

PROJECT MANUAL

PROJECT:

ATHENS HIGH SCHOOL ATHLETICS
TROY HIGH SCHOOL ATHLETICS

OWNER:

TROY SCHOOL DISTRICT
4400 Livernois Road
Troy, Michigan

TMP PROJECT NO.: 22103D & 22104E

BID PACKAGE: 02A

DATE: November 9, 2023

ISSUED FOR: Construction Documents

ARCHITECT

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END OF SECTION

SECTION 00 0115 - LIST OF DRAWINGS

LIST OF DRAWINGS

1.01 GENERAL

- A. Drawings: Drawings consist of the Contract Drawings including drawings listed on the TITLE SHEET page of the separately bound drawing set titled Athens High School Athletics and Troy High School Athletics, dated 11-09-2023 and any subsequent Addenda and Contract modifications which may occur.

END OF SECTION

SECTION 00 8200.02 - TMP ELECTRONIC FILES RELEASE FORM (FREE)

RE: AUTHORIZATION FORM FOR CAD FILE TRANSFERS
PROJECT NAME: ATHENS HIGH SCHOOL ATHLETICS & TROY HIGH SCHOOL
ATHLETICS
TMP PROJECT NO. : 22103D & 22104E BID PACKAGE 02A

Dear Sir/Madam:

Per your request, TMP Architecture, Inc. will electronically transmit requested CAD files upon receipt of an original signed copy of this form which states the conditions of agreement and the receipt of the required compensation fee.

1. By acceptance it is understood and agreed that the data and medium being supplied is to be used only for the project referenced.
2. It is further understood and agreed that the undersigned will hold TMP Architecture, Inc. and its Consultants harmless and indemnify TMP Architecture, Inc. and its Consultants from all claims, liabilities, losses, and so forth, including attorney's fees arising out of the use or misuse of the transferred files.
3. It is understood and agreed that the items transmitted are prepared from CAD files current at the time of preparation. All files are [AutoCAD version 2014 dwg files].
4. This information does not waive the need to verify and review current field conditions and the status of Addenda and/or Bulletin documentation.
5. As a record of information to be transmitted, TMP Architecture, Inc. will prepare a duplicate electronic back-up for its record.
6. Compensation for providing this material will be as follows: **\$0.00 / No Charge**
7. A signed copy of this form must be provided before files will be released. Please remit to [Construction Manager] to be forwarded to the Project Manager at TMP Architecture, Inc. and allow five working days for processing.

REQUESTED DRAWINGS: _____

FIRM REQUESTING FILES:

Company: _____
Address: _____
Signed: _____ Date: _____
Printed Name / Title: _____
Email: _____

TO BE COMPLETED BY TMP ARCHITECTURE, INC.

Released(signed by): _____ TMP Architecture, Inc.
Printed Name/Title: _____ Date: _____

END OF SECTION

SECTION 00 8200 - AVAILABILITY OF ELECTRONIC FILES**AVAILABILITY OF ELECTRONIC FILES****1.01 POLICY**

- A. As a service to Contractor, subcontractors, vendors, material suppliers and others needing electronic copies of Drawings, the Architect will provide CAD files electronically in accordance with the following policy:
1. By acceptance it is understood and agreed that the data and medium being supplied is to be used only for the project referenced.
 2. It is further understood and agreed that the undersigned will hold TMP Architecture, Inc. and its Consultants harmless and indemnify TMP Architecture, Inc. and its Consultants from all claims, liabilities, losses, and so forth, including attorney's fees arising out of the use or misuse of the transferred files.
 3. It is understood and agreed that the files transmitted are prepared from CAD files current at the time of preparation. All files are AutoCAD version 2014 dwg files.
 4. This information does not waive the need to verify and review current field conditions and the status of Addenda and/or Bulletin documentation.
 5. As a record of information to be transmitted, TMP Architecture, Inc. will prepare a duplicate electronic back-up for its record.
 6. Compensation Fee for providing this material will be as follows: \$0.00 / No Charge.
 7. A signed copy of the Release Form and Fee must be provided before files will be released.

1.02 REQUEST PROCEDURE

- A. To receive Drawing CAD files the Release Form must be completed in full and submitted to the Construction Manager to be forwarded to the Project Manager at TMP Architecture, Inc.
1. A signed copy of the Release Form must be submitted.
 - a. Faxed or emailed copies will be accepted.
 2. Upon remittance of the signed Release Form, allow five working days for processing.
 3. Transmission of Drawings will be provided electronically.

1.03 RELEASE FORM

- A. Release Form is located immediately after this Section. Refer to Section 00 8200.02 Electronic Files Release Form.

END OF SECTION

SECTION 01 2300 - ALTERNATES**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Description of Alternates.

1.02 ACCEPTANCE OF ALTERNATES

- A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at Owner's option. Accepted Alternates will be identified in the Owner-Contractor Agreement.
- B. Coordinate related work and modify surrounding work to integrate the Work of each Alternate.

1.03 SCHEDULE OF ALTERNATES

- A. Alternate 1 - Centerfield Logo
 - 1. Base Bid: Do not provide logos at multi-purpose auxiliary fields.
 - 2. Alternate: Provide centerfield logo at multi-purpose auxiliary fields.
- B. Alternate 2 - Troy High School Auxiliary Field Storage Building
 - 1. Base Bid: No storage building at Troy High School Auxiliary field.
 - 2. Alternate: Provide storage building at Troy High School Auxiliary Field as documented on Athletics Fields Drawings.
- C. Alternate 3 - New scoreboards
 - 1. Base Bid: Relocate existing scoreboards to varsity baseball and softball field and no scoreboards at JV baseball and softball.
 - 2. Alternate: Provide and install new scoreboards for varsity baseball and softball fields and relocate existing scoreboards to JV baseball and softball fields.
- D. Alternate 4 - Troy High School JV Baseball and Softball Storage Buildings.
 - 1. Base Bid: No new storage buildings.
 - 2. Alternate: Provide and install new storage buildings at JV baseball and softballs fields as indicated on drawings.

PART 2 PRODUCTS - NOT USED**PART 3 EXECUTION - NOT USED****END OF SECTION**

SECTION 01 2500.01 - TMP SUBSTITUTION REQUEST FORM

SUBSTITUTION REQUEST NUMBER: _____ DATE SUBMITTED: _____

TMP PROJECT NUMBER 22103D & 22104E PROJECT NAME: ATHENS HIGH SCHOOL & TROY HIGH SCHOOL ATHLETICS

SPECIFIED ITEM

SPECIFICATION TITLE: _____

SPECIFICATION SECTION _____ SPECIFICATION ARTICLE/PARAGRAPH: _____

SPECIFIED PRODUCT / DESCRIPTION: _____

SPECIFIED MANUFACTURER: _____

SPECIFIED PRODUCT / MODEL: _____

REASON SPECIFIED ITEM CANNOT BE PROVIDED: _____

PROPOSED SUBSTITUTION

DESCRIPTION OF PROPOSED SUBSTITUTION: _____

PROPOSED MANUFACTURER: _____

ADDRESS: _____

WEBSITE: _____

PRODUCT / MODEL: _____

YEARS PRODUCT/MODEL HAS BEEN MANUFACTURED: _____

DIFFERENCES BETWEEN PROPOSED SUBSTITUTION AND SPECIFIED ITEM: _____

WILL PROPOSED SUBSTITUTION AFFECT OTHER PARTS OF WORK? NO YES

IF YES, EXPLAIN HOW: _____

HOW WILL SUBSTITUTION BENEFIT THE OWNER: COST SAVINGS TIME SAVINGS OTHER
PROVIDE SPECIFIC DETAILS: _____

THE FOLLOWING INFORMATION IS REQUIRED; CHECK TO INDICATE INFORMATION IS ATTACHED. (REQUEST WILL BE REJECTED WITHOUT REQUIRED DATA)

32.01

A. List of references where proposed product has been installed; include address, owner, architect, and date installed.

B. Product data sheets.

- C. Applicable certificates and test reports.
- D. Comparative Data: Provide point-by-point, side-by-side comparison of specified product and proposed substitution addressing essential attributes specified.

INDICATE WHICH OF THE FOLLOWING VOLUNTARY INFORMATION IS ATTACHED, IF ANY:

- DRAWINGS.**
- SAMPLES.**
- OTHER ITEMS:** _____

SIGNATURE

THE UNDERSIGNED CERTIFIES:

The proposed substitution meets or exceeds the quality level of the specified product, equipment, assembly, or system.

To provide the same warranty for the substitution as for the specified product.

Agrees to provide same or equivalent maintenance service and source of replacement parts, as applicable.

Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.

The proposed substitution will have no adverse effects on other work.

The proposed substitution will not affect project schedule.

Waives claims for additional costs or time extension that may subsequently become apparent.

CONTRACTOR / COMPANY: _____

SIGNED BY: _____ **PRINTED NAME:** _____

TITLE: _____

ADDRESS: _____

EMAIL: _____ **PHONE:** _____

ARCHITECT'S RESPONSE

- A. During bidding, Architect will approve substitution requests by issuing an Addendum. Substitutions not approved by addendum are rejected.
- B. During construction, Architect will notify Contractor in writing (see below) of decision to accept or reject request, and incorporate the substitution into the project by Change Order, Construction Change Directive, Architectural Supplementary Instructions, or similar instruments as provided for in the Conditions of the Contract.

SUBSTITUTION APPROVED - PROVIDE SUBMITTALS PER SECTION 01 3000 AND RESPECTIVE SECTION FOR WHICH SUBSTITUTION WAS MADE.

SUBSTITUTION REJECTED - PROVIDE SPECIFIED MATERIALS.

SIGNED BY: _____ **PRINTED NAME:** _____

ARCHITECT'S COMMENTS: _____

END OF SECTION

SECTION 01 2500 - SUBSTITUTION PROCEDURES**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Procedural requirements for proposed substitutions.

1.02 RELATED REQUIREMENTS

- A. Section 01 2500.01 - TMP Substitution Request Form.

1.03 DEFINITIONS

- A. Substitutions: Changes from Contract Documents requirements proposed by Contractor to materials, products, assemblies, and equipment.
 - 1. Substitutions for Cause: Proposed due to changed Project circumstances beyond Contractor's control.
 - 2. Substitutions for Convenience: Proposed due to possibility of offering substantial advantage to the Project.

PART 2 PRODUCTS - NOT USED**PART 3 EXECUTION****3.01 GENERAL REQUIREMENTS**

- A. A Substitution Request for products, assemblies, materials, and equipment constitutes a representation that the submitter:
 - 1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
 - 2. Agrees to provide the same warranty for the substitution as for the specified product.
 - 3. Agrees to provide same or equivalent maintenance service and source of replacement parts, as applicable.
 - 4. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.
 - 5. Waives claims for additional costs or time extension that may subsequently become apparent.
- B. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.
 - 1. Note explicitly any non-compliant characteristics.
- C. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.
 - 1. Forms included in the Project Manual are adequate for this purpose, and must be used.
- D. Limit each request to a single proposed substitution item.
 - 1. Submit an electronic document, combining the request form with supporting data into single document.

3.02 SUBSTITUTION PROCEDURES DURING PROCUREMENT

- A. Submittal Time Restrictions:
- B. Substitution Request Form: TMP Substitution Request Form must be completed and provided at the beginning of each substitution request.
 - 1. Refer to Section 01 2500.01 - TMP Substitution Request Form.
 - 2. Submittals without a completed TMP Substitution Request Form will not be acknowledged, reviewed, or returned. Use only this form; other forms of submission are unacceptable.
- C. Instructions to Bidders specifies time restrictions for submitting requests for substitutions during the bidding period.

3.03 SUBSTITUTION PROCEDURES DURING CONSTRUCTION

- A. Substitution Request Form: TMP Substitution Request Form must be completed and provided at the beginning of each substitution request.
 - 1. Refer to Section 01 2500.01 - TMP Substitution Request Form.

2. Submittals without a completed TMP Substitution Request Form will not be acknowledged, reviewed, or returned. Use only this form; other forms of submission are unacceptable.
- B. Submit request for Substitution for Cause immediately upon discovery of need for substitution, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.
- C. Submit request for Substitution for Convenience within 14 days of discovery of its potential advantage to the project, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.
 1. In addition to meeting general documentation requirements, document how the requested substitution benefits the Owner through cost savings, time savings, greater energy conservation, or in other specific ways.
 2. Document means of coordinating of substitution item with other portions of the work, including work by affected subcontractors.
 3. Bear the costs engendered by proposed substitution of:
 - a. Owner's compensation to the Architect for any required redesign, time spent processing and evaluating the request.
 - b. Other unanticipated project considerations.
- D. Substitutions will not be considered under one or more of the following circumstances:
 1. When they are indicated or implied on shop drawing or product data submittals, without having received prior approval.
 2. Without a separate written request.

3.04 RESOLUTION

- A. Architect may request additional information and documentation prior to rendering a decision. Provide this data in an expeditious manner.
- B. Architect will notify Contractor in writing of decision to accept or reject request.
 1. During construction, Architect's decision following review of proposed substitution will be noted on the submitted form.
 2. During bidding, Architect will approve substitution requests by issuing an Addendum. Substitutions not approved by addendum are rejected.

3.05 ACCEPTANCE

- A. Accepted substitutions change the work of the Project. They will be documented and incorporated into work of the project by Change Order, Construction Change Directive, Architectural Supplementary Instructions, or similar instruments provided for in the Conditions of the Contract.

3.06 CLOSEOUT ACTIVITIES

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.

END OF SECTION



SUBMITTAL AND SAMPLE TRANSMITTAL FORM

01 3000.01

CONST. MANAGER / CONTRACTOR		PROJECT	TMP PROJECT NO.	DATE SUBMITTED		SUBMITTAL NO.	
Name and Address:		Title:	22103D, 22104E				
		Athens High School Athletics 22103D Troy High School Athletics 22104E					
Email:		Location:	* ACTION CODES			Initial Submittal	<input type="checkbox"/>
		Troy School District	R	Reviewed – No Exceptions Taken		Resubmittal	<input type="checkbox"/>
Phone:			RR	Reviewed with Corrections Noted		REVIEWED BY	
			X	Revise and Resubmit			
			NA	Not Approved – Resubmit			
			NA	No Action Taken – Not Reviewed		TMP	<input type="checkbox"/>
					Consultant	<input type="checkbox"/>	
					Reviewer:		
SPECIFICATION SECTION NO.	SUBCONTRACTOR / MANUFACTURER	ITEM DESCRIPTION	NO. OF SAMPLES	NO. OF SAMPLES RETURNED	ACTION CODE *	DATE REVIEWED	DATE RETURNED
Transmittal shall be for one specification section only; do not submit items from multiple sections under the same transmittal. Multi-section submittals will be returned; stamped "X - Not Approved - Resubmit"							
Submittal Stamps may be placed on subsequent blank page.							
CONTRACTOR COMMENTS		ARCHITECT COMMENTS		The undersigned certifies that the above submitted items have been reviewed in detail and are correct and in strict conformance with the Contract Documents except as otherwise noted. NOTE: Approval of items submitted does not relieve Contractor from complying with all requirements of the Contract Documents.			
				CONTRACTOR NAME			
				SIGNATURE			

This page intentionally left blank for Submittal Stamps

SECTION 01 3000 - ADMINISTRATIVE REQUIREMENTS**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Submittals for review, information, and project closeout.
- B. Number of copies of submittals.
- C. Requests for Interpretation (RFI) procedures.
- D. Submittal procedures.

1.02 RELATED REQUIREMENTS

- A. Section 01 3000.01 - TMP Submittal and Sample Transmittal Form.

1.03 REFERENCE STANDARDS

- A. AIA G716 - Request for Information 2004.
- B. CSI/CSC Form 13.2A - Request for Information Current Edition.

PART 2 PRODUCTS - NOT USED**PART 3 EXECUTION****3.01 REQUESTS FOR INTERPRETATION (RFI)**

- A. Definition: A request seeking one of the following:
 - 1. An interpretation, amplification, or clarification of some requirement of Contract Documents arising from inability to determine from them the exact material, process, or system to be installed; or when the elements of construction are required to occupy the same space (interference); or when an item of work is described differently at more than one place in Contract Documents.
 - 2. A resolution to an issue which has arisen due to field conditions and affects design intent.
- B. Preparation: Prepare an RFI immediately upon discovery of a need for interpretation of Contract Documents. Failure to submit a RFI in a timely manner is not a legitimate cause for claiming additional costs or delays in execution of the work.
 - 1. Prepare a separate RFI for each specific item.
 - a. Review, coordinate, and comment on requests originating with subcontractors and/or materials suppliers.
 - b. Do not forward requests which solely require internal coordination between subcontractors.
 - 2. Prepare in a format and with content acceptable to Architect. Use one of the following:
 - a. Use AIA G716 - Request for Information .
 - b. Use CSI/CSC Form 13.2A - Request for Interpretation.
 - c. Other format acceptable to Architect.
 - 3. Combine RFI and its attachments into a single electronic file. PDF format is preferred.
- C. Reason for the RFI: Prior to initiation of an RFI, carefully study all Contract Documents to confirm that information sufficient for their interpretation is definitely not included.
 - 1. Include in each request Contractor's signature attesting to good faith effort to determine from Contract Documents information requiring interpretation.
 - 2. Improper RFIs: Requests not prepared in conformance to requirements of this section, and/or missing key information required to render an actionable response. They will be returned without a response and may include an explanatory notation.
 - 3. Frivolous RFIs: Requests regarding information that is clearly indicated on, or reasonably inferable from, the Contract Documents, with no additional input required to clarify the question. They will be returned without a response and may include an explanatory notation.
 - a. The Owner reserves the right to assess the Contractor for the costs (on time-and-materials basis) incurred by the Architect, and any of its consultants, due to processing of such RFIs.
- D. Content: Include identifiers necessary for tracking the status of each RFI, and information necessary to provide an actionable response.

1. Official Project name and number, and any additional required identifiers established in Contract Documents.
 2. Discrete and consecutive RFI number, and descriptive subject/title.
 3. Issue date, and requested reply date.
 4. Reference to particular Contract Document(s) requiring additional information/interpretation. Identify pertinent drawing and detail number and/or specification section number, title, and paragraph(s).
 5. Annotations: Field dimensions and/or description of conditions which have engendered the request.
 6. Contractor's suggested resolution: A written and/or a graphic solution, to scale, is required in cases where clarification of coordination issues is involved, for example; routing, clearances, and/or specific locations of work shown diagrammatically in Contract Documents. If applicable, state the likely impact of the suggested resolution on Contract Time or the Contract Sum.
- E. Attachments: Include sketches, coordination drawings, descriptions, photos, submittals, and other information necessary to substantiate the reason for the request.
- F. RFI Log: Prepare and maintain a tabular log of RFIs for the duration of the project.
1. Indicate current status of every RFI. Update log promptly and on a regular basis.
 2. Note dates of when each request is made, and when a response is received.
 3. Identify and include improper or frivolous RFIs.
- G. Review Time: Architect will respond and return RFIs to Contractor within seven calendar days of receipt. For the purpose of establishing the start of the mandated response period, RFIs received after 3:00 PM will be considered as having been received on the following regular working day.
1. Response period may be shortened or lengthened for specific items, subject to mutual agreement, and recorded in a timely manner in progress meeting minutes.
- H. Responses: Content of answered RFIs will not constitute in any manner a directive or authorization to perform extra work or delay the project. If in Contractor's belief it is likely to lead to a change to Contract Sum or Contract Time, promptly issue a notice to this effect, and follow up with an appropriate Change Order request to Owner.
1. Response may include a request for additional information, in which case the original RFI will be deemed as having been answered, and an amended one is to be issued forthwith. Identify the amended RFI with an R suffix to the original number.
 2. Do not extend applicability of a response to specific item to encompass other similar conditions, unless specifically so noted in the response.
 3. Upon receipt of a response, promptly review and distribute it to all affected parties, and update the RFI Log.
 4. Notify Architect within seven calendar days if an additional or corrected response is required by submitting an amended version of the original RFI, identified as specified above.

