirements in Section 27 0528, "Pathways for Communications Systems".

3.4 GROUNDING ELECTRODE SYSTEM

- A. Provide a Telecommunications Bonding Conductor (TBC) between the PBB and the electrical service equipment ground busbar no smaller than No. 1/0 AWG and no smaller than the Telecommunications Bonding Backbone (TBB).
- B. Where external equipment ground busbar is not available, provide intersystem bonding termination (IBT) device for connecting telecommunications bonding conductor (TBC) with service busbar.
- C. Comply with requirements in article 250.94 of the National Electric Code (NEC)

3.5 TELECOM BONDING BUSBARS

- A. Provide PBB in main telecommunications equipment room and locate to minimize length of TBC.
- B. Provide SBB in each telecom room.
- C. Install PBB/SBB horizontally, on insulated spacers 4 inchesminimum from wall, 48 inchesabove finished floor unless otherwise indicated.
- D. Install RBB on rack or cabinet using stand-off block insulators to provide a minimum of 0.75 inches of separation for dissimilar metals and to facilitate conductor attachment to RBB. The RBB may be directly mounted/bonded to the rack or cabinet only if doing so allows adequate space for attaching grounding conductors and does not create a dissimilar metals reaction.

3.6 CONNECTIONS

- A. Bond all metallic equipment and pathways in each telecommunications room to the bonding busbar in that room, using insulated grounding conductors not smaller than No. 6 AWG.
- B. Stacking of conductors under a single bolt is not permitted when connecting to busbars.
- C. Assemble the wire connector to the conductor, complying with manufacturer's written instructions and as follows:
 - 1. Use crimping tool and the die specific to the connector.
 - 2. Pre-twist the conductor.
- D. Clean and apply an antioxidant compound to all bolted and compression connections.
- E. Building Entrance Protectors: Bond to the PBB/SBB with insulated bonding conductor.
- F. Busbar Interconnections: Interconnect all SBBs with the PBB using a continuous telecommunications bonding backbone (TBB). If more than one TBB is installed, interconnect TBBs using the backbone bonding conductor (BBC) conductor at the top floor and at every third floor in between. The telecommunications bonding backbone and backbone bonding conductor size shall not be less than 2 kcmils/linear footof conductor length, up to a maximum size of 750 kcmil unless otherwise indicated.

GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS 27 0526 - 6 04/24/2025

- G. Telecommunications Enclosures and Equipment Racks/Cabinets: Bond metallic components of enclosures to the telecommunications bonding and grounding system. Connect the Telecommunications Equipment Bonding Conductor (TEBC) to the Rack Bonding Busbar (RBB) and to the rack/cabinet using a Rack Bonding Conductor (RBC) and listed compression two hole lugs.
- H. Structural Steel: Where the structural steel of a steel frame building is readily accessible within the room or space, bond each SBB and PBB to the vertical steel of the building frame.
- I. Electrical Power Panelboards: Where an electrical panelboard for telecommunications equipment is located in the same room or space, bond each PBB/SBB to the equipment ground bar of the panelboard.
- J. Shielded Cable: Bond the shield of shielded cable to the PBB/SBB in communications rooms and spaces. Comply with TIA-568.1 and TIA-568-.2 when grounding shielded balanced twisted-pair cables.
- K. Rack- and Cabinet-Mounted Equipment: Bond powered equipment chassis to the rack bonding busbar (RBB) using unit bonding conductors (UBC). Power connection shall comply with NFPA 70; the equipment grounding conductor in the power cord of cord- and plug-connected equipment shall be considered as a supplement to bonding requirements in this Section.
- L. Ladder Rack and Cable Tray: Bond ladder rack/cable tray system to the PBB/SBB using manufacturer approved ground lugs and bonding conductors. Remove paint from the ladder rack/cable tray to ensure ground lugs contact bare metal.
- M. Metallic Conduits: In telecommunications rooms, bond metallic conduits longer than 24-inches to the PBB/SBB using insulated ground bushing sized for the conduit and ground conductor to be attached.

3.7 IDENTIFICATION

A. Comply with requirements in Section 27 0553 - Identification for Communications Systems.

3.8 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 - 2. Bond Resistance Test: Test the bonding connections of the system using a certified microohmmeter, taking two-point bonding measurements in each telecommunications equipment room containing a PBB/SBB and using the process recommended by BICSI TDMM. Conduct tests with the facility in operation.
 - a. Measure the resistance between the following:
 - 1) Each PBB/SBB to the nearest electrical equipment ground.
 - 2) Each PBB/SBB to the structural steel.
 - 3) PBB to each SBB.
 - 4) Structural steel to the electrical ground.
 - b. The maximum acceptable value of this bonding resistance is 100 milliohms.

- 3. Test for ground loop leakage currents using a certified digital clamp-on earth ground tester, with a full-scale of not more than 10 A, displaying current in increments of 0.01 A at an accuracy of plus/minus 2.0 percent.
 - With the grounding infrastructure completed and the communications system electronics operating, measure the current in every conductor connected to the PBB and in each SBB.
 Maximum acceptable ac current level is 1 A.
- B. Excessive Ground Resistance: If resistance to ground at the TBC exceeds 5 ohms, notify Engineer promptly and include recommendations to reduce ground resistance.
- C. Grounding system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 27 0526

SECTION 27 0528 - PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General, Special and Supplementary Conditions, Division 01 Specification Sections, Section 26 0010 "General Requirements for Electrical Systems", and 270010 "Supplemental Requirements for Communications" apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Conduits and fittings.
 - 2. Metallic surface pathways.
 - 3. J-Hooks.
 - 4. Boxes, enclosures, and cabinets.
- B. Related Requirements:
 - Refer to Section 26 0543 "Underground Ducts and Raceways for Electrical Systems" for communication system pathway requirements

1.3 REFERENCES

- A. Reference Standards: The following publications are referred to in the text by the basic designation only. The edition/revision of the referenced publications shall be the latest version as of the date of the Contract Documents, unless otherwise specified.
 - 1. Building Industry Consulting Service International (BICSI)
 - a. ANSI/BICSI N1 "Installation Practices for Telecommunications and ICT Cabling and Related Cabling Infrastructure."
 - 2. Telecommunications Industry Association (TIA)
 - a. ANSI/TIA-569, "Commercial Building Standard for Telecommunications Pathways and Spaces"

1.4 SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

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

2.2 CONDUITS AND FITTINGS

- A. Comply with 26 0533 "Raceways and Boxes for Electrical Systems".
- B. Conduit Bodies
 - 1. Telecommunications style with standards based internal bend radius control.

2.3 SURFACE METAL PATHWAYS

- A. Comply with 26 0533 "Raceways and Boxes for Electrical Systems".
- B. Boxes and Fittings: Comply with TIA-569 to maintain minimum cable bend radius.

2.4 J-HOOKS

- A. Description: Comply with UL 2239, single and multi-tiered prefabricated sheet metal wide base cable supports with integral bend radius support for telecommunications cable.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following or an approved equal:
 - 1. Panduit
 - 2. Legrand
 - 3. Eaton B-Line
 - 4. nVent Caddy
 - 5. Thomas & Betts
- C. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- D. Material: Galvanized steel.
- E. J shape.
- F. UL 2043 listed and suitable for use in air handling spaces.
- G. Pre-riveted assembly allowing for attachment to walls, ceilings, beams, threaded rods, drop wires and underfloor supports to meet requirements of application indicated.

2.5 BOXES, ENCLOSURES, AND CABINETS

- A. Comply with 26 0533 "Raceways and Boxes for Electrical Systems".
- B. General Requirements for Boxes, Enclosures, and Cabinets used for communications:
 - 1. Minimum Device Box Dimensions unless noted otherwise:
 - a. Minimum 4 inches square by 3-1/2 inches for 1-inch pathways.
 - b. Minimum 4-11/16 inches square by 3-1/2-inch deep box for pathways 1-1/4 inches and larger.
 - 2. Gangable boxes are prohibited.