3.02 SUBMITTAL SCHEDULE

- A. Submit to Architect for review a schedule for submittals in tabular format.
1. Submit at the same time as the preliminary schedule.
 2. Coordinate with Contractor's construction schedule and schedule of values.
 3. Format schedule to allow tracking of status of submittals throughout duration of construction.
 4. Arrange information to include scheduled date for initial submittal, specification number and title, description of item of work covered, and role and name of subcontractor.
 5. Account for time required for preparation, review, manufacturing, fabrication and delivery when establishing submittal delivery and review deadline dates.

- a. For assemblies, equipment, systems comprised of multiple components and/or requiring detailed coordination with other work, allow for additional time to make corrections or revisions to initial submittals, and time for their review.

3.03 SUBMITTALS FOR REVIEW

- A. When the following are specified in individual sections, submit them for review:
 1. Product data.
 2. Shop drawings.
 3. Samples for selection.
 4. Samples for verification.
- B. Submit to Architect for review for the limited purpose of checking for compliance with information given and the design concept expressed in Contract Documents.
- C. Samples will be reviewed for aesthetic, color, or finish selection.
- D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 01 7800 - Closeout Submittals.

3.04 SUBMITTALS FOR INFORMATION

- A. When the following are specified in individual sections, submit them for information:
 1. Design data.
 2. Certificates.
 3. Test reports.
 4. Inspection reports.
 5. Manufacturer's instructions.
 6. Manufacturer's field reports.
 7. Other types indicated.
- B. Submit for Architect's knowledge as contract administrator or for Owner.

3.05 SUBMITTALS FOR PROJECT CLOSEOUT

- A. Submit Correction Punch List for Substantial Completion.
- B. Submit Final Correction Punch List for Substantial Completion.
- C. When the following are specified in individual sections, submit them at project closeout in compliance with requirements of Section 01 7800 - Closeout Submittals:
 1. Project record documents.
 2. Operation and maintenance data.
 3. Warranties.
 4. Other types as indicated.
- D. Submit for Owner's benefit during and after project completion.

3.06 NUMBER OF COPIES OF SUBMITTALS

- A. Electronic Documents: Submit one electronic copy.
- B. Samples: Submit the number specified in individual specification sections, but not less than 3; one (minimum) of which will be retained by Architect.
 1. After review, produce duplicates.
 2. Retained samples will not be returned to Contractor unless specifically so stated.

3.07 SUBMITTAL PROCEDURES

- A. Transmittal Form: TMP Submittal and Sample Transmittal Form must be completed and provided at the beginning of each submittal.
 1. Refer to Section 01 3000.01 - TMP Submittal and Sample Transmittal Form.
 2. Submittals without a completed TMP Submittal and Sample Transmittal Form will not be acknowledged, reviewed, or returned.
- B. Submittals shall be submitted in electronic form.
 1. Exceptions: Physical samples.

- a. Physical Samples must be accompanied by an electronic copy and a hard/physical copy of the completed TMP Submittal and Sample Transmittal Form.
- C. Electronic Submittals: Comply with the following:
 1. Submittal process shall be through a data management system (i.e. Submittal Exchange) or other approved method agreed to by the Architect and Owner.
 2. File Format: Portable Document Format (PDF).
 3. File Naming: File naming shall be in the following format:
 - a. Specification section number, followed by a hyphen, and a consecutive number indicating sequential submittals for that section; followed by a general description of the submittal contents.
 - 1) Examples:
 - (a) Section 07 9200; first submittal:
 - (1) 07 9200-01 Joint Sealants
 - (b) Section 07 9200; second submittal:
 - (1) 07 9200-02 Joint Sealant Color
 - b. Resubmittals. For revised resubmittals use original number and a sequential combination numerical and alphabetical suffix; hyphen followed by "R" and a two-digit consecutive number indicating sequential resubmittals for that particular submittal.
 - 1) Examples:
 - (a) Section 07 9200; resubmittal of first submittal of section:
 - (1) 07 9200-01-R01 Joint Sealants.
 - (b) Section 07 9200; second resubmittal of first submittal of section:
 - (1) 07 9200-01-R02 Joint Sealants
 - (c) Section 07 9200; first resubmittal of second submittal of section:
 - (1) 07 9200-02-R01 Joint Sealant Color
 4. Each Submittal shall be one file, complete with all attachments.
 - a. Multi-file submittal will not be acknowledged, reviewed, or returned.
 - D. General Requirements:
 1. Use a single transmittal for related items.
 - a. Each transmittal shall be for one specification section only; do not submit items for multiple sections under the same transmittal.
 - 1) Multi-section submittals will be acknowledged and returned; stamped "X - Not Approved - Resubmit".
 2. Submit separate packages of submittals for review and submittals for information, when included in the same specification section.
 3. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the work and Contract Documents.
 - a. Submittals from sources other than the Contractor, or without Contractor's stamp will not be acknowledged, reviewed, or returned.
 4. Deliver each submittal on date noted in submittal schedule, unless an earlier date has been agreed to by all affected parties, and is of the benefit to the project.
 5. Schedule submittals to expedite the Project, and coordinate submission of related items.
 - a. For each submittal for review, allow 14 calendar days excluding delivery time to and from the Contractor.
 - b. For sequential reviews involving Architect's consultants, Owner, or another affected party, allow an additional 7 calendar days.
 6. Identify variations from Contract Documents and product or system limitations that may be detrimental to successful performance of the completed work.
 7. When revised for resubmission, identify all changes made since previous submission.
 8. Distribute reviewed submittals. Instruct parties to promptly report inability to comply with requirements.
 9. Incomplete submittals will not be reviewed, unless they are partial submittals for distinct portion(s) of the work, and have received prior approval for their use.

10. Submittals not requested will be recognized and returned; stamped "NA - No Action Taken - Not Reviewed"
- E. Product Data Procedures:
 1. Submit only information required by individual specification sections.
 2. Collect required information into a single submittal.
 3. Submit concurrently with related shop drawing submittal.
 4. Do not submit (Material) Safety Data Sheets for materials or products unless specifically called for in individual sections.
- F. Shop Drawing Procedures:
 1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting Contract Documents and coordinating related work.
 2. Do not reproduce Contract Documents to create shop drawings.
 3. Generic, non-project-specific information submitted as shop drawings do not meet the requirements for shop drawings.
 4. Non-complying submittals will be acknowledged and returned; stamped "X - Not Approved - Resubmit".
- G. Samples Procedures:
 1. Transmit related items together as single package.
 2. Identify each item to allow review for applicability in relation to shop drawings showing installation locations.
 3. Submit actual physical samples.
 4. Electronic submittals will not be accepted unless prior approval is received from the Architect. Electronic samples without prior approval will be acknowledged and returned; stamped "X - Not Approved - Resubmit."

3.08 SUBMITTAL REVIEW

- A. General: Submittals that do not conform to the requirements of this section will not be acknowledged, reviewed, or returned.
- B. Submittals for Review: Architect will review each submittal, and approve, or take other appropriate action.
- C. Submittals for Information: Architect will acknowledge and may review. See below for actions to be taken.
- D. Architect's actions will be reflected by marking each returned submittal using virtual stamp on electronic submittals.
 1. Where more than one action has been indicated, each shall apply to that portion of the submittal for which the action is indicated.
- E. Architect's review shall not indicate approval of dimensions, quantities or fabrication processes unless specific notations are made by the Architect regarding same.
- F. Architect's and consultants' actions on items submitted for review:
 1. Authorizing purchasing, fabrication, delivery, and installation:
 - a. "Reviewed - No Exceptions Taken", "Approved", or language with same legal meaning.
 - b. "Reviewed with Corrections Noted", "Approved as Noted, Resubmission not required", or language with same legal meaning.
 - 1) At Contractor's option, submit corrected item, with review notations acknowledged and incorporated.
 2. Not Authorizing fabrication, delivery, and installation:
 - a. "Revise and Resubmit", "Not Approved - Resubmit", or language with the same legal meaning.
 - 1) Resubmit revised item, with review notations acknowledged and incorporated.
 3. Not Authorizing manufacturer:
 - a. Rejected - Resubmit, or language with the same legal meaning.
- G. Architect's and consultants' actions on items submitted for information:

1. Items for which no action was taken:
 - a. "No Action Taken - Not Reviewed" or "Received" - to notify the Contractor that the submittal has been received for record only.

END OF SECTION

SECTION 01 4000 - QUALITY REQUIREMENTS**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Submittals.
- B. Quality assurance.
- C. References and standards.
- D. Testing and inspection agencies and services.
- E. Contractor's design-related professional design services.
- F. Control of installation.
- G. Mock-ups.
- H. Tolerances.
- I. Manufacturers' field services.
- J. Defect Assessment.

1.02 REFERENCE STANDARDS

- A. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection 2021.
- B. ASTM E543 - Standard Specification for Agencies Performing Nondestructive Testing 2021.
- C. ASTM E699 - Standard Specification for Agencies Involved in Testing, Quality Assurance, and Evaluating of Manufactured Building Components 2016.

1.03 DEFINITIONS

- A. Contractor's Professional Design Services: Design of some aspect or portion of the project by party other than the design professional of record. Provide these services as part of the Contract for Construction.
 - 1. Design Services Types Required:
 - a. Design-Related: Design services explicitly required to be performed by another design professional due to highly-technical and/or specialized nature of a portion of the project. Services primarily involve engineering analysis, calculations, and design, and are not intended to alter the aesthetic aspects of the design.
- B. Design Data: Design-related, signed and sealed drawings, calculations, specifications, certifications, shop drawings and other submittals provided by Contractor, and prepared directly by, or under direct supervision of, appropriately licensed design professional.

1.04 CONTRACTOR'S DESIGN-RELATED PROFESSIONAL DESIGN SERVICES

- A. Coordination: Contractor's professional design services are subject to requirements of project's Conditions for Construction Contract.
- B. Base design on performance and/or design criteria indicated in individual specification sections.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Design Data: Submit for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for Owner's information.
 - 1. Include a statement or certification attesting that design data complies with criteria indicated, such as building codes, loads, functional, and similar engineering requirements.
 - 2. Include signature and seal of design professional responsible for allocated design services on calculations and drawings.
- C. Test Reports: After each test/inspection, promptly submit 1 copies of report to Architect and to Contractor.
 - 1. Include:

- a. Date issued.
 - b. Project title and number.
 - c. Name of inspector.
 - d. Date and time of sampling or inspection.
 - e. Identification of product and specifications section.
 - f. Location in the Project.
 - g. Type of test/inspection.
 - h. Date of test/inspection.
 - i. Results of test/inspection.
 - j. Compliance with Contract Documents.
 - k. When requested by Architect, provide interpretation of results.
2. Test report submittals are for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for Owner's information.
- D. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Architect, in quantities specified for Product Data.
1. Indicate material or product complies with or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
 2. Certificates may be recent or previous test results on material or product, but must be acceptable to Architect.
- E. Manufacturer's Instructions: When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, for the Owner's information. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.
- F. Manufacturer's Field Reports: Submit reports for Architect's benefit as contract administrator or for Owner.
1. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents.

1.06 QUALITY ASSURANCE

- A. Testing Agency Qualifications:
1. Prior to start of Work, submit agency name, address, and telephone number, and names of full time specialist and responsible officer.
- B. Designer Qualifications: Where professional engineering design services and design data submittals are specifically required of Contractor by Contract Documents, provide services of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

1.07 REFERENCES AND STANDARDS

- A. Comply with reference standard of date of issue current on date of Contract Documents, except where a specific date is established by applicable code.
- B. Obtain copies of standards where required by product specification sections.
- C. Maintain copy at project site during submittals, planning, and progress of the specific work, until Substantial Completion.

1.08 TESTING AND INSPECTION AGENCIES AND SERVICES

- A. As indicated in individual specification sections, Owner or Contractor shall employ and pay for services of an independent testing agency to perform other specified testing.
- B. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.
- C. Contractor Employed Agency:

1. Testing agency: Comply with requirements of ASTM E329, ASTM E543, and ASTM E699.
2. Inspection agency: Comply with requirements of ASTM E329.
3. Laboratory Staff: Maintain a full time specialist on staff to review services.

PART 2 PRODUCTS - NOT USED**PART 3 EXECUTION****3.01 CONTROL OF INSTALLATION**

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.
- D. Comply with specified standards as minimum quality for the work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Have work performed by persons qualified to produce required and specified quality.
- F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.
- G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

3.02 MOCK-UPS

- A. Before installing portions of the Work where mock-ups are required, construct mock-ups in location and size indicated for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work. The purpose of mock-up is to demonstrate the proposed range of aesthetic effects and workmanship.
- B. Accepted mock-ups establish the standard of quality the Architect will use to judge the Work.
- C. Integrated Exterior Mock-ups: Construct integrated exterior mock-up as indicated on drawings. Coordinate installation of exterior envelope materials and products as required in individual Specification Sections. Provide adequate supporting structure for mock-up materials as necessary.
- D. Notify Architect 5 working days in advance of dates and times when mock-ups will be constructed.
- E. Provide supervisory personnel who will oversee mock-up construction. Provide workers that will be employed during the construction at Project.
- F. Tests shall be performed under provisions identified in this section and identified in the respective product specification sections.
- G. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.
- H. Obtain Architect's approval of mock-ups before starting work, fabrication, or construction.
 1. Make corrections as necessary until Architect's approval is issued.
- I. Architect will use accepted mock-ups as a comparison standard for the remaining Work.
- J. Where mock-up has been accepted by Architect and is specified in product specification sections to be removed, protect mock-up throughout construction, remove mock-up and clear area when directed to do so by Architect.

3.03 TOLERANCES

- A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

- B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

3.04 TESTING AND INSPECTION

- A. See individual specification sections for testing and inspection required.
- B. Testing Agency Duties:
 - 1. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
 - 2. Perform specified sampling and testing of products in accordance with specified standards.
 - 3. Ascertain compliance of materials and mixes with requirements of Contract Documents.
 - 4. Promptly notify Architect and Contractor of observed irregularities or non-compliance of Work or products.
 - 5. Perform additional tests and inspections required by Architect.
 - 6. Submit reports of all tests/inspections specified.
- C. Limits on Testing/Inspection Agency Authority:
 - 1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
 - 2. Agency may not approve or accept any portion of the Work.
 - 3. Agency may not assume any duties of Contractor.
 - 4. Agency has no authority to stop the Work.
- D. Contractor Responsibilities:
 - 1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
 - 2. Cooperate with laboratory personnel, and provide access to the Work.
 - 3. Provide incidental labor and facilities:
 - a. To provide access to Work to be tested/inspected.
 - b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
 - c. To facilitate tests/inspections.
 - d. To provide storage and curing of test samples.
 - 4. Notify Architect and laboratory 48 hours prior to expected time for operations requiring testing/inspection services.
 - 5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
 - 6. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
- E. Re-testing required because of non-compliance with specified requirements shall be performed by the same agency on instructions by Architect.
- F. Re-testing required because of non-compliance with specified requirements shall be paid for by Contractor.

3.05 MANUFACTURERS' FIELD SERVICES

- A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust, and balance equipment as applicable, and to initiate instructions when necessary.
- B. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

3.06 DEFECT ASSESSMENT

- A. Replace Work or portions of the Work not complying with specified requirements.

- B. If, in the opinion of Architect, it is not practical to remove and replace the work, Architect will direct an appropriate remedy or adjust payment.

END OF SECTION

SECTION 01 4100 - REGULATORY REQUIREMENTS**PART 1 GENERAL****1.01 SUMMARY OF REFERENCE STANDARDS**

- A. Regulatory requirements applicable to this project are the following:
1. Barrier Free Code: Comply with the following:
 - a. Michigan Building Code; 2015.
 - b. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2009.
 2. School Fire Safety Rules: Michigan School Fire Safety Rules; 2016.
 - a. Includes NFPA 101-2012 - Life Safety Code; 2012, plus amendments.
 3. Building Code: Michigan Building Code; 2015.
 4. Plumbing Code: Michigan Plumbing Code; 2018.
 5. Mechanical Code: Michigan Mechanical Code; 2015.
 6. Electrical Code: NFPA 70 - National Electric Code; 2017.
 - a. Includes 2017 Michigan Construction Code - Part 8 Electrical Code Rules.
 7. Elevator Code: Comply with the following:
 - a. ASME A17.1 - Safety Code for Elevators and Escalators; 2010.
 - b. ASME A18.1- Safety Standard for Platform Lifts and Stairway Chairlifts; 2011.
 - c. Michigan Elevator Safety Board General Rules.
 8. Boiler Code: Michigan Boiler Code.
 - a. Includes the following:
 - 1) ASME Boiler and Pressure Vessel Codes; 2019.
 - 2) National Board Inspection Code; 2019.
 - 3) PA 407 Skilled Trades Regulation Act; 2016.
 9. Energy Code: Michigan Energy Code; 2015.
 - a. Includes ASHRAE Std 90.1 I-P-2013- Energy Standard for Buildings Except Low-Rise Residential Buildings; 2013.
 10. Existing Building Code: Michigan Rehabilitation Code; 2015.
- B. Where specification sections reference more current standards or codes, comply with the more restrictive requirements unless notified in writing by Architect.

PART 2 PRODUCTS - NOT USED**PART 3 EXECUTION - NOT USED****END OF SECTION**

SECTION 01 4216 - DEFINITIONS

PART 1 GENERAL

1.01 SUMMARY

- A. This section supplements the definitions contained in the General Conditions.
- B. Other definitions are included in individual specification sections.

1.02 DEFINITIONS

- A. Furnish: To supply, deliver, unload, and inspect for damage.
- B. Install: To unpack, assemble, erect, apply, place, finish, cure, protect, clean, start up, and make ready for use.
- C. Product: Material, machinery, components, equipment, fixtures, and systems forming the work result. Not materials or equipment used for preparation, fabrication, conveying, or erection and not incorporated into the work result. Products may be new, never before used, or re-used materials or equipment.
- D. Project Manual: The book-sized volume that includes the procurement requirements (if any), the contracting requirements, and the specifications.
- E. Provide: To furnish and install.
- F. Supply: Same as Furnish.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 4219 - REFERENCE STANDARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Requirements relating to referenced standards.

1.02 QUALITY ASSURANCE

- A. For products or workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Comply with the reference standard of date of issue specified in this section, except where a specific date is established by applicable code.
- C. Should specified reference standards conflict with Contract Documents, request clarification from the Architect before proceeding.
- D. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of the Architect shall be altered by Contract Documents by mention or inference otherwise in any reference document.

PART 2 PRODUCTS -- NOT USED

PART 3 EXECUTION -- NOT USED

END OF SECTION

SECTION 01 4533 - CODE-REQUIRED SPECIAL INSPECTIONS AND PROCEDURES**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Code-required special inspections.
- B. Submittals.

1.02 ABBREVIATIONS AND ACRONYMS

- A. AHJ: Authority having jurisdiction.
- B. NIST: National Institute of Standards and Technology.

1.03 DEFINITIONS

- A. Code or Building Code: Michigan Building Code; 2015, specifically Chapter 17 - Special Inspections and Tests.
- B. Authority Having Jurisdiction (AHJ): Agency or individual officially empowered to enforce the building, fire and life safety code requirements of the permitting jurisdiction in which the Project is located.
- C. Special Inspection:
 - 1. Special inspections are inspections and testing of materials, installation, fabrication, erection or placement of components and connections mandated by the AHJ that also require special expertise to ensure compliance with the approved Contract Documents and the referenced standards.
 - 2. Special inspections are separate from and independent of tests and inspections conducted by Owner or Contractor for the purposes of quality assurance and contract administration.

1.04 REFERENCE STANDARDS

- A. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection 2021.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Special Inspection Agency Qualifications: Prior to the start of work, the Special Inspection Agency is required to:
 - 1. Submit agency name, address, and telephone number, names of full time specialist and responsible officer.
 - 2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.
 - 3. Submit certification that Special Inspection Agency is acceptable to AHJ.
- C. Special Inspection Reports: After each special inspection, Special Inspector is required to promptly submit at least two copies of report; one to Architect and one to the AHJ.
 - 1. Include:
 - a. Date issued.
 - b. Project title and number.
 - c. Name of Special Inspector.
 - d. Date and time of special inspection.
 - e. Identification of product and specifications section.
 - f. Location in the Project.
 - g. Type of special inspection.
 - h. Date of special inspection.
 - i. Results of special inspection.
 - j. Compliance with Contract Documents.

- 2. Final Special Inspection Report: Document special inspections and correction of discrepancies prior to the start of the work.
- D. Fabricator Special Inspection Reports: After each special inspection of fabricated items at the Fabricator's facility, Special Inspector is required to promptly submit at least two copies of report; one to Architect and one to AHJ.
 - 1. Include:
 - a. Date issued.
 - b. Project title and number.
 - c. Name of Special Inspector.
 - d. Date and time of special inspection.
 - e. Identification of fabricated item and specification section.
 - f. Location in the Project.
 - g. Results of special inspection.
 - h. Verification of fabrication and quality control procedures.
 - i. Compliance with Contract Documents.
 - j. Compliance with referenced standard(s).
- E. Test Reports: After each test or inspection, promptly submit at least two copies of report; one to Architect and one to AHJ.
 - 1. Include:
 - a. Date issued.
 - b. Project title and number.
 - c. Name of inspector.
 - d. Date and time of sampling or inspection.
 - e. Identification of product and specifications section.
 - f. Location in the Project.
 - g. Type of test or inspection.
 - h. Date of test or inspection.
 - i. Results of test or inspection.
 - j. Compliance with Contract Documents.

1.06 SPECIAL INSPECTION AGENCY

- A. Owner will employ services of a Special Inspection Agency to perform inspections and associated testing and sampling in accordance with ASTM E329 and required by the building code.
- B. Employment of agency in no way relieves Contractor of obligation to perform work in accordance with requirements of Contract Documents.

1.07 QUALITY ASSURANCE

- A. Special Inspection Agency Qualifications:
 - 1. Independent firm specializing in performing testing and inspections of the type specified in this section.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 SCHEDULE OF SPECIAL INSPECTIONS, GENERAL

- A. Frequency of Special Inspections: Special Inspections are indicated as continuous or periodic.
 - 1. Continuous Special Inspection: Special Inspection Agency is required to be present in the area where the work is being performed and observe the work at all times the work is in progress.
 - 2. Periodic Special Inspection: Special Inspection Agency is required to be present in the area where work is being performed and observe the work part-time or intermittently and at the completion of the work.

3.02 SPECIAL INSPECTIONS

- A. Special inspections and testing shall be for materials, installation, fabrication, erection or placement of components and connections as indicated on Drawings, but not less than that required by the building code.

END OF SECTION

SECTION 01 6000 - PRODUCT REQUIREMENTS**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Re-use of existing products.
- B. Transportation, handling, storage and protection.
- C. Product option requirements.
- D. Substitution limitations.
- E. Procedures for Owner-supplied products.
- F. Maintenance materials, including extra materials, spare parts, tools, and software.

1.02 SUBMITTALS

- A. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- B. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- C. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
 - 1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

PART 2 PRODUCTS**2.01 EXISTING PRODUCTS**

- A. Do not use materials and equipment removed from existing premises unless specifically required or permitted by Contract Documents.
- B. Unforeseen historic items encountered remain the property of the Owner; notify Owner promptly upon discovery; protect, remove, handle, and store as directed by Owner.
- C. Existing materials and equipment indicated to be removed, but not to be re-used, relocated, reinstalled, delivered to the Owner, or otherwise indicated as to remain the property of the Owner, become the property of the Contractor; remove from site.
- D. Specific Products to be Reused: The reuse of certain materials and equipment already existing on the project site is required.
 - 1. Refer to Drawings and Section 02 4100 - Demolition.

2.02 NEW PRODUCTS

- A. Provide new products unless specifically required or permitted by Contract Documents.

2.03 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.
- B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.
- C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.
- D. Available Products: Products specified by naming one or more Manufacturers as an Available Product indicates that these Manufacturers' products may be provided but other comparable products and Manufacturers not named may also be provided without submitting a request for substitution.

2.04 MAINTENANCE MATERIALS

- A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.
- B. Deliver and place in location as directed; obtain receipt prior to final payment.

PART 3 EXECUTION**3.01 SUBSTITUTION LIMITATIONS**

- A. See Section 01 2500 - Substitution Procedures.

3.02 OWNER-SUPPLIED PRODUCTS

- A. Owner's Responsibilities:
 - 1. Arrange for and deliver Owner reviewed shop drawings, product data, and samples, to Contractor.
 - 2. Arrange and pay for product delivery to site.
 - 3. On delivery, inspect products jointly with Contractor.
 - 4. Submit claims for transportation damage and replace damaged, defective, or deficient items.
 - 5. Arrange for manufacturers' warranties, inspections, and service.
- B. Contractor's Responsibilities:
 - 1. Review Owner reviewed shop drawings, product data, and samples.
 - 2. Receive and unload products at site; inspect for completeness or damage jointly with Owner.
 - 3. Handle, store, install and finish products.
 - 4. Repair or replace items damaged after receipt.

3.03 TRANSPORTATION AND HANDLING

- A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.
- B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.
- C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.
- D. Transport and handle products in accordance with manufacturer's instructions.
- E. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.
- F. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.
- G. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.04 STORAGE AND PROTECTION

- A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication.
- B. Store and protect products in accordance with manufacturers' instructions.
- C. Store with seals and labels intact and legible.
- D. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.
- E. For exterior storage of fabricated products, place on sloped supports above ground.
- F. Provide off-site storage and protection when site does not permit on-site storage or protection.
- G. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.
- H. Comply with manufacturer's warranty conditions, if any.

- I. Do not store products directly on the ground.
- J. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- K. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- L. Prevent contact with material that may cause corrosion, discoloration, or staining.
- M. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- N. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION

SECTION 01 7000 - EXECUTION AND CLOSEOUT REQUIREMENTS**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Examination, preparation, and general installation procedures.
- B. Requirements for alterations work, including selective demolition.
- C. Pre-installation meetings.
- D. Cutting and patching.
- E. Surveying for laying out the work.
- F. Cleaning and protection.
- G. Starting of systems and equipment.
- H. Demonstration and instruction of Owner personnel.
- I. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.
- J. General requirements for maintenance service.

1.02 REFERENCE STANDARDS

- A. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations 2022, with Errata (2021).

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:
 - 1. Structural integrity of any element of Project.
 - 2. Integrity of weather exposed or moisture resistant element.
 - 3. Efficiency, maintenance, or safety of any operational element.
 - 4. Visual qualities of sight exposed elements.
 - 5. Work of Owner or separate Contractor.
 - 6. Include in request:
 - a. Identification of Project.
 - b. Location and description of affected work.
 - c. Necessity for cutting or alteration.
 - d. Description of proposed work and products to be used.
 - e. Effect on work of Owner or separate Contractor.
- C. Project Record Documents: Accurately record actual locations of capped and active utilities.
- D. Warranties: For each affected material under warranty, submit written verification, signed by manufacturer of existing materials, stating that the Owner's full warranty will remain in effect after cutting and patching operations have been completed

1.04 QUALIFICATIONS

- A. For surveying work, employ a land surveyor registered in the State in which the Project is located and acceptable to Architect. Submit evidence of surveyor's Errors and Omissions insurance coverage in the form of an Insurance Certificate. Employ only individual(s) trained and experienced in collecting and recording accurate data relevant to ongoing construction activities,

1.05 PROJECT CONDITIONS

- A. Use of explosives is not permitted.
- B. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.
- C. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.
- D. Perform dewatering activities, as required, for the duration of the project.

- E. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
- F. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.
 - 1. Provide dust-proof enclosures to prevent entry of dust generated outdoors.
 - 2. Provide dust-proof barriers between construction areas and areas continuing to be occupied by Owner.
- G. Erosion and Sediment Control: Plan and execute work by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
 - 1. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.
- H. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.
 - 1. Outdoors: Limit conduct of especially noisy exterior work to the hours of 8 am to 5 pm.
 - 2. Indoors: Limit conduct of especially noisy interior work to the hours of 6 pm to 7 am.
- I. Pest and Rodent Control: Provide methods, means, and facilities to prevent pests and insects from damaging the work.
- J. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations. Comply with federal, state, and local regulations.

1.06 COORDINATION

- A. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- B. Notify affected utility companies and comply with their requirements.
- C. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
- D. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on drawings. Follow routing indicated for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- E. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.
- F. Coordinate completion and clean-up of work of separate sections.
- G. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

1.07 WARRANTIES

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

PART 2 PRODUCTS

2.01 PATCHING MATERIALS

- A. New Materials: As specified in product sections; match existing products and work for patching and extending work.

- B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.
- C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.
- B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.
- C. Examine and verify specific conditions described in individual specification sections.
- D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.
- E. Verify that utility services are available, of the correct characteristics, and in the correct locations.
- F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

3.02 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.03 PREINSTALLATION MEETINGS

- A. When required in individual specification sections, convene a preinstallation meeting at the 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 5 calendar days in advance of meeting date.
- D. Prepare agenda and preside at meeting:
 - 1. Review conditions of examination, preparation and installation procedures.
 - 2. Review coordination with related work.
- E. Record minutes and distribute copies within two days after meeting to participants, with 1 copies to Architect, Owner, participants, and those affected by decisions made.

3.04 LAYING OUT THE WORK

- A. Verify locations of survey control points prior to starting work.
- B. Promptly notify Architect of any discrepancies discovered.
- C. Contractor shall locate and protect survey control and reference points.
- D. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
- E. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
- F. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.
- G. Utilize recognized engineering survey practices.
- H. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:

1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
 2. Grid or axis for structures.
 3. Building foundation, column locations, ground floor elevations.
 4. Controlling lines and levels required for mechanical and electrical trades.
- I. Periodically verify layouts by same means.
- J. Maintain a complete and accurate log of control and survey work as it progresses.

3.05 GENERAL INSTALLATION REQUIREMENTS

- A. In addition to compliance with regulatory requirements, conduct construction operations in compliance with NFPA 241, including applicable recommendations in Appendix A.
- B. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.
- C. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.
- D. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.
- E. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.
- F. Make neat transitions between different surfaces, maintaining texture and appearance.

3.06 ALTERATIONS

- A. Drawings showing existing construction and utilities are based on casual field observation only.
1. Verify that construction and utility arrangements are as indicated.
 2. Report discrepancies to Architect before disturbing existing installation.
 3. Beginning of alterations work constitutes acceptance of existing conditions.
- B. Keep areas in which alterations are being conducted separated from other areas that are still occupied.
1. Provide, erect, and maintain temporary dustproof partitions.
- C. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
1. Where openings in exterior enclosure exist, provide construction to make exterior enclosure weatherproof.
 2. Insulate existing ducts or pipes that are exposed to outdoor ambient temperatures by alterations work.
- D. Remove existing work as indicated and as required to accomplish new work.
1. Remove items indicated on drawings.
 2. Relocate items indicated on drawings.
 3. Where new surface finishes are to be applied to existing work, perform removals, patch, and prepare existing surfaces as required to receive new finish; remove existing finish if necessary for successful application of new finish.
 4. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces as closely as possible.
- E. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove, relocate, and extend existing systems to accommodate new construction.
1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components; if necessary, modify installation to allow access or provide access panel.
 2. Where existing systems or equipment are not active and Contract Documents require reactivation, put back into operational condition; repair supply, distribution, and equipment as required.
 3. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.

- a. Disable existing systems only to make switchovers and connections; minimize duration of outages.
- b. Provide temporary connections as required to maintain existing systems in service.
4. Verify that abandoned services serve only abandoned facilities.
5. Remove abandoned pipe, ducts, conduits, and equipment , including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification; patch holes left by removal using materials specified for new construction.
- F. Protect existing work to remain.
 1. Prevent movement of structure; provide shoring and bracing if necessary.
 2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
 3. Repair adjacent construction and finishes damaged during removal work.
- G. Adapt existing work to fit new work: Make as neat and smooth transition as possible.
 1. Where removal of partitions or walls results in adjacent spaces becoming one, rework floors, walls, and ceilings to a smooth plane without breaks, steps, or bulkheads.
- H. Patching: Where the existing surface is not indicated to be refinished, patch to match the surface finish that existed prior to cutting. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.
- I. Refinish existing surfaces as indicated:
 1. Where rooms or spaces are indicated to be refinished, refinish all visible existing surfaces to remain to the specified condition for each material, with a neat transition to adjacent finishes.
 2. If mechanical or electrical work is exposed accidentally during the work, re-cover and refinish to match.
- J. Clean existing systems and equipment.
- K. Remove demolition debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.
- L. Do not begin new construction in alterations areas before demolition is complete.
- M. Comply with all other applicable requirements of this section.

3.07**CUTTING AND PATCHING**

- A. Whenever possible, execute the work by methods that avoid cutting or patching.
- B. See Alterations article above for additional requirements.
- C. Perform whatever cutting and patching is necessary to:
 1. Complete the work.
 2. Fit products together to integrate with other work.
 3. Provide openings for penetration of mechanical, electrical, and other services.
 4. Match work that has been cut to adjacent work.
 5. Repair areas adjacent to cuts to required condition.
 6. Repair new work damaged by subsequent work.
 7. Remove samples of installed work for testing when requested.
 8. Remove and replace defective and non-complying work.
- D. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.
- E. Employ skilled and experienced installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.
- F. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
- G. Restore work with new products in accordance with requirements of Contract Documents.
- H. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

- I. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 07 8400, to full thickness of the penetrated element.
- J. Patching:
 - 1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
 - a. This includes painted surfaces.
 - b. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.
 - 2. Match color, texture, and appearance.
 - 3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

3.08 PROGRESS CLEANING

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
- C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
- D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

3.09 PROTECTION OF INSTALLED WORK

- A. Protect installed work from damage by construction operations.
- B. Provide special protection where specified in individual specification sections.
- C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
- D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- G. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

3.10 SYSTEM STARTUP

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Notify Architect and Owner 7 calendar days prior to start-up of each item.
- C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.
- D. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- E. Verify that wiring and support components for equipment are complete and tested.
- F. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.
- G. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.

- H. Submit a written report that equipment or system has been properly installed and is functioning correctly.

3.11 DEMONSTRATION AND INSTRUCTION

- A. See Section 01 7900 - Demonstration and Training.
- B. Demonstrate operation and maintenance of products to Owner's personnel two weeks prior to date of Substantial Completion.
- C. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at agreed time, at equipment location.
- D. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
- E. Provide a qualified person who is knowledgeable about the Project to perform demonstration and instruction of Owner's personnel.
- F. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.
- G. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

3.12 ADJUSTING

- A. Adjust operating products and equipment to ensure smooth and unhindered operation.

3.13 FINAL CLEANING

- A. Use cleaning materials that are nonhazardous.
- B. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
- C. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.
- D. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
- E. Clean filters of operating equipment.
- F. Clean debris from roofs, gutters, downspouts, scuppers, overflow drains, area drains, and drainage systems.
- G. Clean site; sweep paved areas, rake clean landscaped surfaces.
- H. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

3.14 CLOSEOUT PROCEDURES

- A. Make submittals that are required by governing or other authorities.
- B. Accompany Contractor on preliminary inspection to determine items to be listed for completion or correction in the Contractor's Correction Punch List for Contractor's Notice of Substantial Completion.
- C. Notify Architect when work is considered ready for Architect's Substantial Completion inspection.
- D. Submit written certification containing Contractor's Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's Substantial Completion inspection.
- E. Conduct Substantial Completion inspection and create Final Correction Punch List containing Architect's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Architect.

- F. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.
- G. Notify Architect when work is considered finally complete and ready for Architect's Substantial Completion final inspection.
- H. Complete items of work determined by Architect listed in executed Certificate of Substantial Completion.

3.15 MAINTENANCE

- A. Provide service and maintenance of components indicated in specification sections.
- B. Maintenance Period: As indicated in specification sections or, if not indicated, not less than one year from the Date of Substantial Completion or the length of the specified warranty, whichever is longer.
- C. Examine system components at a frequency consistent with reliable operation. Clean, adjust, and lubricate as required.
- D. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.
- E. Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of the Owner.

END OF SECTION

SECTION 01 7329 - CUTTING AND PATCHING**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Cutting and patching.

1.02 REFERENCE STANDARDS

- A. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2013.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:
 1. Structural integrity of any element of Project.
 2. Integrity of weather exposed or moisture resistant element.
 3. Efficiency, maintenance, or safety of any operational element.
 4. Visual qualities of sight exposed elements.
 5. Work of Owner or separate Contractor.
 6. Include in request:
 - a. Location and description of affected work.
 - b. Necessity for cutting or alteration.
 - c. Description of proposed work and products to be used.
 - d. Effect on work of Owner or separate Contractor.
- C. Warranties: For each affected material under warranty, submit written verification, signed by manufacturer of existing materials, stating that the Owner's full warranty will remain in effect after cutting and patching operations have been completed.