PART 3 - EXECUTION

3.1 PATHWAY APPLICATION

- A. Comply with requirements in Section 26 0533 Raceways and Boxes for Electrical Systems and Section 26 0543 Underground Ducts and Raceways for Electrical Systems for pathway application except as noted herein.
- B. Minimum Pathway Size: 1-inchtrade size.
 - 1. For Cat6A cable applications: minimum 1-1/4-inch trade size.
- C. Install surface pathways only where indicated on Drawings or where approved by Engineer.
- D. Use of flexible conduit is prohibited.

3.2 INSTALLATION

- A. Comply with the following standards for installation requirements except where requirements indicated on Drawings or in this Section are more stringent:
 - 1. ANSI/BICSI N1.
 - 2. TIA-569.
- B. Comply with requirements in Section 26 0500 Common Work Results for Electrical Systems for hangers, supports, and sleeves.
- C. Comply with requirements in Section 26 0533 Raceways and Boxes for Electrical Systems for installation of raceways and fittings except as noted herein.
- D. Comply with requirements in Section 26 0543 Underground Ducts and Raceways for Electrical Systems for installation of underground duct.
 - 1. Provide fabric innerduct and pull string for all underground duct.
- E. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inchesof changes in direction.

- F. Utilize manufactured sweeps and long radius elbows for all optical-fiber cables.
- G. Surface Pathways:
 - 1. Install surface pathway for surface telecommunications outlet boxes only where indicated on Drawings.
 - 2. Install surface pathway with a minimum 2-inchradius control at bend points.
 - Secure surface pathway with screws or other anchor-type devices at intervals not exceeding 48 inchesand with no less than two supports per straight pathway section. Support surface pathway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- H. Raceways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid and flexible, as follows:
 - 1. 1-InchTrade Size and Larger: Install pathways in maximum continuous lengths of 100-feet.
 - 2. Install with a maximum of two 90-degree bends or equivalent for each length of pathway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
 - 3. Minimum Bend Radius
 - a. For trade size conduits 2-inch or less, provide inside bend radius at least 6 times the internal diameter of the raceway.
 - b. For trade size conduits greater than 2-inch, provide inside bend radius at least 10 times the internal diameter.
 - 4. Pull boxes should be readily accessible and should be installed in straight sections of conduit and not used in place of a bend.
 - 5. Provide a conduit stub-up for each outlet box unless noted otherwise.

I. J-Hooks:

- 1. Size to allow a minimum of 25 percent future capacity without exceeding design capacity limits.
- 2. Provide dedicated support wires, threaded rod, beam clamps, or strut. Do not use ceiling grid support wire or support rods.
- 3. Install at spacing intervals to allow no more than 6-inches of slack and to provide a minimum of 6-inches of clearance from the lowest point of the cables to ceilings, mechanical ductwork and fittings, luminaires, power conduits, power and telecommunications outlets, and other electrical and communications equipment.
- 4. Maximum Spacing: 4-feet on center.
 - For Cat6A installations: 3-foot on center.
- 5. Provide a hook at each change in direction.
- 6. Do not exceed load ratings specified by manufacturer.
- 7. Do not install J-hooks that cannot be maintained without removal of another system.
- 8. Provide additional tiers where required to meet fill capacity and load rating requirements or to separate low voltage systems with varying voltage and power limitations.

3.3 PROTECTION

A. Protect installed cables in open cabling systems:

PROJECT NO. 24-179.000 Harrison REMC - Addition and Renovation Harrison REMC

PATHWAYS FOR COMMUNICATIONS SYSTEMS 27 0528 - 5 04/24/2025

- 1. Install temporary protection for cables in open pathways to safeguard exposed cables against paint overspray, falling objects or debris during construction.
- 2. Replace any cable exposed to paint overspray or other foreign substance that voids the cable warranty, at no cost to the owner.
- 3. Temporary physical protection for cables and J-hooks can be constructed of wood or metal materials and shall remain in place until the risk of damage is over.

END OF SECTION 27 0528

SECTION 27 0536 - CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General, Special and Supplementary Conditions, Division 01 Specification Sections, Section 26 0010 "General Requirements for Electrical", and 270010 "Supplemental Requirements for Communications" apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Wire-mesh cable tray.
 - 2. Cable tray accessories.

1.3 REFERENCES

- A. Abbreviations
- B. Definitions
 - 1. Grounding: Establishing a direct or indirect connection to Earth or some conducting body that serves in place of Earth.
 - 2. Bonding: Method by which all non-energized conductive materials are effectively interconnected to create a low impedance path.
- C. Reference Standards: The following publications are referred to in the text by the basic designation only. The edition/revision of the referenced publications shall be the latest date as of the date of the Contract Documents, unless otherwise specified.
 - 1. Building Industry Consulting Service International (BICSI)
 - 2. ANSI/BICSI N1 "Installation Practices for Telecommunications and ICT Cabling and Related Cabling Infrastructure."
 - 3. National Electrical Manufacturer's Association (NEMA)
 - a. NEMA VE 1 "Metal Cable Tray Systems"
 - b. NEMA VE 2 "Cable Tray Installation Guidelines"
 - 4. Telecommunications Industry Association (TIA)
 - a. ANSI/TIA-569, "Commercial Building Standard for Telecommunications Pathways and Spaces"

1.4 SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR CABLE TRAYS

- A. Cable Trays and Accessories: Identified as defined in NFPA 70 and marked for intended location, application, and grounding.
- B. Source Limitations: Obtain cable trays, components, and accessories from single manufacturer.
- C. Sizes and Configurations: Refer to Drawings for specific requirements for types, materials, sizes, and configurations.

2.2 WIRE-MESH CABLE TRAY

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton B-Line
 - 2. Cablofil
 - 3. Chatsworth
 - 4. MP Husky
 - 5. Siemon
 - 6. Snake Tray
 - 7. nVent WBT Tray

B. Description:

- 1. Configuration: steel wire mesh, complying with NEMA VE 1.
- 2. Minimum Width: 12 inchesunless otherwise indicated on Drawings.
- 3. Minimum Usable Load Depth: 4 inches unless otherwise indicated on Drawings.
- 4. Straight Section Lengths: 10 feet, except where shorter lengths are required to facilitate tray assembly.
- 5. Structural Performance: Capable of supporting a maximum cable load, with a safety factor of 1.5, plus a 200-lbconcentrated load, when tested according to NEMA VE 1.
- 6. Splicing Assemblies: UL classified bolted type, using serrated flange locknuts.
- 7. Splice-Plate Capacity: UL Classified splices located within support span shall not diminish rated loading capacity of cable tray.

C. Materials and Finishes:

1. Steel:

- a. ASTM A 1011/A 1011M for 14 gage and thicker; ASTM A 1008/A 1008M for 16 gage and thinner.
- b. Straight Sections and Fittings: Comply with the minimum mechanical properties of ASTM A 1011/A 1011M. SS. Grade 33.
- c. Steel Tray Splice Plates: ASTM A 1011/A 1011M, HSLAS, Grade 50, Class 1.
- d. Fasteners: Comply with the minimum mechanical properties of ASTM A 510/A 510M, Grade 1008.

- e. Finish: Electrogalvanized after fabrication, complying with ASTM B 633 for use in indoor locations.
 - 1) Hardware: Galvanized, ASTM B 633.