1.04 WARRANTIES

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.
 1. Materials that are still under warranty include, but are not limited to, the following:
 - a. _____.
 - b. _____.
 - c. _____.

PART 2 PRODUCTS**2.01 PATCHING MATERIALS**

- A. New Materials: As specified in product sections; match existing products and work for patching and extending work.
- B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.
- C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 6000 - Product Requirements.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.
- B. Prior to Patching: Before patching, verify compatibility and suitability of substrates, including compatibility with existing finishes or primers. Beginning of patching means acceptance of existing conditions.

3.02 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.
- D. Protect existing work to remain.
 - 1. Prevent movement of structure; provide shoring and bracing if necessary.
 - 2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
- E. Existing Services: Where existing services are required to be removed, relocated, or abandoned, bypass such services before cutting to avoid interruption of services to occupied areas.

3.03 CUTTING AND PATCHING

- A. Whenever possible, execute the work by methods that avoid cutting or patching.
- B. Perform whatever cutting and patching is necessary to:
 - 1. Complete the work.
 - 2. Fit products together to integrate with other work.
 - 3. Provide openings for penetration of mechanical, electrical, and other services.
 - 4. Match work that has been cut to adjacent work.
 - 5. Repair areas adjacent to cuts to required condition.
 - 6. Repair new work damaged by subsequent work.
 - 7. Remove samples of installed work for testing when requested.
 - 8. Remove and replace defective and non-conforming work.
- C. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.
- D. Employ skilled and experienced installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.
- E. Cutting:
 - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces.
 - 2. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
 - 3. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
- F. Restore work with new products in accordance with requirements of Contract Documents.
- G. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- H. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 07 8400 - Firestopping, to full thickness of the penetrated element.
- I. Patching:
 - 1. Repair adjacent construction and finishes damaged during removal work and cutting work.
 - 2. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
 - a. This includes painted surfaces.
 - b. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.
 - 3. Match color, texture, and appearance.

4. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

END OF SECTION

SECTION 01 7800 - CLOSEOUT SUBMITTALS**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Project record documents.
- B. Operation and maintenance data.
- C. Warranties and bonds.

1.02 SUBMITTALS

- A. Project Record Documents: Submit documents to Architect with claim for final Application for Payment.
- B. Operation and Maintenance Data:
 - 1. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Architect will review draft and return one copy with comments.
 - 2. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
 - 3. Submit one copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Architect comments. Revise content of all document sets as required prior to final submission.
 - 4. Submit two sets of revised final documents in final form within 10 days after final inspection.
- C. Warranties and Bonds:
 - 1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
 - 2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
 - 3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 2 PRODUCTS - NOT USED**PART 3 EXECUTION****3.01 PROJECT RECORD DOCUMENTS**

- A. General:
 - 1. Project Record Documents include:
 - a. Complete set of Record Drawings.
 - b. Complete set of Record Submittals.
 - c. Complete set of Specifications.
 - 2. Project Record Documents shall be submitted in electronic form.
 - a. File Format: Portable Document Format (PDF).
 - b. Files shall be named and organized in a searchable, easy to understand, system.
 - 3. Ensure entries are complete and accurate, enabling future reference by Owner.
 - 4. Record information concurrent with construction progress.
- B. Record Drawings: Record Drawings shall include the following:
 - 1. Complete set of Drawings.
 - a. Indicate and record actual construction including, but not limited to, the following:
 - 1) Show all systems and assemblies as they exist at completion of the Work.
 - 2) Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - 3) Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
 - 4) Field changes of dimension and detail.
 - 5) Details not on original Contract drawings.
 - 2. Addenda.
 - 3. Change Orders and other modifications to the Contract.

- C. Record Submittals: Record Submittals shall include the following:
 - 1. Complete set of Submittals, including resubmittals.
 - 2. Shop Drawings shall indicate all field changes and other variations from the Submittal as originally reviewed by Architect.
- D. Specifications: Specifications shall include the following:
 - 1. Complete Project Manual including all specifications, front end material, reports, and information available to bidders, as originally bid.
 - 2. Addenda.
 - 3. Change Orders and other modifications to the Contract.

3.02 OPERATION AND MAINTENANCE DATA

- A. Source Data: For each product or system, list names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
- B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
- C. 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.
- D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.03 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

- A. For Each Product, Applied Material, and Finish:
 - 1. Product data, with catalog number, size, composition, and color and texture designations.
- B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.
- C. Additional information as specified in individual product specification sections.
- D. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

3.04 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

- A. For Each Item of Equipment and Each System:
 - 1. Description of unit or system, and component parts.
 - 2. Identify function, normal operating characteristics, and limiting conditions.
 - 3. Include performance curves, with engineering data and tests.
 - 4. Complete nomenclature and model number of replaceable parts.
- B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.
- C. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.
- D. Include color coded wiring diagrams as installed.
- E. 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.
- F. 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.
- G. Provide servicing and lubrication schedule, and list of lubricants required.
- H. Include manufacturer's printed operation and maintenance instructions.

- I. Include sequence of operation by controls manufacturer.
- J. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- K. Provide control diagrams by controls manufacturer as installed.
- L. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- M. Include test and balancing reports.
- N. Additional Requirements: As specified in individual product specification sections.

3.05**ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS**

- A. General:
 - 1. Operational and Maintenance Manuals include:
 - a. Operational and maintenance data.
 - b. Operational and maintenance data for materials and finishes.
 - c. Operational and maintenance data for equipment and systems.
 - 2. Operational and Maintenance Manuals shall be submitted both in electronic form and as hard copy/durable manuals.
 - a. Subject to Owner approval, hard copy/durable manuals may be omitted.
 - b. Electronic File Format: Portable Document Format (PDF).
 - 1) Files shall be named and organized in a searchable, easy to understand, system similar to the descriptions for the hard copy/durable manuals
- B. Assemble operation and maintenance data into durable manuals for Owner's personnel use, with data arranged in the same sequence as, and identified by, the specification sections.
- C. Where systems involve more than one specification section, provide separate tabbed divider for each system.
- D. Binders: Commercial quality, 8-1/2 by 11 inch three D side ring binders with durable plastic covers; 3 inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.
- E. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.
- F. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.
- G. Tables of Contents: List every item separated by a divider, using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.
- H. Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.
- I. Text: Manufacturer's printed data, or typewritten data on 20 pound paper.
- J. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- K. Arrangement of Contents: Organize each volume in parts as follows:
 - 1. Project Directory.
 - 2. Table of Contents, of all volumes, and of this volume.
 - 3. Operation and Maintenance Data: Arranged by system, then by product category.
 - a. Source data.
 - b. Operation and maintenance data.
 - c. Field quality control data.
 - d. Photocopies of warranties and bonds.

3.06 WARRANTIES AND BONDS

- A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial completion is determined.
- B. Verify that documents are in proper form, contain full information, and are notarized.
- C. Co-execute submittals when required.
- D. Retain warranties and bonds until time specified for submittal.
- E. Manual: Bind in commercial quality 8-1/2 by 11 inch three D side ring binders with durable plastic covers.
- F. Cover: Identify each binder with typed or printed title WARRANTIES AND BONDS, with title of Project; name, address and telephone number of Contractor and equipment supplier; and name of responsible company principal.
- G. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual, with each item identified with the number and title of the specification section in which specified, and the name of product or work item.
- H. Separate each warranty or bond with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List Subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

END OF SECTION

SECTION 01 7900 - DEMONSTRATION AND TRAINING**PART 1 GENERAL****1.01 SUMMARY**

- A. Demonstration of products and systems to be commissioned and where indicated in specific specification sections.
- B. Training of Owner personnel in operation and maintenance is required for:
 - 1. All software-operated systems.
 - 2. HVAC systems and equipment.
 - 3. Plumbing equipment.
 - 4. Electrical systems and equipment.
 - 5. Items specified in individual product Sections.
- C. Training of Owner personnel in care, cleaning, maintenance, and repair is required for:
 - 1. Roofing, waterproofing, and other weather-exposed or moisture protection products.
 - 2. Finishes, including flooring, wall finishes, ceiling finishes.
 - 3. Fixtures and fittings.
 - 4. Items specified in individual product Sections.

1.02 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures; except:
- B. Draft Training Plans: Owner will designate personnel to be trained; tailor training to needs and skill-level of attendees.
 - 1. Submit not less than four weeks prior to start of training.
 - 2. Revise and resubmit until acceptable.
 - 3. Provide an overall schedule showing all training sessions.
 - 4. Include at least the following for each training session:
 - a. Identification, date, time, and duration.
 - b. Description of products and/or systems to be covered.
 - c. Name of firm and person conducting training; include qualifications.
 - d. Intended audience, such as job description.
 - e. Objectives of training and suggested methods of ensuring adequate training.
 - f. Methods to be used, such as classroom lecture, live demonstrations, hands-on, etc.
 - g. Media to be used, such as slides, hand-outs, etc.
 - h. Training equipment required, such as projector, projection screen, etc., to be provided by Contractor.
- C. Training Manuals: Provide training manual for each attendee; allow for minimum of two attendees per training session.
 - 1. Include applicable portion of O&M manuals.
 - 2. Include copies of all hand-outs, slides, overheads, video presentations, etc., that are not included in O&M manuals.
 - 3. Provide one extra copy of each training manual to be included with operation and maintenance data.

1.03 QUALITY ASSURANCE

- A. Instructor Qualifications: Familiar with design, operation, maintenance and troubleshooting of the relevant products and systems.
 - 1. Provide as instructors the most qualified trainer of those contractors and/or installers who actually supplied and installed the systems and equipment.
 - 2. Where a single person is not familiar with all aspects, provide specialists with necessary qualifications.
- B. Coordination: Coordinate demonstration and training of this section with project commissioning requirements.

PART 2 PRODUCTS - NOT USED**PART 3 EXECUTION****3.01 DEMONSTRATION - GENERAL**

- A. Demonstrations conducted during system start-up do not qualify as demonstrations for the purposes of this section, unless approved in advance by Owner.
- B. Demonstrations conducted during Functional Testing need not be repeated unless Owner personnel training is specified.
- C. Demonstration may be combined with Owner personnel training if applicable.
- D. Operating Equipment and Systems: Demonstrate operation in all modes, including start-up, shut-down, seasonal changeover, emergency conditions, and troubleshooting, and maintenance procedures, including scheduled and preventive maintenance.
 - 1. Perform demonstrations not less than two weeks prior to Substantial Completion.
 - 2. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
- E. Non-Operating Products: Demonstrate cleaning, scheduled and preventive maintenance, and repair procedures.
 - 1. Perform demonstrations not less than two weeks prior to Substantial Completion.

3.02 TRAINING - GENERAL

- A. Conduct training on-site unless otherwise indicated.
- B. Do not start training until Functional Testing is complete, unless otherwise specified or approved by the Commissioning Authority.
- C. Provide training in minimum two hour segments.
- D. Training schedule will be subject to availability of Owner's personnel to be trained; re-schedule training sessions as required by Owner; once schedule has been approved by Owner failure to conduct sessions according to schedule will be cause for Owner to charge Contractor for personnel "show-up" time.
- E. Review of Facility Policy on Operation and Maintenance Data: During training discuss:
 - 1. The location of the O&M manuals and procedures for use and preservation; backup copies.
 - 2. Typical contents and organization of all manuals, including explanatory information, system narratives, and product specific information.
 - 3. Typical uses of the O&M manuals.
- F. Product- and System-Specific Training:
 - 1. Review the applicable O&M manuals.
 - 2. For systems, provide an overview of system operation, design parameters and constraints, and operational strategies.
 - 3. Review instructions for proper operation in all modes, including start-up, shut-down, seasonal changeover and emergency procedures, and for maintenance, including preventative maintenance.
 - 4. Provide hands-on training on all operational modes possible and preventive maintenance.
 - 5. Emphasize safe and proper operating requirements; discuss relevant health and safety issues and emergency procedures.
 - 6. Discuss common troubleshooting problems and solutions.
 - 7. Discuss any peculiarities of equipment installation or operation.
 - 8. Discuss warranties and guarantees, including procedures necessary to avoid voiding coverage.
 - 9. Review recommended tools and spare parts inventory suggestions of manufacturers.
 - 10. Review spare parts and tools required to be furnished by Contractor.
 - 11. Review spare parts suppliers and sources and procurement procedures.

- G. Be prepared to answer questions raised by training attendees; if unable to answer during training session, provide written response within three days.

END OF SECTION

SECTION 02 4100 - DEMOLITION**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Selective demolition of built site elements.
- B. Selective demolition of building elements for alteration purposes.
- C. Abandonment and removal of existing utilities and utility structures.
- D. Salvaged items.
- E. Removed and reinstalled items.

1.02 REFERENCE STANDARDS

- A. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations 2022, with Errata (2021).

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

1.04 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: Company specializing in the type of work required.
 - 1. Minimum of 5 years of documented experience.

PART 2 PRODUCTS - NOT USED**2.01 MATERIALS**

- A. Fill Material: As specified in Division 31.

PART 3 EXECUTION**3.01 SCOPE**

- A. Remove portions of existing building as indicated on Drawings including, but not limited to, the following:
 - 1. Remove all paving and curbs as indicated on drawings.
 - 2. Remove indicated foundation walls and footings completely.
 - 3. Remove concrete slabs on grade as indicated on drawings.
 - 4. Remove manholes and manhole covers, curb inlets and catch basins.
 - 5. Remove other items indicated, for salvage and relocation.
 - 6. Unless otherwise indicated, fill excavations, open pits, and holes in ground areas generated as result of removals, using specified fill; compact fill as specified in Division 31.

3.02 GENERAL PROCEDURES AND PROJECT CONDITIONS

- A. Comply with other requirements specified in Section 01 7000.
- B. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
 - 1. Obtain required permits.
 - 2. Comply with applicable requirements of NFPA 241.
 - 3. Prior to start of demolition operations, perform an engineering survey of building condition to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures.
 - 4. Use of explosives is not permitted.
 - 5. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
 - 6. Provide, erect, and maintain temporary barriers and security devices.
 - 7. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
 - 8. Do not close or obstruct roadways or sidewalks without permit.

9. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
 10. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.
- C. Do not begin removal until receipt of notification to proceed from Owner.
 - D. Do not begin removal until built elements to be salvaged or relocated have been removed.
 - E. Protect existing structures and other elements that are not to be removed.
 1. Provide bracing and shoring.
 2. Prevent movement or settlement of adjacent structures.
 3. Stop work immediately if adjacent structures appear to be in danger.
 - F. Minimize production of dust due to demolition operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.
 - G. If hazardous materials are discovered during removal operations, stop work and notify Architect and Owner; hazardous materials include regulated asbestos containing materials, PCB's, and mercury.
 - H. Partial Removal of Paving and Curbs: Neatly saw cut at right angle to surface.

3.03**SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS**

- A. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.
 1. Where concrete cannot be cut full depth, cut concrete to a depth of at least 3/4 inch. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.
- B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.
 1. Refer to Section 04 2000 - Unit Masonry for salvaging brick.
- C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.

3.04**EXISTING UTILITIES**

- A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.
- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.
- D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.
- E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.
- F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.
- G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.
- H. Prepare building demolition areas by disconnecting and capping utilities outside the demolition zone; identify and mark utilities to be subsequently reconnected, in same manner as other utilities to remain.

3.05**SELECTIVE DEMOLITION FOR ALTERATIONS**

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.

1. Verify that construction and utility arrangements are as indicated.
2. Report discrepancies to Architect before disturbing existing installation.
3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.
- B. Separate areas in which demolition is being conducted from other areas that are still occupied.
 1. Provide, erect, and maintain temporary dustproof partitions of construction as specified and/or indicated on Drawings .
- C. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
- D. Remove existing work as indicated and as required to accomplish new work.
 1. Remove items indicated on Drawings.
- E. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove existing systems and equipment as indicated.
 1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.
 2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
 3. Verify that abandoned services serve only abandoned facilities before removal.
 4. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification.
- F. Protect existing work to remain.
 1. Prevent movement of structure; provide shoring and bracing if necessary.
 2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
 3. Repair adjacent construction and finishes damaged during removal work.
 4. Patch as specified for patching new work.

3.06 SALVAGED ITEMS

- A. Clean salvaged items.
- B. Pack or crate items after cleaning. Identify contents of containers.
- C. Store items in a secure area until delivery to Owner.
- D. Transport items to Owner's storage area on-site.
- E. Protect items from damage during transport and storage.

3.07 REMOVED AND REINSTALLED ITEMS

- A. Clean and repair items to functional condition adequate for intended reuse.
- B. Pack or crate items after cleaning and repairing. Identify contents of containers.
- C. Protect items from damage during transport and storage.
- D. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

3.08 EXISTING ITEMS TO REMAIN

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

3.09 DEBRIS AND WASTE REMOVAL

- A. Remove debris, junk, and trash from site.
- B. Leave site in clean condition, ready for subsequent work.
- C. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

SECTION 02 4110 – SALVAGE & RELOCATION OF FIELD ITEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section is a part of the entire set of Contract Documents and shall be coordinated with the applicable provisions of the other parts.
- B. Related Sections:
 - 1. Section 31 1000 Site Preparation
 - 2. Section 31 2010 Earthwork
 - 3. Section 03 3000 Cast In Place Concrete
- C. Work Includes Salvage & Relocation of the Following Items:
 - 1. Precast concrete storage building at Troy Athens
 - 2. Baseball and softball scoreboards
 - 3. Batting cages - hardware and netting

1.2 SCOPE

- A. The work under this section of the specifications shall consist of the relocation of all items as indicated on the drawings. Contractor shall furnish all labor, materials and equipment to complete the work according to the drawings and specifications.
- B. All other facilities and items that are indicated shall remain and be protected from construction damage.

PART 2 - PRODUCTS

N/A

PART 3 - EXECUTION

3.1 EXECUTION

- A. General
 - 1. Contractor shall relocate items shown on drawings. Locations shall be within District boundaries.
 - 2. Methods to be used in relocating items to be determined by the Contractor and approved by the Owner. Equipment damaged during relocation shall be replaced or repaired at the Contractor's expense.
 - 3. All work to be performed shall be under applicable Government Codes.
 - 4. All items requiring electrical or water will be attached to existing sources and left in working condition.
 - 5. All underground electric wiring shall be installed in PVC Conduit (with exception to 24 volt electrical irrigation wire).
 - 6. Demolish existing footings to a depth of 24" below proposed finish grade.
 - 7. Restoration of all existing equipment locations shall be performed by Contractor.
- B. Removal of Debris
 - 1. Prompt removal of demolished items (i.e., concrete footings, slabs, etc.) from the site. Legally dispose of debris/material, including obtaining permission from applicable regulatory authority for disposal of debris/material to proper waste disposal site.

END OF SECTION

SECTION 03 3000 – CAST IN PLACE CONCRETE

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Design Mixtures: For each concrete mixture
- C. Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement.

1.03 INFORMATIONAL SUBMITTALS

- A. Material certificates
- B. Material test reports

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- B. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1.05 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on concrete mixtures.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
- B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

1.07 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 306.1.
 - 1. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- B. Hot-Weather Placement: Comply with ACI 301.