2.3 CABLE TRAY ACCESSORIES

- A. Fittings: Tees, crosses, risers, elbows, and other fittings indicated, of same materials and finish as cable tray.
- B. Barrier Strips: Same materials and finishes as for cable tray.
- C. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

2.4 SOURCE QUALITY CONTROL

A. Testing: Test and inspect cable trays according to NEMA VE 1.

PART 3 - EXECUTION

3.1 CABLE TRAY INSTALLATION

- A. Install cable trays according to BICSI N1, NEMA VE 2, and TIA-569.
- B. Install cable trays as a complete system, including fasteners, hold-down clips, support systems, barrier strips, adjustable horizontal and vertical splice plates, elbows, reducers, tees, crosses, cable dropouts, adapters, covers, and bonding.
- C. Install cable trays to provide a minimum of 12-inch clear space above the top of the cable tray for cable installation.
- D. Install cable trays with enough horizontal workspace to permit access for installing cables.
- E. Install cable trays so all splices are accessible for inspection and adjustment.
- F. Install cable trays to provide a minimum of 3-inch (6-inch recommended) clear space above ceiling tile and grid.
- G. Remove burrs and sharp edges from cable trays.
- H. Fasten cable tray supports to building structure.
- Design fasteners and supports to carry cable tray, number of cables at full capacity, and a concentrated load of 200 lb. Comply with requirements in Section 26 0500 – Common Work Results for Electrical Systems.

CABLE TRAYS FOR COMMUNICATIONS SYSTEMS 27 0536 - 4 04/24/2025

- J. Place supports so spans do not exceed maximum spans and provide clearances shown on Drawings. Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.
- K. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.
- L. Support assembly to prevent twisting from eccentric loading.
- M. Locate and install supports according to NEMA VE 2. Do not install more than one cable tray splice point between supports.
- N. Support wire-basket cable trays with trapeze hangers, or wall brackets.
- O. Support trapeze hangers for wire-basket trays with minimum 1/4-inchdiameter rods.
- P. Make connections to equipment with flanged fittings fastened to cable trays and to equipment. Support cable trays independent of fittings. Do not carry weight of cable trays on equipment enclosure.
- Q. Install expansion connectors where cable trays cross building expansion joints and in cable tray runs that exceed dimensions recommended in NEMA VE 2. Space connectors and set gaps according to applicable standard.
- R. Make changes in direction and elevation using manufacturer's recommended fittings and integral bend radius control.
- S. Make cable tray connections using manufacturer's recommended fittings.
- T. Install capped metal sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.
- U. Where indicated, install permanent covers, after installing cable. Install cover clamps according to NEMA VE 2. Clamp covers on cable trays installed outdoors with heavy-duty clamps.

3.2 CABLE TRAY GROUNDING

- A. Ground cable trays according to NFPA 70 unless additional grounding is specified. Comply with requirements in Section 27 0526 Grounding and Bonding for Communications Systems.
- B. Bond cable trays together with splice plates listed for grounding purposes or with listed bonding jumpers.
- C. When using epoxy- or powder-coat painted cable trays as a grounding conductor, completely remove coating at all splice contact points or ground connector attachment. After completing splice-to-grounding bolt attachment, repair the coated surfaces with coating materials recommended by cable tray manufacturer.

3.3 CABLE INSTALLATION

A. Install cables after each cable tray run has been completed and inspected.

- B. Initial fill ratio shall not exceed 25%.
- C. Initial cable fill shall not exceed 50% of the manufacturer's listed load rating.
- D. Fasten cables on vertical runs with cable clamps or cable ties every 18-inches according to NEMA VE 2. Fasten cables on horizontal runs where required to maintain a neat and workmanlike installation.
- E. Tighten clamps and ties only enough to secure the cable, without indenting the cable jacket. Install cable ties with a tool that includes an automatic pressure-limiting device and trim excess to prevent further tightening.
- F. Fasten and support cables that pass from one cable tray to another or drop from cable trays to equipment enclosures. Fasten cables to the cable tray at the point of exit and support cables independent of the enclosure. The cable length between cable trays or between cable tray and enclosure shall be no more than 72 inches.
- G. Provide radius drop-outs wherever multiple cables are existing the cable tray.
- H. In existing construction, remove inactive or dead cables from cable trays.

3.4 CONNECTIONS

- A. Remove paint from all connection points before making connections. Repair paint after the connections are completed.
- B. Connect pathways to cable trays according to requirements in NEMA VE 2.

3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections
 - 1. After installing cable trays, provide visual survey for compliance with requirements.
 - Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable trays, vibrations, and thermal expansion and contraction conditions, which may cause or have caused damage.
 - 3. Verify that communications cabling is separated from power circuits by barriers or are installed in separate cable trays.
 - 4. Verify there are no intruding items such as pipes, hangers, or other equipment in the cable tray.
 - 5. Remove dust deposits, trash of any description, and any blockage of tray ventilation.
 - 6. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorque in suspect areas.
 - 7. Check for improperly sized or installed bonding jumpers.
 - 8. Check for missing, incorrect, or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
 - Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable trays. Test entire cable tray system for continuity. Maximum allowable resistance is 1 ohm.

B. Prepare test and inspection reports.

3.6 PROTECTION

- A. Protect installed cable trays and cables.
 - 1. Install temporary protection for cables in open trays to safeguard exposed cables against paint overspray, falling objects, or debris during construction.
 - 2. Replace any cable exposed to paint overspray or other foreign substance that voids the cable warranty, at no cost to the owner.
 - 3. Temporary physical protection for cables and cable tray can be constructed of wood or metal materials and shall remain in place until the risk of damage is over.
 - 4. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.
 - 5. Repair damage to paint finishes with matching touchup coating recommended by cable tray manufacturer.

END OF SECTION 27 0536

SECTION 27 4100 - LOW VOLTAGE SYSTEMS

PART 1 - GENERAL

- 1.1 RELATED DOCUMENTS:
- 1.1.1 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections apply to work of this section.
- 1.1.2 Division 26 Basic Materials and Methods sections apply to work specified in this section.
- 1.1.3 080671 DOOR HARDWARE
- 1.2 DESCRIPTION OF WORK:
- 1.2.1 Extent low voltage system work is indicated by drawings and schedules, and is hereby defined to include, but not by way of limitation, conduit, backboxes, electrical rough-in, pull strings, etc. Systems include fire alarm systems, audio visual systems, video surveillance systems, access control systems, panic alarms and other low voltage system rough-ins indicated on plans.
- 1.2.2 Rough-ins shall be installed from wiring diagrams provided by vendor. The contractor shall coordinate with vendor prior to bid and include all necessary equipment to complete required work.
- 1.3 QUALITY ASSURANCE:
- 1.3.1 NEC Compliance: Comply with NEC as applicable to communication system materials and installations.
- 1.3.2 NEMA Compliance: Comply with applicable portions of NEMA standards pertaining to types of electrical equipment enclosures.
- 1.4 SUBMITTALS:
- 1.4.1 Product Data: Submit complete product data and literature.

PART 2 - PRODUCTS

- 2.1 MATERIALS:
- 2.1.1 Refer to applicable Division-26 Basic Materials and Methods sections for electrical raceways, boxes and fittings required in connection with low voltage systems.

PART 3 - EXECUTION

- 3.1 INSTALLATION OF LOW VOTLAGE SYSTEM:
- 3.2 Coordinate with the owner's low voltage installer and provide conduit and backboxes of types indicated, where shown, in accordance with the drawings and schedules and with recognized industry practices. Ensure systems comply with installation requirements of NEC.
- 3.3 Coordinate with other electrical work, including raceways, cable tray, electrical boxes and fittings, as necessary to interface installation of a/v system work with other work.
- 3.4 Low voltage cabling in j-hooks installed above ceiling. Provide j-hook paths for all vendor installed cable routes.

END OF SECTION 27 4100

ORNAMENTAL CANTILEVER GATES 32 3100 - 1 04/24/2025

AMERISTAR® PERIMETER SECURITY USA INC. TransPort Traverse II® - Ornamental Cantilever Gate System CONSTRUCTION SPECIFICATION - SECTION 32 3100

PART 1 - GENERAL

1.01 WORK INCLUDED

The contractor shall provide all labor, materials, and appurtenances necessary for installation of the industrial ornamental cantilever gate system defined herein at Harrison REMC in Corydon, IN.