PART 2 PRODUCTS

2.01 CONCRETE, GENERAL

- A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301.
 - 2. ACI 117.

2.02 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

2.03 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

- B. Plain-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, plain, fabricated from as-drawn steel wire into flat sheets.
- C. Deformed-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, flat sheet.
- D. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice."

2.04 CONCRETE MATERIALS

- A. Cementitious Materials:
 - 1. Portland Cement: ASTM C 150/C 150M, Type I, gray.
 - 2. Fly Ash: ASTM C 618, Class F or C.
 - 3. Slag Cement: ASTM C 989/C 989M, Grade 100 or 120.
- B. Normal-Weight Aggregates: ASTM C 33/C 33M, graded.
 - 1. Maximum Coarse-Aggregate Size: 1 inch nominal.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Air-Entraining Admixture: ASTM C 260/C 260M.
- D. 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/C 494M, Type A.
 - 2. Refer to 03 3003 for Moisture Vapor Reducing Admixture.
- E. Water: ASTM C 94/C 94M and potable.

2.05 CURING MATERIALS

- A. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- B. Water: Potable.
- C. All interior slab on grade concrete shall be moisture cure only.

2.06 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

2.07 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
- B. Cementitious Materials: Use fly ash, pozzolan, slag cement, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.
- C. Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing admixture in concrete, as required, for placement and workability.

2.08 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Refer to structural general notes.

2.09 FABRICATING REINFORCEMENT

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

2.10 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, 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. Moisture Vapor Reduction Admixture (MVRA):
 - a. Where required add admixture as recommended in ACI 211.1 and at rates required by manufacturer.

PART 3 EXECUTION

3.01 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 structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Chamfer exterior corners and edges of permanently exposed concrete.

3.02 EMBEDDED ITEM INSTALLATION

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.03 VAPOR-RETARDER INSTALLATION

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
 - 1. Lap joints 6 inches and seal with manufacturer's recommended tape.
 - 2. Vapor Retarder Over Granular Fill: Install compactible granular fill before placing vapor retarder as indicated on drawings.

3.04 STEEL REINFORCEMENT INSTALLATION

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

3.05 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth 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 groover 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.
- 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.

3.06 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.
- B. 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.
 - 1. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.

3.07 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.
- C. Rubbed Finish: Apply the following to smooth-formed-finished as-cast concrete where indicated:
 - 1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
 - 2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix 1 part portland cement to 1-1/2 parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
 - 3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix 1 part portland cement and 1 part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.
- D. 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.

3.08 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.
 - 1. Apply scratch finish to surfaces to receive mortar setting beds for bonded cementitious floor finishes.
- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.
 - 1. Apply float finish to surfaces to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.
- D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel

marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
 2. Finish and measure surface, so gap at any point between concrete surface and an unlevelled, freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch.
- E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thinnest method. While concrete is still plastic, slightly scarify surface with a fine broom.
1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.
1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.09 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. 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.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for remainder of curing period.
- D. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
1. Moisture Curing: Keep surfaces continuously moist for not less than seven days.
 2. 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.

3.10 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.

3.11 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

END OF SECTION

SECTION 03 3003 - CAST-IN-PLACE CONCRETE REQUIREMENTS FOR FLOOR SLABS**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Underslab vapor retarder.
- B. Floor flatness and levelness tolerances; slabs on grade and suspended slabs.
- C. Liquid densifier/hardener.

1.02 REFERENCE STANDARDS

- A. ASTM D4263 - Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method 1983 (Reapproved 2018).
- B. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs 2017 (Reapproved 2023).
- C. ASTM E1643 - Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs 2018a.
- D. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes 2019a.
- E. ASTM E1155 - Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers 2020.
- F. ASTM E1155M - Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers (Metric) 2014.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of floor slab installation and the work of this section; require attendance by all affected installers.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.
- C. Mix Design: Submit proposed concrete mix design.
- D. Field Quality Control Reports: Provide the following:
 - 1. F(F) Floor Flatness and F(L) Floor Levelness measurements as specified.
- E. Submit documentation from manufacturers certifying that curing products and methods are compatible with concrete staining and polishing materials and methods.
- F. Manufacturer's Qualification Statement.
- G. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than 5 years of documented experience.
- B. Obtain moisture vapor reduction admixture from a single manufacturer.
- C. In addition to requirements of this Section comply with requirements of Section 03 3000 - Cast-in-Place Concrete.
 - 1. If there is a conflict between sections, comply with the more stringent requirement unless otherwise indicated by Architect.
- D. Concrete Curing:
 - 1. Prior to installing and curing concrete floor slabs to be stained and polished, verify with polished concrete materials manufacturer that curing products and methods are compatible with concrete staining and polishing.

1.06 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Slabs with Moisture Vapor Reduction Admixture (MVRA): Provide warranty to cover the cost of flooring failures due to moisture migration from slabs for ten years.
 - 1. Include cost of repair or removal of failed flooring, placement of topical moisture remediation system, and replacement of flooring with comparable flooring system.

PART 2 PRODUCTS**2.01 UNDERSLAB VAPOR RETARDER**

- A. Underslab Vapor Retarder: Sheet material complying with ASTM E1745, Class A; stated by manufacturer as suitable for installation in contact with soil or granular fill under concrete slabs. The use of single ply polyethylene is prohibited.
 - 1. Installation: Comply with ASTM E1643.
 - 2. Accessory Products: Vapor retarder manufacturer's recommended tape, adhesive, mastic, prefabricated boots, etc., for sealing seams and penetrations.
 - 3. Minimum Thickness: 15 mil.
 - 4. Products:
 - a. Fortifiber Building Systems Group: www.fortifiber.com.
 - b. Intoplast Group; Barrier-Bac VB-350: www.barrierbac.com.
 - c. ISI Building Products; Viper VaporCheck II 15-mil (Class A): www.isibp.com.
 - d. Poly-America; Husky Yellow Guard 15-mil Vapor Barrier: www.yellowguard.com.
 - e. Stego Industries, LLC; 15 mil: www.stegoindustries.com.
 - f. W. R. Meadows, Inc; PERMINATOR Class A - 10 mils (0.25 mm): www.wrmeadows.com.
 - g. Substitutions: See Section 01 6000 - Product Requirements.

2.02 CONCRETE MIX DESIGN

- A. General: Comply with requirements of Section 03 3000 - Cast-in-Place Concrete and as follows.

2.03 REINFORCEMENT MATERIALS

- A. Comply with requirements of Section 03 3000 - Cast-in-Place Concrete.

2.04 DENSIFIERS AND HARDENERS

- A. Liquid Densifier/Hardener: Penetrating chemical compound that reacts with concrete, filling the pores and dustproofing; for application to concrete after set.
 - 1. Composition: Sodium silicate.
 - 2. Products:
 - a. Dayton Superior Corporation; Densifier J13: www.daytonsuperior.com.
 - b. Euclid Chemical Company; EUCO DIAMOND HARD: www.euclidchemical.com.
 - c. Kaufman Products Inc; SureHard: www.kaufmanproducts.net.
 - d. L&M Construction Chemicals, Inc, a subsidiary of Laticrete International, Inc; SEAL HARD: www.lmcc.com.
 - e. W. R. Meadows, Inc; Liqui-Hard: www.wrmeadows.com.
 - f. Substitutions: See Section 01 6000 - Product Requirements.
 - 3. Locations:
 - a. Use at following locations: Unless otherwise indicated, unfinished exposed concrete floors, equipment pads, ramps, steps, and stairs are to be finished using liquid densifier/hardener.

PART 3 EXECUTION**3.01 INSTALLATION - GENERAL**

- A. In addition to requirements of this Section comply with requirements of Section 03 3000 - Cast-in-Place Concrete.

3.02 UNDERSLAB VAPOR RETARDER

- A. Interior Slabs on Grade: Install vapor retarder under interior slabs on grade. Lap joints minimum 6 inches. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions. Repair damaged vapor retarder before covering.
1. Vapor Retarder Over Granular Fill: Install compactible granular fill before placing vapor retarder as indicated on drawings.

3.03 FLOOR FLATNESS AND LEVELNESS TOLERANCES

- A. General: Unless more stringent requirements are indicated or specified in Section 03 3000 - Cast-in-Place Concrete, comply with floor flatness and levelness values specified in this section.
- B. Minimum F(F) Floor Flatness and F(L) Floor Levelness Values:
1. Exposed to View and Foot Traffic: F(F) of 25; F(L) of 20, on-grade only.
 2. Under Thick-Bed Tile: F(F) of 20; F(L) of 15, on-grade only.
 3. Under Carpeting: F(F) of 25; F(L) of 20, on-grade only.
 4. Under Thin Resilient Flooring and Thinset Tile: F(F) of 35; F(L) of 25, on-grade only.
 5. Under Wood Gymnasium Floors and Stage Floors: F(F) of 50.
 - a. Verify that concrete subfloor surface is smooth and flat to plus or minus 1/8 inch in 10 feet.
 6. Stained and Polished Concrete Floors: F(F) of 50; F(L) of 30, on-grade only.
- C. Measure F(F) Floor Flatness and F(L) Floor Levelness in accordance with ASTM E1155 (ASTM E1155M), within 48 hours after slab installation; report both composite overall values and local values for each measured section.
- D. Correct the slab surface if composite overall value is less than specified and if local value is less than two-thirds of specified value or less than F(F) 13/F(L) 10.
- E. Correct defects by grinding or by removal and replacement of the defective work. Areas requiring corrective work will be identified. Re-measure corrected areas by the same process.

3.04 CONCRETE CURING REQUIREMENTS

- A. At Slabs for Stained and Polished Concrete Floors: Cure with evaporation control and wet curing methods.
1. Chemically reactive curing agents, membrane curing agents, and other topically applied curing compounds are not permitted.

3.05 LIQUID DENSIFIER/HARDENER

- A. Apply liquid densifier/hardener in accordance with manufacturer's instructions.
- B. Verify that surface is free of previous coatings, sealers, curing compounds, water repellents, laitance, efflorescence, fats, oils, grease, wax, soluble salts, residues from cleaning agents, and other impediments to adhesion.
- C. Verify that water vapor emission from concrete and relative humidity in concrete are within limits established by liquid densifier/hardener manufacturer according to ASTM D4263 and ASTM F2170.
- D. Protect adjacent non-coated areas from drips, overflow, and overspray; immediately remove excess material.

3.06 FIELD QUALITY CONTROL

- A. Slab Testing: Cooperate with manufacturer of specified moisture vapor reduction admixture (MVRA) to allow access for sampling and testing concrete for compliance with warranty requirements.

END OF SECTION

SECTION 03 3005 – CAST IN PLACE CONCRETE - ATHLETICS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section is a part of the entire set of Contract Documents and shall be coordinated with the applicable provisions of the other parts.
- B. Related Sections:
 - 1. Section 31 2010 Earthwork - Athletics

1.2 SCOPE

- A. The work under this section of the specifications shall consist of furnishing all labor, materials and equipment necessary to construct cast-in place concrete pavement for parking lots, curbs and gutters, sidewalks, and wheel stops.

1.3 QUALITY ASSURANCE

- A. Reference Standards:
 - 1. American Society for Testing and Materials (ASTM):
 - a. ASTM C 94-97 – Standard Specification for Ready Mixed Concrete
 - b. ASTM C 171-69 (1975) - Standard Specification for Sheet Materials for Curing Concrete
 - c. ASTM C 309-74 - Standard Specification for Liquid Membrane Forming Compound for Curing Concrete
 - d. ASTM D 1751-73 - Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
 - 2. MDOT current Standard Specifications for Construction

1.4 SUBMITTALS & TEST REPORTS

- A. Submit aggregate and concrete mix designs proposed for review. Contractor is to confirm that materials provided meet the required specifications and are to provide material certification to the Architect. Material certifications shall indicate that products meet or exceed the specified requirements indicated on the plans and the regulating authority.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Installer shall be experienced with at least five (5) years in business who has completed concrete pavement work similar to the design, materials and requirements indicated for this project.
- B. Manufacturer Qualifications: Manufacturer of ready-mix concrete products complying with ASTM C94 requirements for production facilities and equipment and approved by governing jurisdictions for State Department of Transportation.
 - 1. Manufacturer must be certificated according to the National Ready Mix Concrete Association's Plant Certification Program.
- C. Testing Agency Qualifications: The independent testing agency shall be qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.
- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant and each aggregate from a single source.

1.6 ENVIRONMENTAL REQUIREMENTS AND PROJECT CONDITIONS

- A. Allowable concrete temperatures
 - 1. Cold Weather: Maximum and minimum, ASTM C94
 - 2. Hot Weather: Maximum concrete temperature - 90 degrees F. (23 degrees C.)
- B. Do not place concrete during rain, sleet or snow.

PART 2 - PRODUCTS

2.1 FORMS

- A. Form Materials: Plywood, metal, metal framed plywood, or other approved panel materials to provide a full-depth, continuous, smooth exposed surface.
 - 1. Use flexible or curved forms for conditions that require curved finishes.
- B. Form Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect the concrete surfaces.

2.2 STEEL REINFORCEMENT

- A. Reinforcement Bars: ASTM A 615/A, 615M, Grade 60, deformed billet steel, unfinished.
- B. Plain-Steel Welded Wire Fabric: ASTM A 185, fabricated flat sheets, unfinished.
- C. Steel Bar Mats: ASTM A 184/A 184M; with ASTM A 615/A 615M, Grade 60 deformed bars, assembled with clips.
- D. Epoxy-Coated Reinforcement Bars: ASTM A 775/A 775M. with ASTM A 615/A 615M, Grade 60 deformed bars.
- E. Joint Dowel Bars: Plain steel bars, ASTM A 615/A 615M, Grade 60. Cut bars true to length with ends squared and free of any burrs.
- F. Tie Bars: ASTM A 615/A 615M, Grade 60 deformed.
- G. Epoxy Coated Joint Dowel Bars: ASTM A 775/A 775M. with ASTM A 615/A 615M, Grade 60, plain steel bars.
- H. Bar Supports: Bolsters, chairs, spaces, and other devices necessary for spacing, supporting, and fastening reinforcement bars, welded wire fabric, and dowels in place. Manufacture bar supports according to CRS'II's Manual of Standard Practice from steel wire, plastic, or precast concrete or fiber-reinforced concrete of greater compressive strength than concrete.
- I. Epoxy Repair Coating: Liquid two-part epoxy repair coating, compatible with epoxy coating on reinforcement.

2.3 MATERIALS

- A. Use the same brand and type of cementitious material from the same manufacturer through the entire project. All material to meet current MDOT specifications.

2.4 CONCRETE MIXES

- A. Prepare mix design, proportioned according to ACI 211.1 and ACI 301, for each type and strength of normal-weight concrete determined by lab trial mixes.
- B. Use a qualified testing agency for preparing and reporting proposed mix designs for the testing batch.
- C. Provide mixes for sidewalks, curbs, gutters, and roads meeting the following properties:
 - 1. Compressive Strength (28 days): 3500psi, unless indicated otherwise
 - 2. Maximum Water to Cement Ratio: 45 percent by weight
 - 3. Maximum Aggregate Size: 1.5 inches (38mm)
- D. Cementitious Material: Limit percentages, by weight of cementitious materials other than portland cement according to current ACI 301 requirements for concrete exposed chemicals used for de-icing.
- E. Air-entraining admixtures shall be used at manufacturer's prescribed rates to result in concrete at point of placement, with an air content of 5.0 to 8.5 percent.
- F. Slump: two (2) to three (3) inches

2.5 CONCRETE MIXING

- A. Ready-Mixed Concrete: Comply with requirements and ASTM C94 and ASTM C1116
 - 1. When air temperature is between 85 degrees F and 90 degrees F, reduce mixing and delivery time from 75 minutes to 90 minutes; when air temperature is above 90 degrees F, reduce mixing and delivery time to 60 minutes.
- B. Project Site Mixing: Comply with requirements and measure, batch, and mix concrete materials and concrete according to ASTM C94. Mix concrete materials in appropriate drum-type batch machine mixer.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Verify the earthwork is completed to correct line and grade. Notify the Owner/Landscape Architect of any incomplete work by previous contractors.
- B. Check that sub-grade is smooth, compacted, and free of frost or excessive moisture.
- C. Do not commence work until conditions are satisfactory.

3.2 WEATHER PROTECTION

- A. Cold weather: When the mean daily air temperature is 40 degrees F. or below, provide suitable protection for concrete work to maintain a minimum concrete temperature of 50 degrees F. for five

(5) days (or 70 degrees F. for three (3) days). After the protection period, do not let concrete cool more than 20 degrees F. in each successive day

- B. Hot weather: Place concrete according to recommendations in ACI 305R when hot-weather conditions exist.
- C. Wet weather: Unless adequate protection is provided, do not place concrete in rain, sleet or snow.

3.3 JOINTS

- A. Construct all joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles, unless noted otherwise.
- B. At locations where new concrete abuts existing concrete, building walls and slabs, place expansion joint material and joint sealants.
- C. Expansion Joints: Place 1 inch wide expansion joints at maximum 40 foot intervals, if not indicated on drawings. Joints to be full depth of pavement and joint sealant placed at all expansion joints.
- D. Install all dowel bars and support assemblies at joints if indicated on the plans. Coat one-half of dowel length to prevent concrete bonding to one side of the joint.
- E. Contraction Joints: form any weakened plane contraction joints, sectioning concrete into areas. Construct ¼ inch wide contraction joints for a depth equal to one-third of the concrete thickness. Maximum spacing of the joints shall be 8'-0".
 - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with tool to a 3/8" radius. Repeat any grooving of joint after application of surface finishes.
 - 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond blades. Joint cuts not to exceed 1/8 inch wide, when cutting will not tear or damage the surface and develop a contraction cracks.
 - 3. Doweled Contraction Joints: install dowel bars and support assemblies at joints where indicated.
- F. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after floating with an edging tool at a 3/8 inch radius.

3.4 INSTALLATION

- A. Contractor shall install the first section of sidewalk as a quality sample in place. Upon approval of sample by Landscape Architect, further installation can proceed.
- B. The sub-grade upon which concrete is to be placed shall be prepared by excavation or filling with suitable earth to such depth below the finished grade line, that when tamped or rolled until smooth, firm and hard, the sub-grade will be uniform and at the required depth below finished grade line.
- C. Unsuitable sub-grade soils shall be replaced as directed.
- D. Gravel backfill, when specified in the drawings, shall be constructed to the required depth and thoroughly compacted.
- E. Cast in Place Concrete
 - 1. Set forms to line and grade
 - 2. Install forms over full length of walk and oil before use.
 - 3. Forms shall be set accurately to line and grade. If the forms are set more than 0.01 foot (3mm) above or below grade or more than 0.01 foot (6mm) from prescribed alignment, they shall be corrected before any concrete is placed
 - 4. Flexible or curved forms of proper radii shall be used on all curves having a radius of 100 feet or less.
 - 5. Form contraction joints by tooling.
 - 6. Install expansion joint material behind walks at abutment curbs and adjacent structures with expansion joints every 100 feet (30m) or as detailed. Retaining wall shall have expansion joints every 25 feet.
 - 7. Provide sawcuts in concrete every 10 lineal feet. Sawcut depth shall be no more 3/4" deep and 1/8" in width.
 - 8. Place top of expansion joint material flush with walk surface, unless noted otherwise on plans.
 - 9. Place concrete with mechanical vibrators.
 - 10. Consolidate concrete with mechanical vibrators.
 - 11. Round edges of walks at top with finishing tool, 1/4" to 3/8" radius. 1" radius for retaining wall.