1.02 RELATED WORK

Section 31 0000 - Earthwork Section 03 0000 - Concrete

1.03 SYSTEM DESCRIPTION

The manufacturer shall supply a total industrial ornamental cantilever gate system of the Ameristar® TransPort Traverse II® Majestic design. The system shall include all components (i.e., tracks, uprights, bracing, pickets, hardware and fasteners) required.

1.04 QUALITY ASSURANCE

The contractor shall provide laborers and supervisors who are thoroughly familiar with the type of construction involved and materials and techniques specified.

1.05 REFERENCES

- ASTM A653/A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- ASTM B117 Practice for Operating Salt-Spray (Fog) Apparatus.
- ASTM B221 Aluminum and Aluminum Alloy Extruded Bars, Shapes and Tubes
- ASTM D523 Test Method for Specular Gloss.
- ASTM D714 Test Method for Evaluating Degree of Blistering in Paint.
- ASTM D822 Practice for Conducting Tests on Paint and Related Coatings and Materials using Filtered Open-Flame Carbon-Arc Light and Water Exposure Apparatus.
- ASTM D1654 Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.
- ASTM D2244 Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.
- ASTM D2794 Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
- ASTM D3359 Test Method for Measuring Adhesion by Tape Test.

1.06 SUBMITTAL

The manufacturer's submittal package shall be provided prior to installation.

1.07 PRODUCT HANDLING AND STORAGE

Upon receipt at the job site, all materials shall be checked to ensure that no damages occurred during shipping or handling. Materials shall be stored in such a manner to ensure proper ventilation and drainage, and to protect against damage, weather, vandalism and theft.

PART 2 - MATERIALS

2.01 MANUFACTURER

All industrial ornamental cantilever gates shall conform to the Ameristar® TransPort Traverse II® gate system, Majestic Majestic

PROJECT NO. 24-179.000
Harrison REMC - Addition and Renovation
Harrison REMC

ORNAMENTAL CANTILEVER GATES 32 3100 - 2 04/24/2025

2.02 MATERIAL

A. The materials used for cantilever gate framing (uprights & diagonal bracing) shall be manufactured from ASTM A653 Steel with yield strength of 34,800 PSI, a tensile strength of 37,700PSI and a standard mill finish. The TransPort™ aluminum extrusions for top and bottom enclosed tracks shall be alloy and temper designation 6005-T5 to meet ASTM B221.

- **B.** Material for pickets shall be 1" square x 16 ga. steel pickets on gate systems less than 22' openings, gate systems greater than 22' openings shall have 1" square x 1/8" wall aluminum pickets. Picket on center spacing shall not exceed 5". Pickets shall be securely fastened to face of top and bottom enclosed track extrusions.
- C. Material for gate uprights shall be 2 ½" X 16 ga. and diagonal bracing shall be 2" square x 16 ga. steel. The cross-sectional shape of the enclosed-track shall confirm to the manufacturers Traverse-Trak[™] design with a single extrusion consisting of a 3.75" x 7" channeled support with integrated 3" x 3" enclosed-track raceway. Gates less than 18-foot openings shall be constructed as a single-track system, gates greater than 20-foot openings shall be constructed as a spliced track system.
- **D.** Steel material for fence posts and pickets shall be galvanized prior to forming in accordance with the requirements of ASTM A653/A653M, with minimum yield strength of 45,000 psi (310 MPa). The steel shall be hot-dip galvanized to meet the requirements of ASTM A653/A653M with a minimum zinc coating weight of 0.90 oz/ft² (276 g/m²), Coating Designation G-90. Depending on application and gate size, material for gate support posts shall be 4" x 11 Ga., or 6" x 3/16".
- **E.** Support carriage trolly assemblies, for the gates enclosed bottom track, shall have two mounting options: concrete slab or post mount bracket configuration, and shall support the vertical load of the gate. The gates center of gravity shall be centered on the bottom support carriage trolly assemblies. Installation of the carriage trolly assemblies shall be per manufacturer's installation instructions (written or video).

2.03 FABRICATION

- **A.** Gate frame uprights and diagonal bracing shall be prefabricated and pre-punched to accept frame fasteners. Enclosed track shall be pre-punched to accept gate uprights. Pickets shall be precut to specified length and predrilled to accept picket to track fasteners. Posts shall be precut to specified lengths.
- **B.** Top and bottom enclosed track extrusions shall be mechanically fastened to vertical gate uprights and intermediate supports, as required by assembly instructions. Diagonal bracing shall be mechanically fastened to vertical gate uprights and intermediate supports, as required by assembly instructions. Pickets shall be mechanically fastened to top and bottom enclosed track, as required by assembly instructions.
- **C.** The manufactured gate components shall be subjected to the Ameristar thermal stratification coating process (high-temperature, in-line, multi-stage, and multi-layer) including, as a minimum, a six-stage pretreatment/wash and an electrostatic spray application of a polyester finish. The topcoat shall be a "no-mar" TGIC polyester powder coat finish with a minimum thickness of 2 mils (0.0508mm). The color shall be <u>Black</u>. The stratification-coated framework shall be capable of meeting the performance requirements for each quality characteristic shown in **Table 1**.

PART 3 - EXECUTION 3.01 PREPARATION

All new installation shall be laid out by the contractor in accordance with the construction plans.

3.02 GATE INSTALLATION

A. Cantilever support posts shall be set in concrete footers having a minimum depth of 48" (Note: In most cases, local soil, code restrictions and inclement weather conditions may require a greater depth). Posts shall be spaced according to gate specific submittal drawings. Optional Safety Kit must be included if the gate is automated. The "Earthwork" and "Concrete" sections of this specification shall govern material requirements for the concrete footer.

ORNAMENTAL CANTILEVER GATES 32 3100 - 3 04/24/2025

B. Gate to be installed per manufacturers gate installation instructions (written or video). For Gates that will be automated, the contractor shall be responsible to ensure the gate, and installation, meet ASTM F2200 and UL325 Standards.

3.03 GATE INSTALLATION MAINTENANCE

When cutting/drilling posts adhere to the following steps to seal the exposed steel surfaces; 1) Remove all metal shavings from cut area. 2) Apply zinc-rich primer to thoroughly cover cut edge and/or drilled hole; let dry. 3) Apply 2 coats of custom finish paint matching fence color. Failure to seal exposed surfaces per steps 1-3 above will negate warranty. Ameristar spray cans or paint pens shall be used to prime and finish exposed surfaces; it is recommended that paint pens be used to prevent overspray. Use of non-Ameristar parts or components will negate the manufactures' warranty.

3.04 GATE INSTALLATION

Gate posts shall be spaced according to the manufacturers' drawings, dependent on clear opening. The manufacturers' gate drawings shall identify the necessary gate hardware required for the application. Gate hardware shall be provided by the manufacture of the gate and shall be installed per manufacturer's recommendations.

3.05 CLEANING

The contractor shall clean the jobsite of excess materials; post-hole excavations shall be scattered uniformly away from posts.

Table 1 – Coating Performance Requirements							
Quality Characteristics	aracteristics ASTM Test Method Performance Requirements						
Adhesion	D3359 – Method B	Adhesion (Retention of Coating) over 90% of test area (Tape and knife test).					
Corrosion Resistance	B117, D714 & D1654chart	Corrosion Resistance over 1,000 hours (Scribed per D1654; failure mode is accumulation of 1/8" coating loss from scribe or medium #8 blisters).					
Impact Resistance	D2794	Impact Resistance over 60 inch lb. (Forward impact using 0.625" ball).					
Weathering Resistance	D822 D2244, D523 (60° Method)	Weathering Resistance over 1,000 hours (Failure mode is 60% loss of gloss or color variance of more than 3 delta-E color units).					

STEEL ORNAMENTAL FENCES 32 3119 - 1 04/24/2025

AMERISTAR® PERIMETER SECURITY USA INC.

Montage II® - Heavy Industrial Steel Ornamental Fence System – Fusion Welded and Rackable CONSTRUCTION SPECIFICATION - SECTION 32 3119

PART 1 - GENERAL

1.01 WORK INCLUDED

The contractor shall provide all labor, materials and appurtenances necessary for installation of the welded ornamental steel fence system defined herein at Harrison REMC in Corydon, IN.

1.02 RELATED WORK

Section 31 0000 - Earthwork Section 03 0000 - Concrete

1.03 SYSTEM DESCRIPTION

The manufacturer shall supply a total fence system of Montage II[®] *Welded and Rackable* (ATF – All Terrain Flexibility) Ornamental Steel <u>Majestic</u> design. The system shall include all components (i.e., panels, posts, gates and hardware) required.

1.04 QUALITY ASSURANCE

The contractor shall provide laborers and supervisors who are thoroughly familiar with the type of construction involved and materials and techniques specified.

1.05 REFERENCES

- ASTM A653/A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- ASTM B117 Practice for Operating Salt-Spray (Fog) Apparatus.
- ASTM D523 Test Method for Specular Gloss.
- ASTM D714 Test Method for Evaluating Degree of Blistering in Paint.
- ASTM D822 Practice for Conducting Tests on Paint and Related Coatings and Materials using Filtered Open-Flame Carbon-Arc Light and Water Exposure Apparatus.
- ASTM D1654 Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.
- ASTM D2244 Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.
- ASTM D2794 Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
- ASTM D3359 Test Method for Measuring Adhesion by Tape Test.
- ASTM F2408 Ornamental Fences Employing Galvanized Steel Tubular Pickets.

1.06 SUBMITTAL

The manufacturer's literature shall be submitted prior to installation.

1.07 PRODUCT HANDLING AND STORAGE

Upon receipt at the job site, all materials shall be checked to ensure that no damage occurred during shipping or handling. Materials shall be stored in such a manner to ensure proper ventilation and drainage, and to protect against damage, weather, vandalism and theft.

1.08 PRODUCT WARRANTY

A. All structural fence components (i.e. rails, pickets, and posts) shall be warranted within specified limitations, by the manufacturer for a period of 20 years from date of original purchase. Warranty shall cover any defects in material finish, including cracking, peeling, chipping, blistering or corroding.

B. Reimbursement for labor necessary to restore or replace components that have been found to be defective under the terms of manufactures warranty shall be guaranteed for five (5) years from date of original purchase.

STEEL ORNAMENTAL FENCES 32 3119 - 2 04/24/2025

PART 2 - MATERIALS 2.01 MANUFACTURER

The fence system shall conform to Montage II[®] *Welded and Rackable* (ATF – All Terrain Flexibility) Ornamental Steel, <u>Majestic™</u>design, <u>extended picket</u> bottom rail treatment, 2-Rail style manufactured by Ameristar Fence Products, Inc., in Tulsa, Oklahoma.

2.02 MATERIAL

- **A.** Steel material for fence panels and posts shall conform to the requirements of ASTM A653/A653M, with a minimum yield strength of 45,000 psi (310 MPa) and a minimum zinc (hot-dip galvanized) coating weight of 0.90 oz/ft2 (276 g/m2), Coating Designation G-90.
- **B.** Material for pickets shall be 1" square x 14 Ga. tubing. The rails shall be steel channel, 1.75" x 1. 75" x .105". Picket holes in the rail shall be spaced 4.715" o.c. Fence posts and gate posts shall meet the minimum size requirements of Table 1.

2.03 FABRICATION

- A. Pickets, rails and posts shall be pre-cut to specified lengths. Rails shall be pre-punched to accept pickets.
- **B.** Pickets shall be inserted into the pre-punched holes in the rails and shall be aligned to standard spacing using a specially calibrated alignment fixture. The aligned pickets and rails shall be joined at each picket-to-rail intersection by Ameristar's proprietary fusion welding process, thus completing the rigid panel assembly (Note: The process produces a virtually seamless, spatter-free goodneighbor appearance, equally attractive from either side of the panel).
- **C.** The manufactured panels and posts shall be subjected to an inline electrodeposition coating (E-Coat) process consisting of a multi-stage pretreatment/wash, followed by a duplex application of an epoxy primer and an acrylic topcoat. The minimum cumulative coating thickness of epoxy and acrylic shall be 2 mils (0.058 mm). The color shall be Black. The coated panels and posts shall be capable of meeting the performance requirements for each quality characteristic shown in Table 2 (Note: The requirements in Table 2 meet or exceed the coating performance criteria of ASTM F2408).
- **D.** The manufactured fence system shall be capable of meeting the vertical load, horizontal load, and infill performance requirements for Industrial weight fences under ASTM F2408.
- **E.** Swing gates shall be fabricated using 1.75" x 14ga Forerunner double channel rail, 2" sq. x 12ga. gate ends, and 1" sq. x 14ga. pickets. Gates that exceed 6' in width will have a 1.75" sq. x 14ga. intermediate upright. All rail and upright intersections shall be joined by welding. All picket and rail intersections shall also be joined by welding. Gusset plates will be welded at each upright to rail intersection. Cable kits will be provided for additional trussing for all gates leaves over 6'.
- **F.** Pedestrian swing gates shall be self-closing, having a gate leaf no larger than 48" width. Integrated hinge-closer set (2 qty) shall be ADA compliant that shall include a variable speed and final snap adjustment with compact design (no greater than 5" x 6" footprint). Hinge-closer set (2 qty) shall be tested to a minimum of 500,000 cycles and capable of self-closing gates up to a maximum gate weight of 260 lbs. and maximum weight load capacity of 1,500 lbs. Hinge-closer device shall be externally mounted with tamper-resistant security fasteners, with full range of adjustability, horizontal (.5" 1.375") and vertical (0 .5"). Maintenance free hinge-closer set shall be tested to operate in temperatures of negative 20 F to 200 F degrees, and swings to negative 2 degrees to ensure reliable final lock engagement.

PART 3 - EXECUTION 3.01 PREPARATION

All new installation shall be laid out by the contractor in accordance with the construction plans.

3.02 FENCE INSTALLATION

Fence post shall be spaced according to Table 3, plus or minus ½". For installations that must be raked to follow sloping grades, the post spacing dimension must be measured along the grade. Fence panels shall be attached to posts with brackets supplied by the

manufacturer. Posts shall be set in concrete footers having a minimum depth of 36" (Note: In some cases, local restrictions of freezing weather conditions may require a greater depth). The "Earthwork" and "Concrete" sections of this specification shall govern material requirements for the concrete footer. Posts setting by other methods such as plated posts or grouted core-drilled footers are permissible only if shown by engineering analysis to be sufficient in strength for the intended application.

3.03 FENCE INSTALLATION MAINTENANCE

When cutting/drilling rails or posts adhere to the following steps to seal the exposed steel surfaces; 1) Remove all metal shavings from cut area. 2) Apply zinc-rich primer to thoroughly cover cut edge and/or drilled hole; let dry. 3) Apply 2 coats of custom finish paint matching fence color. Failure to seal exposed surfaces per steps 1-3 above will negate warranty. Ameristar spray cans or paint pens shall be used to prime and finish exposed surfaces; it is recommended that paint pens be used to prevent overspray. Use of non-Ameristar parts or components will negate the manufactures' warranty.

3.04 GATE INSTALLATION

Gate posts shall be spaced according to the manufacturers' gate drawings, dependent on standard out-to-out gate leaf dimensions and gate hardware selected. Type and quantity of gate hinges shall be based on the application; weight, height, and number of gate cycles. The manufacturers' gate drawings shall identify the necessary gate hardware required for the application. Gate hardware shall be provided by the manufacturer of the gate and shall be installed per manufacturer's recommendations.

3.05 CLEANING

The contractor shall clean the jobsite of excess materials; post-hole excavations shall be scattered uniformly away from posts.