12. Finished exposed walk surfaces with wood float followed by brushing with broom, smooth band of 12", unless otherwise shown on drawings.
13. Apply plastic sheeting or curing material and cure for seven (7) days.
14. Apply plastic sheeting or curing material
15. Do not allow free drop of more than five (5) feet. Use elephant trunk when necessary.

F. Slip form concrete to the same quality standards as cast in place.

1. Construct concrete curb with slip form curb machine.
2. Apply curing material and cure for seven (7) days.
3. Saw expansion and contraction joints after concrete has sufficiently hardened.

3.5 FIELD QUALITY CONTROL

- A. Slump Tests: Make slump tests whenever concrete is being poured at the direction of the Owner.
- B. Compression Tests: Prepare standard test cylinders during the placing of concrete in accordance with ASTM 31 and ASTM 172. One set (three (3) cylinders) is required for each day's pour.
- C. Maintain two (2) cylinders at 50 to 70 degrees F. and protect from loss of moisture at the job site for a period of not over 48 hours, then deliver to the laboratory for curing and testing at seven (7) and twenty-eight (28) days, respectively. Place third cylinder near the in place concrete and cure completely at the job in the same manner as the in place concrete. Deliver this cylinder to the laboratory for testing at twenty-eight (28) days. Cure and test cylinders in accordance with ASTM C31, C39 and C192. Submit test reports to the Landscape Architect in duplicate

3.6 PAVING TOLERANCES

- A. Comply with tolerances of ACI 117 and as follows:
 1. Elevation variation: 1/4 inch
 2. Thickness: Plus 3/8 inch, minus 1/4 inch
 3. Surface Variation: gap below 10 foot long, unlevelled straightedge not to exceed 1/4 inch.
 4. Maximum cross slope for walks, ramps, or platforms: 2%
 5. Maximum longitudinal walk slopes not requiring landings and handrails: 5%
 6. Maximum longitudinal ramp slopes: 8.33% (1 on 12 slope)

3.7 PROTECTION OF FINISHED SURFACES

- A. All finished surfaces of concrete shall be protected so as to prevent damage. Marking temporary nailing or other damaging use of surfaces will be prohibited.

3.8 PATCHING

- A. Patch to match material, color and texture of surrounding area.
- B. Replace defective work if patching is not acceptable to the Landscape Architect.

3.9 REPAIR/REPLACE

- A. Within first year of placement, concrete will be replaced at no additional cost to the Owner, if horizontal and/or vertical cracks exceed 1/8" in width.
- B. Hairline cracks do not qualify for concrete replacement.

3.10 CLEAN-UP

- A. The Contractor shall remove excess excavated material from the site of the work. Spread and finish grade within five (5) feet of pad edge. Finish grading is incidental to pad installation. Contractor shall clean up and dispose of rubble and construction satisfactory to the Owner and Landscape Architect.

END OF SECTION

SECTION 03 3053 – CONCRETE TURF ANCHOR

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section is a part of the entire set of Contract Documents and shall be coordinated with the applicable provisions of the other parts.
- B. Related Sections:
 - 1. Section 03 3005 Cast-in-Place Concrete
 - 2. Section 06 1050 Turf Wood Nailer

1.2 SCOPE

- A. The work under this section of the specifications shall consist of furnishing all labor, materials and equipment necessary to install new concrete turf anchor.

1.3 QUALITY ASSURANCE

- A. Materials and methods of construction shall comply with the following standards:
 - 1. American Society for Testing and Materials, (ASTM).
 - 2. American Concrete Institute (ACI).
- B. Maintain field records of time, date of placing, curing, and removal of forms of concrete in each portion of work.

1.4 SUBMITTALS

- A. Submit concrete mix designs. Obtain approval before placing concrete.
- B. Product data:
 - 1. Submit complete materials list of items proposed for the work. Identify materials source.
 - 2. Submit admixture, curing, compound, retarder, and accessory item product data.
 - 3. Submit materials certificates for aggregates, reinforcing, and joint filler
- C. Submit concrete delivery tickets. Show the following:
 - 1. Batch number.
 - 2. Mix by class or sack content with maximum size aggregate.
 - 3. Admixtures.
 - 4. Air content.
 - 5. Slump.
 - 6. Time of loading.
- D. Submit concrete test reports.

1.5 PROJECT CONDITIONS

- A. Work notifications: Notify Landscape Architect at least 24 hours prior to installation of concrete.
- B. Establish and maintain required lines and grade elevations.
- C. Do not install concrete work over wet, saturated, muddy, or frozen subgrade.
- D. Do not install concrete when air temperature is below 40 degrees F. Use of calcium chloride, salt, or any other admixture to prevent concrete from freezing is prohibited.
- E. Protect adjacent work.
- F. Provide temporary barricades and warning lights as required for protection of project work and public safety.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Portland cement: ASTM C150, Type 1, natural color.
- B. Aggregate: Provide ASTM C33 normal weight aggregates, 1" maximum size, clean, uncoated crushed stone or gravel coarse aggregate free of materials which cause staining or rust spots; fine aggregate shall be clean natural sand.
- C. Water: Clean, fresh, and potable.
- D. Air-entraining admixture: ASTM C260.
- E. Water-reducing admixture: ASTM C494.

2.2 MIXES

- A. Provide ASTM C94 ready-mixed concrete. Batch mixing at site not acceptable.

1. Strength: 3,500 psi minimum at 28 days.
2. Slump range: 2" to 4" maximum.
- B. Provide an approved water-reducing admixture in all concrete.
- C. Provide an air-entraining admixture in all concrete. Air content 5% to 7%.
- D. Indicate water added to mix at job site on each delivery ticket. Show quantity of water added. Site water tempered mixes exceeding specified slump range will be rejected as not complying with specification requirements.

2.3 ACCESSORIES

- A. Granular base: AASHTO M43, #6 (3/8" to 3/4") uniformly graded, clean crushed stone or gravel.
- B. Forms: Wood or metal of sufficient strength to resist concrete placement pressure and to maintain horizontal and vertical alignment during concrete placement. Provide forms straight, free of defects and distortion, and height equal to full depth of concrete work.
 1. Provide 2" nominal thickness, surfaced plank wood forms for straight sections. Use flexible metal, 1" lumber or plywood forms to form radius bends.
 2. Synthetic turf anchoring curb system: Forms shall be prefabricated metal forms to produce tongue and groove joint. Automated self propelled curb-and-gutter equipment shall not be allowed.
- C. Joint filler: ASTM D1751, premolded non-extruding asphalt-impregnated fiberboard, thickness indicated.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine subgrades and installation conditions. Do not start concrete work until unsatisfactory conditions are corrected.

3.2 PREPARATION

- A. Proof roll the subgrade and do all necessary rolling and compacting to obtain firm, even subgrade surface. Fill and consolidate depressed areas. Remove uncompactable materials, replace with clean fill and compact to 100% of the maximum dry density in accordance with ASTM D698 Standard Proctor Method.
- B. Remove loose material and debris from base surface before placing concrete.
- C. Install, align, and level forms. Stake and brace forms in place. Maintain following grade and alignment tolerances:
 1. Top of form: Maximum 1/8" in 10'-0".
 2. Vertical face: Maximum 1/4" in 10'-0".
- D. Coat form surfaces in contact with concrete with form release agent. Clean forms after each use and coat with form release agent as necessary to assure separation from concrete without damage.

3.3 INSTALLATION

- A. Concrete placement:
 1. Comply with ACI 304 "Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete", and as specified.
 2. Protect concrete from physical damage or reduced strength due to weather extremes during mixing, placing, and curing. In cold weather comply with ACI 306, "Recommended Practice for Cold Weather Concreting". In hot weather comply with ACI 305, "Recommended Practice for Hot Weather Concreting".
 3. Moisten base to provide a uniform dampened condition at the time concrete is placed. Verify manholes or other structures are at required finish elevation and alignment before placing concrete.
 4. Place and spread concrete to the full depth of the forms. Use only square-end shovels or concrete rakes for hand-spreading and consolidating concrete. Exercise care during spreading and consolidating operations to prevent segregation of aggregate and dislocation of reinforcement.
 5. Place concrete in a continuous operation between expansion joints. Provide expansion joints

- when sections cannot be placed continuously.
6. Place concrete in one course, monolithic construction, for the full width and depth of concrete work.
 7. Provide curb profiles indicated.
- B. Joints:
1. Construct control, expansion, and construction joints properly aligned with face perpendicular to concrete surface.
 2. Tooled control joints, sectioning concrete into areas indicated. Tool joints to depth equal to not less than 1/2" depth.
 3. Sawcut control joints every 10' LF. Sawcut depth shall be no more 3/4" deep and 1/8" in width.
 4. Provide expansion joints using premolded joint filler at concrete work abutting curbs, walls, structures, walks, and other fixed objects.
 - a. Protect the top edge of the joint filler during concrete placement.
 - b. 1/2" width expansion joints every 100 LF
- C. Concrete finishing:
1. Perform concrete finishing using mechanical or hand methods as required.
 2. Upon completion of floating, and after bleed water has disappeared and concrete can sustain foot pressure with nominal indentation, cut concrete away from forms. Work edges with an edging tool. Round edges to 1/2" radius.
 3. Install control joints at indicted locations during edging operations.
- D. Curing:
1. Cure concrete with a non-staining liquid membrane-forming compound. Spray apply in accordance with manufacturer's recommended coverage rate. Apply curing compound immediately after completing surface finish.

3.4 FIELD QUALITY CONTROL

- A. Provide field quality control testing and inspection during concrete operations.
- B. Contractor shall provide adequate notice, cooperate with, provide access to the work, obtain samples, and assist test agency and their representatives in execution of their function.
- C. Testing:
1. Provide slump test on first load of concrete delivered each day and whenever requested due to changes in consistency or appearance of concrete.
 2. Provide air indicator tests and air meter tests for all air-entrained concrete.
 - a. Perform air indicator test with a "Chase" AE 35 or equal air indicator, and air meter test in accordance with ASTM C231 or C173. Test first load of concrete delivered each day.
 - b. Furnish copies of field records and tests reports as listed for strength tests.
 3. Strength testing:
 - a. Provide 1 set of 3 test specimens for each 50 CY placed in any one day. Secure samples in accordance with ASTM C172 and mold specimens in accordance with ASTM C31.
 - b. Test 1 specimen at 7 days and 2 specimens at 28 days in accordance with ASTM C39.
 - c. Furnish copies of field records and test reports as follows:
 - 1 copy to Contractor
 - 1 copy to Ready Mix Supplier
 4. Record the exact location of the concrete in the work represented by each set of cylinders and show on test reports.
 5. Provide an insulated moist box for protection of the test cylinders until shipped to the laboratory.

3.5 PROTECTION

- A. Protect concrete work from damage due to construction and vehicular traffic until final acceptance. Exclude construction and vehicular traffic from concrete pavements for at least 14 days.

3.6 CLEANING

- A. Perform cleaning during installation of the work and upon completion of the work. Remove from site all excess materials, debris, and equipment. Repair damage resulting from concrete operations.

- B. Sweep concrete sidewalks and pavement, wash free of stains, discoloration, dirt, and other foreign material immediately prior to final acceptance.

END OF SECTION

SECTION 03 3800 – POST-TENSIONED CONCRETE – TENNIS COURT

PART 1 - GENERAL

1.1 SUMMARY

- A. This section is a part of the entire set of Contract Documents and shall be coordinated with the applicable provisions of the other parts.

1.2 SCOPE

- A. The contract work to be performed under the specification consists of furnishing all of the required labor, materials, equipment, implements, parts, and supplies necessary for or appurtenant to the construction of post tension concrete tennis courts in accordance with the specifications and drawings.

1.3 QUALITY ASSURANCE

- A. The contract work to be done in a thorough, workmanship manner by qualified contractors and shall conform to standards for tennis court construction. Contractors will provide proof of insurance and bonds requested by the owner. Prime contractor will perform at least eighty-five percent (85%) of the work with his own forces.
- B. Warranty Guarantee: The contractors guarantee their respective work against defective materials or faulty workmanship for a period of two (2) years; five (5) years for the surface.
- C. This specification section is performance based. If the design recommendations of the Contractor's Structural Engineer conflict with this specification, the Structural Engineer's recommendations shall take precedence.

1.4 SUBMITTALS

- A. The Post-Tensioning Contractor is responsible to provide shop drawings which detail the proposed arrangement and spacing of tendons and details associated with the proposed design. Provide product data related to the encapsulated anchors proposed.
- B. Stressing logs are a requirement to be provided to the Landscape Architect to verify conformance.
- C. Contractor shall provide all required certification of stressing equipment and required calibration of stressing equipment.
- D. Contractor shall be responsible to provide complete structural drawings and structural calculations, prepared by a Structural Engineer. Drawings shall include perimeter beam, concrete design, and rebar layout. Drawings and calculations shall be signed and sealed by a Registered Structural Engineer licensed in the State of Michigan.

PART 2 - PRODUCTS

2.1 SITE PREPARATION

- A. Rough Grading
 - 1. Trees, bushes and other growing vegetation will be removed from the site. The area will be graded to plus or minus one inch (1") to provide a uniform one percent (1%) slope in one plane. All fills will be placed in six inch (6") layers and will be compacted to ninety-five percent (95%) standard proctor at optimum moisture. The rough grade will be done so as to provide positive drainage away from the tennis court and, if needed, to provide intercepting swales to prevent drainage onto the court.
- B. Fine Grading
 - 1. Fine grading will be done with automatic laser regulated equipment capable of providing a true accurate plane to plus or minus one fourth inch (1/4").

BASE COURSES - GRADATION LIMITS

<u>Sieve Size</u>	<u>Percent Passing</u>
2"	100
1/2"	50 - 85
No. 4	40 - 75
No. 50	8 - 28
No. 200	0 - 5

2.2 COURT PAVING

- A. Description of Work: Work covered by this specification concerns all labor, material and equipment necessary for construction of a four inch (4") thick post-tensioned concrete slab for.
- B. Vapor Barrier: Place a two-layer six (6) mill polyethylene vapor barrier over the base material and extend it up to the perimeter beam.
- C. Forming: Forms shall be accurately set to the lines and to plus or minus one-fourth inch (1/4") of finished grades indicated on drawings and be securely staked to prevent settlement or movement during placement of concrete. Forms shall remain until concrete has taken final set.
- D. Tensioning Cables and Anchors: Post tensioning standards shall conform to the "PTI Guide Specifications for Post-Tensioning Materials":
 - 1. The tensioning standards shall consist of one-half inch (1/2") diameter, 7-wire, stress relieved standards, having a guaranteed minimum ultimate tensile strength of 270,000 psi (270 kips). Strands shall conform to ASTM A-416. Cables shall be fabricated to proper length for each slab, coated with a permanent rust preventative lubricant and encased in slippage sheathing. All breaks in the sheathing shall be repaired with tape prior to concrete placement. A maximum of six (6) inches exposed strands is permitted at the dead-end Anchor.
 - 2. All cables shall be supported on chairs and loosely tied two inches (2") high at all intersections (too tightly tied, tendon friction will increase when tensioning) to prevent vertical and horizontal movement during concrete placement. Strands shall be placed with no greater spacing that two feet (2') six inches (6") wide in both directions. See drawing details for cable spacing.
 - 3. After the forms are removed and the concrete has set to a minimum of 2,000 psi, the tensioning procedure may be applied.
 - 4. Each tendon may initially be tensioned to a maximum of eighty percent (80%) of ultimate breaking strength and anchored at a minimum of seventy percent (70%) of ultimate breaking strength.

<u>Ultimate Breaking Strength</u>	<u>80%</u>	<u>70%</u>
41,300	33,000	28,900

The cable ends shall be cut off and cone holes grouted flush with edge of slab.

- E. Joints: Between each court, plus or minus one foot (1'), there shall be a 3 ½ metal keyway keyed construction joint. (See plans for location and detailed drawing.) At a one-foot (1') offset from net line there shall be a 3 ½ metal keyway. (See drawings for location and detail.)
- F. Placing: A full court shall be placed in one (1) continuous operation without intervening joints of any kind. The four inch (4") thick slab will be placed with a sixty-foot (60') mechanical screed capable of providing a surface true to three-eighths inch (3/8") in sixty feet (60') and not vary more than one-eighth inch (1/8") under a ten foot (10') straight edge in all directions.
- G. Curing: Immediately after finishing, the concrete shall be kept moist by covering with polyethylene, sprinkling, or ponding. **No curing compounds shall be used.**
- H. Concrete Compressive Strength: The concrete shall have a compressive strength of not less than 4,000 psi after twenty-eight (28) days. Ready-mixed concrete shall be mixed and delivered according to ASTM C-94 specifications for ready-mixed concrete with a four-inch (4") maximum slump.
- I. **Additives containing fly-ash or chloride ions shall not be permitted.**

PART 3 - EXECUTION

3.1 INSPECTION

- A. Verify the earthwork is completed to correct line and grade. Notify the Owner/Architect of any incomplete work by previous contractors.

- B. Check that sub-grade is smooth, compacted and free of frost or excessive moisture.
- C. Do not commence work until conditions are satisfactory.

3.2 WEATHER PROTECTION

- A. Cold weather: When the mean daily air temperature is 40°F. or below, provide suitable protection for concrete work to maintain a minimum concrete temperature of 50°F. for five (5) days (or 70°F. for three (3) days). After the protection period do not let concrete cool more than 20°F. in each successive day.
- B. Hot weather: Employ suitable means to prevent too rapid drying. Shade fresh concrete as soon as possible without marring surface.
- C. Wet weather: Unless adequate protection is provided, do not place concrete in rain sleet, or snow.

3.3 INSTALLATION

- A. Contractor shall install the first section of sidewalk/slab/foundation as a quality sample in place. Upon approval of sample by Architect, further installation can proceed.
- B. The sub-grade upon which concrete is to be placed shall be prepared by excavation or filling with suitable earth to such depth below the finished grade line, that when tamped or rolled until smooth, firm and hard, the sub-grade will be uniform and at the required depth below finished grade line.
- C. Unsuitable sub-grade soils shall be replaced as directed.
- D. Gravel backfill, when specified in the drawings, shall be constructed to the required depth and thoroughly compacted.
- E. Cast in Place Concrete:
 - 1. Set forms to line grade
 - 2. Install forms over full length of walk and oil before use.
 - 3. Forms shall be set accurately to line and grade. If the forms are set more than 0.01 foot (3mm) above or below grade or more than 0.01 foot (6mm) from prescribed alignment, they shall be corrected before any concrete is placed.
 - 4. Flexible or curved forms of proper radii shall be used on all curves having a radius of 100 feet or less.
 - 5. Place concrete with mechanical vibrators.
 - 6. Consolidate concrete with mechanical vibrators.
 - 7. Finished exposed walk surface with wood float followed by brushing with medium broom, smooth band of 12", unless otherwise shown on drawings.
 - 8. Apply plastic sheeting and cure for (7) days.
 - 9. Replace sections that pocket water.
 - 10. Do not allow free drop of more than five (5) feet. Use elephant trunk when necessary.