Table 1 – Minimum Sizes for Montage II Posts							
Fence Posts	Panel Height						
2-1/2" x 12 Ga.	Up to & Including 6' Height						
3" x 12 Ga.	Over 6' Up to & Including 8' Height						
	·						
Gate Leaf	<u>Gate Height</u>						
<u>Gate Lear</u>	Up to & Including 4'	Over 4' Up to & Including 6'	Over 6' Up to & Including 8'				
Up to 4'	2-1/2" x 12 Ga.	3" x 12 Ga.	3" x 12 Ga.				
4'1" to 6'	3" x 12Ga.	4" x 11 Ga.	4" x 11 Ga.				
6'1" to 8'	3" x 12 Ga.	4" x 11 Ga.	6" x 3/16"				
8'1" to 10'	4" x 11 Ga.	6" x 3/16"	6" x 3/16"				
10'1" to 12'	4" x 11 Ga.	6" x 3/16"	6" x 3/16"				
12'1" to 14'	4" x 11 Ga.	6" x 3/16"	6" x 3/16"				
14'1" to 16'	6" x 3/16"	6" x 3/16"	6" x 3/16"				

Table 2 – Coating Performance Requirements				
Quality Characteristics	ASTM Test Method	Performance Requirements		
Adhesion	D3359 – Method B	Adhesion (Retention of Coating) over 90% of test area (Tape and knife test).		
Corrosion Resistance	B117, D714 & D1654	Corrosion Resistance over 1,500 hours (Scribed per D1654; failure mode is accumulation of 1/8" coating loss from scribe or medium #8 blisters).		
Impact Resistance	D2794	Impact Resistance over 60 inch lb. (Forward impact using 0.625" ball).		
Weathering Resistance	D822 D2244, D523 (60° Method)	Weathering Resistance over 1,000 hours (Failure mode is 60% loss of gloss or color variance of more than 3 delta-E color units).		

	Table 3 – Montage II – Post Spacing By Bracket Type				
Span	For INVINCIBLE®	For CLASSIC, GENESIS, & MAJESTIC			

PROJECT NO. 24-179.000 Harrison REMC - Addition and Renovation Harrison REMC

STEEL ORNAMENTAL FENCES 32 3119 - 4 04/24/2025

8' Nominal (91-1/2" Rail)				8' Nominal (92-5/8" Rail)						
Post Size	2-1/2"	3"	2-1/2"	3"	2-1/2"	3"	2-	3"	2-1/2"	3"
							1/2"			
Bracket	Industrial		Ind	dustrial	Industrial		Industrial		Industrial	
Туре	Flat Mount		Line		Univ	Universal Flat		Flat Mount Swiv		vivel
	(BB301)*		2-1/2" (BB319)		2.5" (2.5" (BB302) (BB301)		B301)	(BB304)*	
	, ,		3" (BB320)		3" (BB303)					
Post										
Settings	94-1/2"	95"	94-1/2"	95"	96"	96-1/2"	96"	96-1/2"	*96"	*96-1/2"
± ½" O.C.										

*Note: When using BB304 swivel brackets on either or both ends of a panel installation, care must be taken to ensure the spacing between post and adjoining pickets meets applicable codes. This will require trimming one or both ends of the panel. When using the BB301 flat mount bracket for Invincible style, rail may need to be drilled to accommodate rail to bracket attachment.

SECTION 32 92 00 - LAWNS AND GRASSES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish labor, materials, equipment, special tools, supervision and services required to complete establishment of lawns.
- B. Seed all lawn areas indicated on the drawings. All areas throughout the project that are newly provided or disturbed by any grading activities are to be seeded, whether indicated or not. See description above for areas to be sodded in lieu of seeding.
- Seed any areas of construction project limits where disturbed by construction activities, whether indicated
 or not.

1.2 QUALITY CONTROL

- A. Requirements of Regulatory Agencies:
 - 1. Indiana State Seed Law.
 - 2. Indiana Highway Commission Standard Specifications 621.02.
- B. Standards:
 - 1. Indiana Association of Nurserymen.
 - 2. American Association of Nursery Horticultural Standards.
- C. Source Quality Control:
 - 1. Producer's tests for purity and germination of seed, dated within nine months of sowing.

1.3 DELIVERY, STORAGE AND HANDLING

- A. Delivery:
 - 1. Deliver seed and fertilizer in supplier's original unopened package.
- B. Store seed and fertilizer in cool, dry area protected from exposure to elements, ground moisture or spoilage.
- C. Handling:
 - 1. Handle seed and fertilizer materials to prevent contamination or spillage.

1.4 SITE CONDITIONS

- A. Perform seeding only when preceding related work has been completed.
- B. Do not perform seeding after a rain or when wind velocity exceeds 15 mph.
- C. Restrict foot and vehicular traffic from lawn areas after planting to end of establishment period.

1.5 SUBMITTALS

A. Product Data:

- 1. Submit manufacturer's published literature describing products.
- 2. Submit design mixture of seed.

PART 2 - PRODUCTS

2.1 SEED

- A. Percentages by weight, approximate:
 - 1. 80% Fine Blade Fescue (chewings fescue, creeping red fescue and hard fescue).
 - 2. 10% Kentucky Bluegrass.
 - 3. 10% Perennial Rye.

B. Germination:

1. 80% minimum.

2.2 SEED-STARTER STRAW MAT / BLANKET

A. Description:

- 1. Basis of Specification: "Guardian", Seed-Starter Mat.
- 2. 100% weed-free wheat straw.
- 3. To keep seed in place, shield seeds from pecking birds and hold moisture for seed germination.
- 4. To not clump, wash or blow away.
- 5. Mat/Blanket and all fasteners shall completely biodegrade and disappear once lawn is established, without physical removal.

B. Materials:

- 1. 3.33 feet wide x 54 feet long roll of seed protection mulch mat/blanket.
- 2. Biodegradable "BioSTAKEs", 4 inches in length, 36 per roll.

2.3 FERTILIZER

- A. Commercial Mixture 8-16-16 or as recommended by State Agricultural Extension Service.
- B. Note that this fertilizer mix has a 1-2-2 or low nitrogen N-P-K ratio, which shall be maintained.

2.4 ACCESSORIES

- A. Mulch:
 - 1. Straw, weed free, as specified in Indiana Highway Specifications 913.05.
 - 2. Manufactured Products:
 - a. Conwed Fibers; "Hydro Mulch".
 - b. Sylva Corporation, Inc.; "Sylva-Fiber".
- B. Stakes:
 - 1. Softwood, 3/4" x 8", for sodded slopes as required.
- C. Erosion Control Blanket:
 - 1. Basis of Specification:
 - a. "American Excelsior Company", AEC Premier Straw Double Net.
 - b. "Forestry Suppliers, Inc.", Jute Mesh Erosion Control Mat.
 - 2. Acceptable alternate products may be submitted by the Contractor for approval by the Architect.
 - 3. Shall contain agricultural straw fibers, free of weeds, for the purpose of erosion control, revegetation and lawn establishment atop newly seeded areas.
 - 4. Blanket and all fasteners shall completely biodegrade and disappear once lawn is established, without physical removal.
 - 5. May use Seed-Starter Straw Mat / Blanket in lieu of the erosion control blanket.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Verify that preceding work affecting ground surface is completed.
- B. Seed:
 - 1. Immediately before seeding is to occur, the entire surface shall be scarified as required and raked until the surface is smooth, friable and a uniformly fine texture.
 - 2. Till soil thoroughly to minimum depth of 4".
 - 3. Apply fertilizer to soil at rate of 12 pounds per 1,000 square feet immediately prior to seeding.
 - 4. Rake or lightly till fertilizer into soil.

3.2 Watering:

- 1. When topsoil is exceedingly dry, moisten to depth of 4", 48 to 72 hours prior to start of seeding.
- 2. Perform watering to prevent run off.

3.3 SEEDING

- A. Shall only be done within the seasons as follows, unless allowed by the Architect and Owner:
 - 1. March 1 to May 15.
 - 2. September 1 to October 15.
- B. Before the seed is to be sown, all soft spots and inequalities in grade shall be corrected.
- C. Prior to seeding, mix commercial fertilizer into the seedbed at a rate of 12 pounds per 1,000 square feet.
- D. Seed shall be spread uniformly over entire area in 2 operations at rate of 5 pounds per 1,000 square feet each, for a total of 10 pounds per 1,000 square feet.
- E. Apply second seeding at right angles over the first.
- F. Seeding operation may be by mechanical spreader, broadcast method, drill equipment or hydroseed.
- G. Lightly cover seed by hand raking lawn areas to depth of 1/4".
- H. Smooth and firm all seeded areas with 200 pound roller and water with a fine spray.
- I. Install mulch over all seeded areas at a rate of 1,500 pounds per acre and crimp in place for anchorage. It may be applied via hydraulic mulching equipment or may be added to a water slurry in a hydraulic seeder and combined into a single operation. Straw applied at a rate of two bales per 1,000 square feet may serve as an alternative to the aforementioned mechanical mulching process at contractor's option.
- J. Contractor shall establish a smooth, uniform turf and surface composed of the specified grasses.
- K. Immediately following seeding and mulching, an approved erosion control blanket shall be placed over all areas having a slope of 5:1 or greater. The erosion control blanket shall be staked or stapled into place as per the manufacturer's recommendations. May use Seed-Starter Straw Mat / Blanket in lieu of the erosion control blanket.

3.4 SEED-STARTER STRAW MAT / BLANKET

- A. Prepare the area to be protected by raking the soil to a depth of 1 2 inches and removing large dirt clods, sticks and other obstructions.
- B. Apply seed and fertilizer, as specified for seed, and lightly rake into the soil.

- C. Roll out seed-starter mat/blanket over the prepared area making sure to remove any folds or wrinkles in the material. Do not install mat over existing vegetation. If necessary, the mat may be cut to size with sharp scissors or shears.
- D. Fasten material to the soil by installing three biodegradable plastic "BioSTAKEs" across the leading edge of the mat, per manufacturer's instructions, by driving them into the ground with a rubber mallet.
- E. Continue installation by the mat with "BioSTAKEs" per manufacturer's instructions, being sure to smooth out any wrinkles or folds. If the full roll is not used, secure the terminating end of the mat with three "BioSTAKEs", as done on the leading edge.
- F. For large areas requiring more than one mat, seam mats together by overlapping edges 2 3 inches and staking per manufacturer's instructions.
- G. For very steep slopes and ditches, bury leading edge (edge of mat at top of slope) in a 6 inch by 6 inch trench to prevent runoff water from getting under mat, per manufacturer's instructions.
- H. Immediately following installation, gently water entire area, thoroughly wetting both the mat and underlying soil. Keep soil moist for the first 30 to 60 days, or until uniform grass establishment is achieved.
- I. Leave mat and biodegradable plastic "BioSTAKEs" in place. They will degrade naturally as grass becomes established and typically can be moved over within 30 to 45 days.

3.5 LAWN ESTABLISHMENT

- A. Provide daily maintenance until lawn is well established.
- B. Provide necessary lawn care including fertilizing, weed eradication, watering, mowing, removal of excess clippings and replacement of unsuitable sod.
- C. Watering:
 - 1. Keep soil moist during seed germination period.
 - 2. Supplement rainfall to produce total of 2 inches per day after germination of seed
 - 3. Water planting when soil moisture is below optimum level for best plant growth.
- D. Establish period for lawns:
 - 1. Seeded Lawns:
 - a. Extend until uniform stand of grass shows over entire area.

3.6 CLEAN-UP

- A. Remove trash and excess materials from the project site.
- B. Maintain paved areas in clean conditions.
- C. Remove barriers and signs from project site at termination of establishment period.

PROJECT NO. 24-179.000 Harrison REMC - Addition and Renovation Harrison REMC LAWNS AND GRASSES 32 9200 - 6 04/24/2025

PART 4 - SUBMITTAL CHECK LIST

A. Product Data.

END OF SECTION 32 92 00

SECTION 32 9300 - TREES, PLANTS AND GROUND COVER

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnishing, installing and guaranteeing plantings as scheduled. Furnish labor, materials, equipment, special tools, supervision and services to perform all landscape work indicated, noted and detailed on the drawings and specified herein.

B. Section Includes:

- 1. Trees and Plants.
- Wood Mulch.
- 3. Stone or Rock Mulch.
- 4. Topsoil.
- 5. Fertilizer and Herbicide.
- Accessories.

1.2 QUALITY ASSURANCE

A. Comply with the following standards:

- 1. "American Standard for Nursery Stock," Latest Edition, American Association of Nurserymen.
- 2. Plant Hardiness Zone Map, Latest Edition, Miscellaneous Publication No. 814 Agricultural Research Service, U.S. Department of Agriculture.
- 3. Indiana Association of Nurserymen Standards.
- 4. Indiana State Highway Standard Specifications, Latest Edition.

1.3 DELIVERY, STORAGE AND HANDLING

A. Delivery:

- 1. Deliver fertilizer in supplier's original unopened package.
- 2. Pack, transport and handle plants with utmost care to protect against injury.
- 3. Ball and burlap wrap and tie plants, or mud cover bare roots.
- 4. Maintain plant stock in shade house for week after digging.
- 5. Label trees and plants to remain legible min. 60 days.
- 6. Do not prune trees before delivery.

1.4 JOB CONDITIONS

- A. Install trees, shrubs and ground cover planting before lawns are installed.
- B. Coordinate sequence of work with other trades.

1.5 WARRANTY

- A. Guarantee new plant material for one year after all plants are installed.
- B. During period of one year, replace dead, dying and unhealthy plants, and those whose appearance has been destroyed due to loss of branches and other damage.
- C. Guarantee replacement plants under this guarantee for one year from date of installation.
- D. Repair damage to other plants or lawns during plant replacement at no cost to Owner.
- E. Guarantee to include plant material, soil preparation, guying and maintenance.

1.6 SUBMITTALS

A. Product Data:

- 1. Submit manufacturer's published literature describing products.
- 2. Submit schedule of planting materials or verification of items as scheduled on the Drawings.

PART 2 - PRODUCTS

2.1 PLANTS

A. Planting Schedule:

- 1. Indicates quantity, size and type of planting.
- 2. If discrepancies between a listed quantity and plant quantities indicated on the plan, provide quantities as shown on the plan.

B. Quality:

- 1. True to type, name and variety, well-formed and shaped, with normal, well- developed branches and vigorous root system.
- 2. Sound, healthy, vigorous, free from defects, disfiguring knots, sun-scald, abrasions, injuries, diseases, insect eggs, borers and all other forms of infections.
- 3. Nursery grown in accordance with good horticultural practices.
- 4. Grown under the same climate conditions as the location of this project for at least two (2) years prior to date of planting on this project.
- 5. Plants which have been held in storage will be rejected if they show signs of growth during storage.
- 6. Collected plants shall be taken from subgrade favorable to good root development.
- 7. All collected material shall be clean, sound stock and shall be free from decaying stumps.

C. Measurements:

TREES, PLANTS AND GROUND COVER 32 9300 - 3 04/24/2025

- 1. Size and grading conform to American Association of Nurserymen's standards unless otherwise specified.
- 2. A plant shall be dimensioned as it stands it its natural position.
- 3. For plants specified by a range of sizes, provide plants not less than the minimum size. Not less than 50% of the plants shall be as large as the average size specified.
- 4. Large plants which have been cut back to the specified sizes will not be accepted.
- 5. Take caliper measurements 6" above ground line for trees less that 4" caliper, 12" above ground lines for 4" caliper and larger.
- 6. Provide plant materials which are matched specimens from a single block source.

2.2 MULCH

- A. Natural cypress, shredded, where wood mulch is indicated.
- B. White rolled river gravel rock mulch, where rock or stone mulch is indicated.
- C. Hay or straw, weed free, as specified in Indiana Highway Specifications 913.05.
- D. Peat Moss:
 - 1. Shredded, loose, free of mineral and waste matter.
 - 2. Minimum organic matter by weight, oven-dry: 85%.
 - 3. Ash content: 10% max.
 - 4. Moisture content: 35% max.