3.4 FIELD QUALITY CONTROL

- A. Slump Tests: Make slump tests whenever concrete is being poured at the direction of the Owner.
- B. Compression Tests: Prepare standard test cylinders during the placing of concrete in accordance with ASTM 31 and ASTM 172. One set (three (3) cylinders) is required for each day's pour.
- C. Maintain two (2) cylinders at 50 to 70°F. and protect from loss of moisture at the job site for a period of not over 48 hours, then deliver to the laboratory for curing and testing at seven (7) and twenty-eight (28) days, respectively. Place third cylinder near the in place concrete and cure completely at the job in the same manner as the in place concrete. Deliver this cylinder to the laboratory for testing at twenty-eight (28) days. Cure and test cylinders in accordance with ASTM C31, C39 and C192. Submit test reports to the Architect in duplicate.

3.5 PROTECTION OF FINISHED SURFACE

- A. All finished surfaces of concrete shall be protected so as to prevent damage. Making temporary nailing or other damaging use of surface will be prohibited.

3.6 PATCHING

- A. Patch to match material, color and texture of surrounding area.
- B. Replace defective work if patching is not acceptable to the Architect.

3.7 CLEAN UP

- A. The contractor shall remove excess excavated material from the site of the work. Spread and finish grade topsoil within five (5) feet of pad edge. Topsoil is incidental to concrete installation. Contractor shall clean up and dispose of rubble and construction debris satisfactory of the Owner and the Architect.

END OF SECTION

SECTION 04 2000 - UNIT MASONRY**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Concrete block.
- B. Reinforcement and anchorage.
- C. Flashings.
- D. Cavity wall insulation.
- E. Lintels.
- F. Accessories.
- G. Products installed under this section:
 - 1. Precast architectural concrete units set in masonry; furnished by Section 03 4500 - Precast Architectural Concrete.
 - 2. Cast stone units set in masonry; furnished by Section 04 7200 - Cast Stone Masonry.
 - 3. Loose steel lintels in unit masonry; furnished by Section 05 5000 - Metal Fabrications.
 - 4. Manufactured reglets embedded in unit masonry; furnished by Section 07 6200 - Sheet Metal Flashing and Trim.
- H. Products furnished under this section:
 - 1. Dovetail anchor slots for connecting masonry to cast-in-place concrete; installed by Section 03 3000 - Cast-in-Place Concrete.
 - 2. Structural steel anchor sections for connecting masonry to structural steel; installed by Section 05 1200 - Structural Steel Framing.

1.02 REFERENCE STANDARDS

- A. ACI 315 - Guide to Presenting Reinforcing Steel Design Details; 2018.
- B. ASTM D1056 - Standard Specification for Flexible Cellular Materials—Sponge or Expanded Rubber 2020.
- C. ASTM D2000 - Standard Classification System for Rubber Products in Automotive Applications 2018.
- D. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components 2023.
- E. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2023.
- F. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications 2023.
- G. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement 2022.
- H. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire 2019.
- I. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete 2022.
- J. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units 2022.
- K. ASTM C91/C91M - Standard Specification for Masonry Cement 2023.
- L. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar 2018.
- M. ASTM C270 - Standard Specification for Mortar for Unit Masonry 2019a, with Editorial Revision.
- N. ASTM C404 - Standard Specification for Aggregates for Masonry Grout 2018.
- O. ASTM C476 - Standard Specification for Grout for Masonry 2023.
- P. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete 2016.

- Q. ASTM C1072 - Standard Test Methods for Measurement of Masonry Flexural Bond Strength 2022.
- R. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms 2023a.
- S. ASTM C 1329 - Standard Specification for Mortar Cement - 2016.
- T. ASTM C1714/C1714M - Standard Specification for Preblended Dry Mortar Mix for Unit Masonry 2019a.
- U. ASTM D226/D226M - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing 2017 (Reapproved 2023).
- V. ASTM E514/E514M - Standard Test Method for Water Penetration and Leakage Through Masonry 2020.
- W. BIA Technical Notes No. 7 - Water Penetration Resistance – Design and Detailing 2017.
- X. BIA Technical Notes No. 13 - Ceramic Glazed Brick Exterior Walls 2017.
- Y. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures 2022, with Errata.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Product Coordination and Limitations: Provide products that when combined with materials and components of other sections, form exterior wall assemblies as detailed on Drawings, that comply with NFPA 285 testing and acceptance criteria.

1.04 SUBMITTALS

- A. Product Data: Provide data for the following:
 - 1. Masonry Units:
 - a. Include data on material properties.
 - b. Masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
 - 2. Cementitious materials. Include name of manufacturer, brand name and type.
 - 3. Mortar admixtures.
 - 4. Preblended, dry mortar mixes. Include description of type and proportion of ingredients.
 - 5. Grout mixes. Include description of type and proportion of ingredients.
 - 6. Sound Isolating anchors.
 - 7. Anchors, ties, weep/cavity vent, preformed control-joint gaskets, cavity drainage material, and metal accessories.
- B. Shop Drawings: Indicate pertinent dimensions, materials, anchorage, size and type of fasteners, and accessories for masonry.
 - 1. Masonry Units: Indicate sizes, profiles, coursing, and locations of special units.
 - 2. Reinforcing: Indicate bending, lap lengths, and placement of unit masonry reinforcing bars.
 - a. Comply with ACI 315.
 - 3. Flashings: Provide details of embedded flashings including end dams, corners, drips, weeps.
- C. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
 - 1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C91/C 91M for air content.
 - 2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirements.
- D. Samples: Submit 3 samples of standard block and decorative block units to illustrate color, texture, and extremes of color range.

- E. Manufacturer's Certificate: Certify that water repellent admixture manufacturer has certified masonry unit manufacturer as an approved user of water repellent admixture in the manufacture of concrete block.
- F. Test Reports:
 - 1. Concrete masonry manufacturer's test reports for units with integral water repellent admixture.
 - 2. Masonry Veneer Anchors: At wall cavities greater than 4-1/2 inches, provide masonry veneer anchor manufacturer's test reports indicating compliance with TMS 402/602 for lateral load requirements; wall cavity depth includes airspace and cavity wall insulation thickness.
- G. NFPA 285 Documentation: For each product, submit documentation listing compatible materials and components that when used together in wall assemblies as detailed on Drawings, comply with NFPA 285 testing and acceptance criteria.
- H. Manufacturer's Qualification Statement.
- I. Installer's Qualification Statement.
- J. Cold-Weather and Hot-Weather Procedures: Detail description of methods, material, and equipment to be used to comply with requirements.

1.05 QUALITY ASSURANCE

- A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.
- B. Fire Rated Assemblies: Comply with applicable codes and UL Assembly Numbers indicated.
- C. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section with minimum 5 years of documented experience.
- D. Installer Qualifications: Company specializing in performing work of the type specified and with at least 5 years of documented experience.

1.06 MOCK-UPS

- A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for material and execution.
- B. Construct a masonry wall as a mock-up panel sized 8 feet long by 6 feet high; include mortar, accessories, structural backup, wall openings, flashings (with lap joint, corner, and end dam), through-wall flashing (omit masonry above half of flashings, wall insulation, and sealant-filled joint at least 16 inches long in exterior wall in mock-up).
- C. Include upper corner of door opening at corner of exterior wall mockup. Make opening approximately 12 inches wide by 16 inches high.
- D. Locate where directed.
- E. Clean one-half of exposed faces of mockups with masonry cleaner as indicated.
- F. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
 - 1. Approval of mockups is also for other materials and construction qualities specifically approved by Architect in writing.
 - 2. Approval of mockups does not constitute approval of deviations from Contract Documents contained in the mock-ups unless Architect specifically approves such deviations in writing.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

- B. Store masonry units on elevated platforms in a dry location. If units are not stored in a enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.08 FIELD CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, protections, and sills with waterproof sheeting at end of each days's work. Cover partially completed masonry when construction is not in progress.
 - 1. Extend cover a minimum of 24 inches (600 mm) down both sides of walls, and hold cover securely in place.
 - 2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches (600 mm) down face next to unconstructed wythe, and hold cover in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
 - 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
 - 2. Protect sills, ledges, and projections from mortar droppings.
 - 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 - 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in **TMS 602/ACI 530.1/ASCE 6**.
 - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.
- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in **TMS 602/ACI 530.1/ASCE 6**.

PART 2 PRODUCTS

2.01 UNIT MASONRY, GENERAL

- A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6, except as modified by requirements in the Contract Documents.
- B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work and will be within 20 feet (6 m) vertically and horizontally of a walking surface.

C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.

1. Where fire-resistance-rated construction is indicated, units shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

2.02 CONCRETE MASONRY UNITS (CMU)

A. Concrete Block: Comply with referenced standards and as follows:

1. Size: Standard units with nominal face dimensions of 16 by 8 inches and nominal depths as indicated on drawings for specific locations.
2. Special Shapes: Provide non-standard blocks configured for corners, lintels, headers, control joint edges, and other detailed conditions.
3. Exposed Outside Block Corners: Provide bullnose, radiused, corners unless otherwise indicated on Drawings.
 - a. Field-ground radiused corners are not permitted.
 - b. Stop bullnose at bulkhead/soffits.
 - c. Provide square corners at door frame even with block and bullnose where door frame is set back from corner.
4. Load-Bearing and Non-Loadbearing Units: ASTM C90, normal weight.
 - a. Standard Units:
 - 1) Exposed Faces: Manufacturer's standard color and texture as approved by Architect per ASTM C90.
 - 2) Manufacturers:
 - (a) Consumers Concrete Corp.: www.consumersconcrete.com.
 - (b) Fendt Builder's Supply, Inc.: www.fendtproducts.com.
 - (c) Grand Blanc Cement Products: www.grandblancementproducts.com.
 - (d) Michigan Certified Products, Inc.: www.micertconcrete.com.
 - (e) National Block Company: www.nationalblock.com.
 - (f) Substitutions: See Section 01 6000 - Product Requirements.
 - b. Decorative Units:
 - 1) Split-face:
 - (a) Color: Architect to Select from Standard Color Range.
 - (b) Factory-Applied Sealer: Not Allowed.
 - (c) Manufacturers:
 - (1) Fendt Builder's Supply, Inc.: www.fendtproducts.com.
 - (2) Grand Blanc Cement Products: www.grandblancementproducts.com.
 - (3) Substitutions: Not permitted.
5. Units with Integral Water Repellent: Concrete block units as specified in this section with polymeric liquid admixture added to concrete masonry units at the time of manufacture.
 - a. Locations: Provide at exposed exterior concrete block and elsewhere as indicated.
 - b. Performance of Units with Integral Water Repellent:
 - 1) Water Permeance: When tested per ASTM E514/E514M and for a minimum of 72 hours.
 - (a) No water visible on back of wall above flashing at the end of 24 hours.
 - (b) No flow of water from flashing equal to or greater than 0.032 gallons per hour at the end of 24 hours.
 - (c) No more than 25 percent of wall area above flashing visibly damp at end of test.
 - 2) Flexural Bond Strength: ASTM C1072; minimum 10 percent increase.
 - 3) Compressive Strength: ASTM C1314; maximum 5 percent decrease.
 - c. Limitations:
 - 1) Use only in combination with mortar containing integral water repellent admixture.
 - 2) Source Limitations: Use water repellent admixtures for masonry units and mortar from a single manufacturer.

- d. Products:
 - 1) BASF Corp.; MasterPel 240: www.master-builders-solutions.basf.us.
 - 2) 04 2 (The); an RPM company; Eucon Blocktite Admixture: www.euclidchemical.com.
 - 3) GCP Applied Technologies Inc.; Dry-Block Block Admixture: www.gcpat.com.
 - 4) Substitutions: See Section 01 6000 - Product Requirements.

2.03 MORTAR AND GROUT MATERIALS

- A. Masonry Cement: ASTM C91/C91M.
- B. Mortar Cement: ASTM C1329.
- C. Mortar Aggregate: ASTM C144.
- D. Grout Aggregate: ASTM C404.
- E. Pigments for Colored Mortar: Pure, concentrated mineral pigments specifically intended for mixing into mortar and complying with ASTM C979/C979M.
 - 1. Color(s): As selected by Architect from manufacturer's full range.
 - 2. Manufacturers:
 - a. Davis Colors: www.daviscolors.com.
 - b. Lambert Corporation: www.lambertusa.com.
 - c. Solomon Colors: www.solomoncolors.com/sle.
 - d. Substitutions: See Section 01 6000 - Product Requirements.
- F. Water: Clean and potable.
- G. Integral Water Repellent Admixture for Mortar: Polymeric liquid admixture added to mortar at the time of manufacture.
 - 1. Locations: Provide at exposed exterior concrete block and elsewhere as indicated.
 - 2. Limitations:
 - a. Use only in combination with masonry units manufactured with integral water repellent admixture.
 - b. Source Limitations: Use water repellent admixtures for masonry units and mortar from a single manufacturer.
 - 3. Meet or exceed performance specified for water repellent admixture used in masonry units.
 - 4. Products:
 - a. BASF Corp.; MasterPel 210MA: www.master-builders-solutions.basf.us.
 - b. Euclid Chemical Company (The); an RPM company; Blocktite Mortar Admixture: www.euclidchemical.com.
 - c. GCP Applied Technologies Inc.; Dry-Block Mortar Admixture: www.gcpat.com.
 - d. Substitutions: See Section 01 6000 - Product Requirements.
- H. Packaged Dry Material for Mortar for Unit Masonry:
 - 1. At Contractor's option, prepackaged dry material for mortar may be used subject to compliance with mortar requirements of this section including, but not limited to, the following:
 - a. Mortar Types: As indicated.
 - b. Color(s): As selected by Architect from manufacturer's full range.
 - c. Use only water repellent admixture for mortar from the same manufacturer as water repellent admixture in masonry units.
 - 2. Portland Cement Based: Premixed Portland cement, hydrated lime, and sand; complying with ASTM C1714/C1714M and capable of producing mortar of the specified strength in accordance with ASTM C270 with the addition of water only.
 - a. Manufacturers:
 - 1) Amerimix, an Oldcastle brand; www.amerimix.com.
 - 2) The QUIKRETE Companies; www.quikcrete.com.
 - 3) SPEC MIX, Inc.: www.specmix.com.
 - 4) Substitutions: See Section 01 6000 - Product Requirements.

3. Masonry Cement Based: Premixed masonry cement and mason's sand; complying with ASTM C1714/C1714M and capable of producing mortar of the specified strength in accordance with ASTM C270 with the addition of water only.
 - a. Manufacturers:
 - 1) Amerimix, an Oldcastle brand; www.amerimix.com.
 - 2) The QUIKRETE Companies; www.quikcrete.com.
 - 3) SPEC MIX, Inc.; www.specmix.com.
 - 4) Substitutions: See Section 01 6000 - Product Requirements.
- I. Packaged Dry Material for Grout for Masonry: Premixed cementitious materials and dried aggregates; capable of producing grout of the specified strength in accordance with ASTM C476 with the addition of water only.
 1. At Contractor's option, prepackaged dry material for grout may be used subject to compliance with grout requirements of this section.
 2. Manufacturers:
 - a. Amerimix, an Oldcastle brand; www.amerimix.com.
 - b. The QUIKRETE Companies; www.quikcrete.com.
 - c. SPEC MIX, Inc.; www.specmix.com.
 - d. Substitutions: See Section 01 6000 - Product Requirements.

2.04 REINFORCEMENT AND ANCHORAGE

- A. Manufacturers:
 1. Basis-of-Design Product: The design for each item specified is based on the product named. Provide either the named product or a comparable product by one of the following:
 - a. Fero Corp.; www.ferocorp.com.
 - b. Heckmann Building Products; www.heckmannbuildingprods.com.
 - c. Hohmann & Barnard, Inc.; www.h-b.com.
 - d. Wire-Bond; www.wirebond.com.
 - e. Substitutions: See Section 01 6000 - Product Requirements.
- B. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi), deformed billet bars; uncoated.
- C. Reinforcing Bar Positioners: 0.156 inch, ASTM A1064/A1064M steel wire, hot dip galvanized after fabrication to 16 CFR 1201 Class B.
 1. Basis-of-Design Product: Hohmann & Barnard, Inc.; www.h-b.com: RB and RB-Twin Rebar Positioners.
- D. Reinforcing Bar Lap Joint Ties: ASTM A1064/A1064M steel wire, mill galvanized to 16 CFR 1201 Class 3.
 1. Basis-of-Design Product: Hohmann & Barnard, Inc.; www.h-b.com: Spyra-Lox Rebar Lap-Joint Tie.
- E. Single Wythe Joint Reinforcement: Truss or ladder type; ASTM A1064/A1064M steel wire, hot dip galvanized after fabrication to 16 CFR 1201 Class B; 0.1483 inch side rods with 0.1483 inch cross rods; width as required to provide not more than 1 inch and not less than 1/2 inch of mortar coverage on each exposure.
 1. Basis-of-Design Product: Hohmann & Barnard, Inc.; www.h-b.com: 120 Truss-Mesh or 220 Ladder-Mesh.
- F. Adjustable Multiple Wythe Joint Reinforcement: Truss or ladder type with adjustable ties or tabs spaced at 16 in on center ASTM A1064/A1064M steel wire, hot dip galvanized after fabrication to ASTM A153/153M, Class B; 0.1483 inch side rods with 0.1483 inch cross rods and adjustable components of 0.1875 inch wire; width of components as required to provide not more than 1 inch and not less than 1/2 inch of mortar coverage from each masonry face.
 1. Basis-of-Design Product: Hohmann & Barnard, Inc.; www.h-b.com: 170 Truss LOX-ALL Adjustable Eye Wire or 270 Ladder LOX-ALL Adjustable Eye Wire with 2X-HOOK.

- G. Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by 1/4 inch thick by 24 inches long, with ends turned up 2 inches; hot dip galvanized to ASTM A153/A153M Class B.
 - 1. Basis-of-Design Product: Hohmann & Barnard, Inc.; www.h-b.com: 344 Rigid Partition Anchor.
- H. Adjustable Masonry Veneer Anchors: 2-piece anchors that permit differential movement between masonry veneer and structural backup, hot dip galvanized to ASTM A 153/A 153M, Class B.
 - 1. For cold-formed metal framing and sheathing back-up.
 - 2. Anchor plates: Not less than 0.075 inch thick, designed for fastening to structural backup through sheathing by two fasteners.
 - 3. Wire ties: Rectangular shape, 0.1875 inch thick.
 - 4. Vertical adjustment: Not less than 2 inches.
 - 5. Basis-of-Design Product: Hohmann & Barnard, Inc.; www.h-b.com: HB-213 anchors with 2X-HOOK.