2.3 TOPSOIL

- A. Fertile, friable surface soil, free of materials toxic to plant growth.
 - 1. Classifiable as loam, silt loam, silty clay loam, or clay loam.
 - 2. PH range of 5.5 7.5.
 - 3. Organic content: 3% min., 20% max. (chromic acid reduction test).
 - 4. Free of grass, roots, stumps, brush and stone 2" or greater in diameter.

2.4 FERTILIZER AND HERBICIDE

- A. Soil fertilizer: Commercial 12-12-12.
- B. Granular plant food: Commercial 20-10-5.
- C. Planting tablets: Commercial fertilizer plant food tablets, "Agriform": 20-10-5. 5-25 gram weight.
- D. Herbicide: "Ronstar" or equal.

2.5 ACCESSORY MATERIALS

- A. Water: Free of oil, acids, alkalis, salts or any substance injurious to plants.
- B. Tree Paint: Standard horticultural antiseptic compound.
- C. Tree Wrap: Arboricultural wrapping paper, crepe surface, 4" wide, brown color, double layer.
- D. Porous Material: Gravel or coarse aggregate #2 ranging from 1 to 3 inches.
- E. PVC Pipe: 4" perforated or 4" solid.
- F. Miscellaneous Hardware: Eye bolts, cable clamps, turnbuckles, galvanized.
- G. Cable: Galvanized steel, 12 gauge.
- H. Hose: 2-ply reinforced rubber, ³/₄" diameter, black or green.
- I. Antidessicant: "Wilt Pruf", as manufactured by Nursery Specialty Products, Inc., or equal.
- J. Borer Control: Conform to article 611.12 of Highway Specifications.
- K. Sand: Medium textured, screened and washed.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Pits and trenches with flat, square bottom, a minimum 6" deeper than balls or roots, such that the root crown of plant is flush with finish grade prior to mulching to prevent crown rot.
- B. Width: Min. 1 ft. greater that diameter of ball or spread of roots of plants; and 2 ft. greater for trees.
- C. Lightly compact the soil well around the rootball of all trees and plants to place them in a straight and true vertical orientation, with the plants self-supporting.
- D. If deciduous trees cannot support themselves upright after planting, wrap and guy trees to secure them in position until they achieve the ability to be self-supporting. Protect all trees with tree stakes. Remove all staking within one year of growth.
- E. Prepare planting mix in pits under plants and as backfill.

3.2 PLANTING

A. Setting Plants:

- 1. Locate where indicated on drawing.
- 2. Set trees plumb and brace in position.

- 3. Ascertain locations of utility lines, electric cables and conduits, water lines, sprinklers to avoid disturbing subsurface lines and planting.
- 4. Avoid overhead obstructions to large planting.
- 5. Remove bindings and wrapping materials from top of balls and around trunks.
- 6. Do not remove burlap from under balls.

B. Back Filling:

- 1. Use topsoil mixture containing 25 % peat moss.
- 2. Fill all voids carefully.
- 3. Avoid breaking or bruising roots.
- 4. Tamp backfill firm to prevent settlement.
- 5. Construct saucer of clay around plants as detailed.
- 6. Water thoroughly.
- 7. Add backfill if settling from watering occurs.
- 8. Apply herbicide to soil surface after backfilling.

C. Pruning:

- 1. Perform pruning by experienced plantsmen using sharp tools.
- 2. Prune after planting to remove broken or damaged branches and roots.
- 3. Improperly pruned plants must be replaced.

D. Mulching:

- 1. Mulch shrubs to minimum 6" outside drip line of shrubs.
- 2. Mulch trees and planting beds as shown on drawings.

3.3 PLANTING MAINTENANCE

- A. Begin maintenance immediately after planting and continue through one full growing season.
- B. Reset plants to upright position to proper grade as necessary.
- C. Remove and replace all dead plants.
- D. Water, remulch, fertilize, spray, tighten guy wires as required for keeping plants in healthy growing condition.

3.4 CLEAN-UP

- A. Remove debris and excess material from site.
- B. Clean spills from pavement and finished surfaces.
- C. Repair or replace damaged sodded or seeded areas.

PROJECT NO. 24-179.000 Harrison REMC - Addition and Renovation Harrison REMC TREES, PLANTS AND GROUND COVER 32 9300 - 6 04/24/2025

PART 4 - SUBMITTAL CHECK LIST

A. Product Data.

END OF SECTION 32 9300

SECTION 32 9414 - ALUMINUM MAINTENANCE EDGING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish labor, materials, equipment, special tools, supervision and services as required for all work related to the Aluminum Maintenance Edging as indicated, noted and detailed on the Drawings and specified herein.

1.2 WARRANTY

A. 15-year limited warranty from manufacturing defects in materials or workmanship.

1.3 DELIVERY, STORAGE AND HANDLING

A. Delivery:

- 1. Deliver in supplier's original unopened package.
- 2. Pack, transport and handle plants with utmost care to protect against injury.
- 3. Do not bend, twist or break.

1.4 SUBMITTALS

A. Product Data:

- 1. Submit manufacturer's published literature describing products.
- 2. Submit manufacturer's installation procedures.

PART 2 - PRODUCTS

2.1 MAINTENANCE EDGING

- A. Provide one of the following approved manufactured products:
 - 1. "PermaLoc Corporation", "CleanLine". 1-800-356-9660

B. Construction:

- 1. Constructed for straight-line and gentle curve applications.
- 2. Corrugated profile with exposed top edge.
- 3. Shall have loops on side of section to receive stakes spaced approximately 2 feet apart along its entire length.

C. Material:

1. Extruded aluminum, 6063 alloy, T-6 hardness.

D. Size:

- 1. 3/16 inch thickness.
- 2. 4 inches high.
- 3. 8 feet and 16 feet lengths.

E. Connection Method:

1. Section ends shall splice together with a horizontal 1 inch wide x 4 inches long aluminum sliding connector.

F. Stakes:

- 1. Manufactured and supplied by same manufacturer and product set.
- 2. 12 inch long standard stake.
- 3. Stakes to interlock into preformed section loops.
- 4. Provide longer, heavier gage stakes as required to firmly secure into ground as needed for its permanent intended use.

G. Finish:

- 1. Mill Finish Natural Aluminum.
- 2. All edging, stakes, connectors and accessories to receive the same finish.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Ensure that all underground utility lines are located and will not interfere with the proposed edging installation before beginning work.
- B. Locate border line of edging with string or other means to assure border straightness and curves as designed.

3.2 INSTALLATION

- A. All installation procedures shall be per manufacturer's published Manufactured Guidelines.
- B. Set edging into trench with the horizontal base resting on compacted sub-base.
- C. Top of edging to be maximum of 1/2 inch above compacted finish grade on turf side.
- D. Loops for stakes are to be placed on the turf side.

- E. Drive stakes through edging loops until locked in place.
- F. Requires minimum of 3 stakes evenly spaced for each 8 feet section and 8 stakes evenly spaced for each 16 feet section.
- G. At square corners, notch cut the base only and form a continuous corner from a single piece. Do not abut two separate pieces at a corner.
- H. At a curved radius, either at corners or at angled runs, cut edging partially up through its height from bottom and turn back to desired angle to form rounded exposed radius.

3.3 BACKFILLING

- A. Backfill both sides of edging.
- B. Confirm and adjust if necessary that sections are securely held together.
- C. Compact backfill material along edging to provide top of edging at desired height above finish grade of turf.

3.4 CLEAN-UP

- A. Remove debris and excess material from site.
- B. Clean scraps and shavings from site.
- C. Repair or replace damaged sodded or seeded areas.

PART 4 - SUBMITTAL CHECK LIST

A. Product Data.

END OF SECTION 32 9414