2.05 FLASHINGS

- A. Flexible Fabric Flashing - Self-Adhering: Self-adhering stainless steel/polymer fabric flashing. ASTM A240/A240M; 2 mil type 304 stainless steel sheet bonded on one side to one sheet of polymer fabric. Flashing shall be self-adhering using a pressure-sensitive adhesive.
 - 1. Type 304 stainless steel.
 - a. Thickness: 2 mils, minimum.
 - 2. Basis-of-Design Product: Provide York Manufacturing, Inc.; York 304: www.yorkmfg.com, or one of the following products:
 - a. Hohmann & Barnard, Inc.; Mighty-Flash SA: www.h-b.com.
 - b. Wire-Bond; Bond-N-Flash SA: www.wirebond.com.
 - c. Substitutions: See Section 01 6000 - Product Requirements.
- B. Factory-Fabricated Inside and Outside Flashing Corners and End Dams: Stainless steel.
 - 1. Manufacturer shall be the same as flexible fabric flashing manufacturer.
- C. Factory-Fabricated Drip Plates including Inside and Outside Corners: Stainless steel.
 - 1. Pre-formed smooth drip plates with hemmed edges.
 - 2. Manufacturer shall be the same as stainless steel/polymer fabric flashing manufacturer.
- D. Flashing Sealant/Adhesives: Silicone, polyurethane, or silyl-terminated polyether/polyurethane or other type required or recommended by flashing manufacturer; type capable of adhering to type of flashing used.
 - 1. Manufacturer shall be the same as flexible fabric flashing manufacturer.

2.06 CAVITY WALL INSULATION

- A. Refer to Section 07 2119 Foamed-In-Place Insulation.

2.07 ACCESSORIES

- A. Preformed Control Joints: Rubber material. Provide with corner and tee accessories, fused joints. ASTM D2000, 2AA-805.
 - 1. Manufacturers:
 - a. Hohmann & Barnard, Inc: www.h-b.com/sle.
 - b. WIRE-BOND: www.wirebond.com/#sle.
 - c. Substitutions: See Section 01 6000 - Product Requirements.
- B. Compressible Joint Filler: Closed cell neoprene; oversized 50 percent to joint width; self expanding; in maximum lengths available. ASTM D1056, Grade 2A1.
 - 1. Manufacturers:
 - a. Hohmann & Barnard, Inc: www.h-b.com/sle.
 - b. WIRE-BOND: www.wirebond.com/#sle.
 - c. Substitutions: See Section 01 6000 - Product Requirements.

- C. Cavity Mortar Control/Drainage Material: Semi-rigid polyethylene or polyester mesh panels, sized to thickness of wall cavity, and designed to prevent mortar droppings from clogging weeps and cavity vents and allow proper cavity drainage.
1. Mortar Diverter: Semi-rigid mesh designed for installation at flashing locations.
 - a. Full depth of cavity and 10 inches high, with dovetail-shaped notches 7 inches deep that prevent clogging with mortar droppings.
 - b. Basis-of-Design Product: Provide Hohmann & Barnard, Inc.; www.h-b.com; Mortar Trap or a comparable product by one of the following:
 - 1) Advanced Building Products Inc.; www.advancedbuildingproducts.com.
 - 2) Heckmann Building Products; www.heckmannbuildingprods.com.
 - 3) Mortar Net Solutions; www.mortarnet.com.
 - 4) Wire-Bond; www.wirebond.com.
 - 5) Substitutions: See Section 01 6000 - Product Requirements.
- D. Building Paper: ASTM D226/D226M, Type I ("No.15") asphalt felt.
- E. Termination Bars: Stainless steel, 1/8 inch thick by 1-1/2 inch high with 3/8 inch sealant flange at top; compatible with flashing membrane and adhesives.
1. Manufacturers:
 - a. Advanced Building Products Inc.; www.advancedbuildingproducts.com
 - b. Heckmann Building Products; www.heckmannbuildingprods.com.
 - c. Hohmann & Barnard, Inc.; www.h-b.com.
 - d. Wire-Bond; www.wirebond.com.
 - e. York Manufacturing, Inc.; www.yorkmfg.com
 - f. Substitutions: See Section 01 6000 - Product Requirements.
- F. Weep Inserts and Cavity Vents:
1. Type: Plastic cellular/honeycomb design.
 2. Color(s): As selected by Architect from manufacturer's full range.
 3. Basis-of-Design Product: Provide Hohmann & Barnard, Inc.; www.h-b.com; QV Quadro-Vent or a comparable product by one of the following:
 - a. Advanced Building Products Inc.; www.advancedbuildingproducts.com.
 - b. Heckmann Building Products; www.heckmannbuildingprods.com.
 - c. Mortar Net Solutions; www.mortarnet.com.
 - d. Wire-Bond; www.wirebond.com.
 - e. Substitutions: See Section 01 6000 - Product Requirements.
- G. Mortar and Grout Screen: 1/4 inch square, polypropylene monofilament screening for preventing grout flow; width sized to match masonry widths.
1. Basis-of-Design Product: Provide Hohmann & Barnard, Inc.; www.h-b.com; MGS or a comparable product by one of the following:
 - a. Heckmann Building Products; www.heckmannbuildingprods.com.
 - b. Wire-Bond; www.wirebond.com.
 - c. Substitutions: See Section 01 6000 - Product Requirements.
- H. Masonry Cleaners:
1. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
 - a. Basis-of-Design Products: Provide PROSOCO, Inc.; www.prosoco.com: Sure Klean 600 or Sure Klean Vana Trol or a comparable product by one of the following:
 - 1) Diedrich Technologies, Inc.; www.diedrichtechnologies.com.
 - 2) Substitutions: See Section 01 6000 - Product Requirements.

2.08 LINTELS

- A. Masonry Lintels: Masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and weight classification; reinforcing bars as indicated, and filled with grout.
- B. Loose Steel Lintels: Refer to Section 05 5000 - Metal Fabrications.

2.09 MORTAR AND GROUT MIXING

- A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.
 - 1. Masonry below grade and in contact with earth: Type M.
 - 2. Exterior, loadbearing masonry: Type S.
 - 3. Exterior, non-loadbearing masonry: Type N.
 - 4. Interior, loadbearing masonry: Type N.
 - 5. Interior, non-loadbearing masonry: Type N.
 - 6. Precast concrete units: Same Type as wall masonry in which unit is set.
 - 7. Limestone units: Same Type as wall masonry in which unit is set.
 - 8. Pointing Mortar: Type N.
- B. Colored Mortar: Proportion selected pigments and other ingredients to match Architect's sample, without exceeding manufacturer's recommended pigment-to-cement ratio.
- C. Grout: ASTM C476; consistency required to fill completely volumes indicated for grouting; fine grout for spaces with smallest horizontal dimension of 2 inches or less; coarse grout for spaces with smallest horizontal dimension greater than 2 inches.
 - 1. Grout Strength: 3000 psi at 28 days, unless otherwise indicated.
- D. Admixtures: Add to mixture at manufacturer's recommended rate and in accordance with manufacturer's instructions; mix uniformly.
- E. Mixing: Use mechanical batch mixer and comply with referenced standards.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify that field conditions are acceptable and are ready to receive masonry.
- B. Verify that foundations are within tolerances specified.
- C. Verify that related items provided under other sections are properly sized and located.
- D. Verify that built-in items are in proper location, and ready for roughing into masonry work.
- E. Verify that reinforcing dowels are properly placed.

3.02 PREPARATION

- A. Direct and coordinate placement of metal anchors supplied for installation under other sections.

3.03 INSTALLATION, GENERAL

- A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.
- B. Build chases and recesses to accommodate items specified in this and other Sections.
- C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.
- D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.
- F. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.

3.04 COURSING

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Concrete Masonry Units: Unless otherwise indicated:
 - 1. Bond: Running.
 - 2. Coursing: One unit and one mortar joint to equal 8 inches.
 - 3. Mortar Joints: Concave.
 - 4. Mortar Joint Thickness: 3/8 inch.

3.05 PLACING AND BONDING

- A. Lay hollow masonry units with face shell bedding on head and bed joints.
- B. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
- C. Remove excess mortar and mortar smears as work progresses.
- D. Remove excess mortar with water repellent admixture promptly. Do not use acids, sandblasting or high pressure cleaning methods.
- E. Interlock intersections and external corners.
- F. Tooth-in cutting and patching masonry work unless otherwise indicated on Drawings.
- G. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- H. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
- I. Cut mortar joints flush where wall tile is scheduled or resilient base is scheduled.
- J. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.
- K. Isolate cast stone units and precast architectural concrete units from clay masonry with building paper or similar method of providing a continuous bond break/slip plane.

3.06 WEEPS INSERTS/CAVITY VENTS

- A. Install weep inserts in veneer and cavity walls at 24 inches on center horizontally above through-wall flashing, above shelf angles and lintels, and at bottom of walls.
- B. Install cavity vents in veneer and cavity walls at 24 inches on center horizontally below shelf angles and lintels and near top of walls.

3.07 CAVITY MORTAR CONTROL

- A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.
- B. Provide not less than 2 inches of airspace between back of masonry veneer and face of insulation.
 - 1. Keep airspace clean of mortar droppings and other materials during construction. Bevel beds away from airspace, to minimize mortar protrusions into airspace. Do not attempt to trowel or remove mortar fins protruding into airspace.
- C. For cavity walls, build inner wythe ahead of outer wythe to accommodate accessories.
- D. Install cavity mortar diverter at base of cavity and at other flashing locations as recommended by manufacturer to prevent mortar droppings from blocking weep/cavity vents.

3.08 HORIZONTAL JOINT REINFORCEMENT AND ANCHORAGE - SINGLE WYTHE MASONRY AND CAVITY WALL MASONRY

- A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches on center.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
- C. Place continuous joint reinforcement in first and second joint below top of walls.

- D. Lap joint reinforcement ends minimum 6 inches.
- E. Embed ties and anchors in mortar joint and extend into masonry unit a minimum of 1-1/2 inches with at least 5/8 inch mortar cover to the outside face of the anchor.

3.09 MASONRY VENEER REINFORCEMENT AND ANCHORAGE

- A. Masonry Back-Up: Embed anchors to bond veneer at maximum 16 inches on center vertically and 16 inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.
- B. Stud Back-Up: Secure veneer anchors to stud framed back-up and embed into masonry veneer at maximum 16 inches on center vertically and 16 inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.
- C. Embed ties and anchors in mortar joint and extend into masonry veneer unit a minimum of 1-1/2 inches with at least 5/8 inch mortar cover to the outside face of the anchor.

3.10 MASONRY FLASHINGS

- A. General:
 - 1. Install masonry flashings according to manufacturer's instructions and as indicated on the Drawings.
 - 2. Remove or cover protrusions or sharp edges that could puncture flashings.
 - 3. Lap end joints of flashings at least 6 inches, minimum, and seal watertight with flashing sealant/adhesive.
 - 4. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
 - a. Extend flashings full width at such interruptions and at least 6 inches, minimum, into adjacent masonry or turn up at least 8 inches, minimum, to form watertight pan at non-masonry construction.
 - 5. Terminate flashing up 8 inches minimum on vertical surface of backing:
 - a. Install vertical leg of flashing over fluid-applied or self-adhered air/vapor barriers over backing or per manufacturer's direction, unless otherwise indicated.
 - b. Anchor vertical leg of flashing into backing with a termination bar and sealant.
 - 6. Install flashing in accordance with manufacturer's instructions and BIA Technical Notes No. 7, unless more stringent requirements are specified in this section.
- B. Flexible Fabric Flashing:
 - 1. Use factory-fabricated drip plates, corners and end dams.
 - 2. Joints/Splices: Overlap adjacent fabric flashing at least 2 inches, minimum.
 - 3. Extend flexible fabric flashing to within 1/4 inch of exterior face of masonry overlapping metal drip plate.
 - 4. Extend flexible fabric flashing full width of cavity space and turn up inner masonry wythe or sheathing at least 14 inches.
 - 5. Secure flexible fabric flashing to wall with continuous termination bar and apply sealant across top of termination bar.

3.11 LINTELS

- A. Install loose steel lintels over openings.
- B. Install reinforced unit masonry lintels over openings where steel lintels are not scheduled.
 - 1. Unless otherwise indicated, reinforce as follows:
 - a. Openings to 48 inches: Place two, No. 4 reinforcing bars 1 inch from bottom web.
 - b. Openings from 48 inches to 80 inches: Place two, No. 5 reinforcing bars 1 inch from bottom web.
 - c. Openings over 80 inches: Reinforce openings as detailed.
 - 2. Do not splice reinforcing bars.
 - 3. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.

4. Place and consolidate grout fill without displacing reinforcing.
 5. Allow masonry lintels to attain specified strength before removing temporary supports.
- C. Where the Drawings do not indicate otherwise, provide reinforced unit masonry lintels at all openings and penetrations wider than 12 inches in brick and 24 inches in CMU.
- D. Maintain minimum 8 inch bearing on each side of opening unless otherwise indicated.

3.12 BOND BEAMS

- A. Bond Beams: At bond beams or other locations for horizontally reinforced masonry, provide special masonry units or saw to accommodate reinforcement.
- B. Reinforce bond beams with 2, No. 5 bars, 1 inch from bottom web unless otherwise indicated.
- C. Lap reinforcing bar splices minimum 24 bar diameters, unless otherwise indicated.
- D. Place and consolidate grout fill without displacing reinforcing.

3.13 VERTICAL MASONRY REINFORCEMENT

- A. Reinforcement: Size and place vertical masonry reinforcement to comply with TMS 402/602 requirements and as indicated on Drawings.
- B. Place and consolidate grout fill without displacing reinforcing.

3.14 GROUTING

- A. Reinforced Hollow Unit Masonry: Keep vertical cores to be grouted clear of mortar, including bed area of first course.
- B. Perform grouting by means of high-lift technique, except in locations that mandate use of low-lift grouting technique.
1. Do not use high-lift grouting where size of cavities mandates use of fine grout.
- C. Low-Lift Grouting:
1. Limit height of pours to 12 inches.
 2. Limit height of masonry to 16 inches above each pour.
 3. Pour grout only after vertical reinforcing is in place; place horizontal reinforcing as grout is poured. Prevent displacement of bars as grout is poured.
 4. Place grout for each pour continuously and consolidate immediately; do not interrupt pours for more than 1-1/2 hours.
- D. High-Lift Grouting:
1. Verify that horizontal and vertical reinforcement is in proper position and adequately secured before beginning pours.
 2. Clean out masonry cells and other cavities to be grouted by high pressure water spray or compressed air. Remove debris, allow to dry, and inspect before sealing cleanout openings.
 3. Hollow Masonry: Limit lifts to maximum 4 feet and pours to maximum height of 24 feet.
 4. Place grout for spanning elements in single, continuous pour.

3.15 GROUTED COMPONENTS

- A. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
- B. Place and consolidate grout fill without displacing reinforcing.
- C. At bearing locations, fill masonry cores with grout for a minimum 12 inches either side of opening.

3.16 CONTROL AND EXPANSION JOINTS

- A. Do not continue horizontal joint reinforcement through control or expansion joints.
- B. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.
1. Refer to Section 07 9200 - Joint Sealants for sealant installation.

3.17 BUILT-IN WORK

- A. As work progresses, install built-in metal door frames, anchor bolts, plates, and reglets and other items to be built into the work and furnished under other sections.
- B. Install built-in items plumb, level, and true to line.
- C. Bed anchors of metal door frames in adjacent mortar joints. Fill frame voids solid with grout.
 - 1. Fill adjacent masonry cores with grout minimum 12 inches from framed openings.

3.18 TOLERANCES

- A. Dimensions and Locations of Elements:
 - 1. Location of elements in plan; do not vary from that indicated on Drawings by more than:
 - a. Plus or minus 1/2 inch.
 - 2. Dimensions in cross section; do not vary from that indicated on Drawings by more than:
 - a. Minus 1/4 inch.
 - b. Plus 1/2 inch.
- B. Maximum Variation from Alignment of Columns and Pilasters: 1/4 inch.
- C. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.
- D. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.
- E. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.
- F. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.
- G. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.
- H. Lines and Levels:
 - 1. Maximum variation from level:
 - a. Includes, but is not limited to, the following:
 - 1) Lintels.
 - 2) Sills.
 - 3) Parapets.
 - 4) Reveals.
 - 5) Other conspicuous lines.
 - b. Do not vary from level by more than:
 - 1) 1/4 inch in 20 feet.
 - 2) 1/2 in in 40 feet or more.
 - 2. Maximum variation from plumb:
 - a. Includes, but is not limited to, the following:
 - 1) External corners.
 - 2) Control and expansion joints.
 - 3) Reveals.
 - 4) Other conspicuous lines.
 - b. Do not vary from plumb by more than:
 - 1) 1/4 inch in 20 feet.
 - 2) 1/2 in in 40 feet or more.
- I. Mortar Joint Thickness: Do not vary thickness indicated by more than plus or minus 1/8 inch.

3.19 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000 - Quality Requirements.

3.20 CLEANING

- A. Protect surrounding elements and finishes from damage due to cleaning procedures.
- B. Appearance Standard: Cleaned surfaces are to have a uniform appearance as viewed from 10 feet away, subject to Architect's approval.
- C. Remove excess mortar and mortar droppings.
- D. Clean soiled surfaces with cleaning solution.

- E. Apply masonry cleaners to masonry surfaces according to manufacturer's written instructions; use brush or spray application.
 - 1. Periodically during rinsing, test pH of rinse water running off of cleaned area to determine that chemical cleaner is completely removed.
 - a. Repeat rinsing until tested pH of water runoff is between 6.7 and 7.5.

END OF SECTION

SECTION 05 5000 - METAL FABRICATIONS**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Shop fabricated steel items, including:
 - 1. Loose steel lintels.
 - 2. Steel framing supports for the following:
 - a. Roof openings.
 - b. Ceiling-hung toilet compartments.
 - c. Mechanical and electrical equipment.
 - d. Applications where framing and supports are not specified in other Sections.
 - e. Other items as indicated on Drawings.
 - 3. Other items as indicated on Drawings.
- B. Downspout boots.
- C. Slotted channel framing.

1.02 REFERENCE STANDARDS

- A. ANSI A14.3 - American National Standard for Ladders -- Fixed -- Safety Requirements 2008 (Reaffirmed 2018).
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.
- C. ASTM A48/A48M - Standard Specification for Gray Iron Castings 2022.
- D. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless 2022.
- E. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.
- F. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2023.
- G. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates 2018.
- H. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength 2021.
- I. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2023.
- J. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink) 2020.
- K. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination 2020.
- L. AWS D1.1/D1.1M - Structural Welding Code - Steel 2020, with Errata (2023).
- M. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer 2004.
- N. SSPC-SP 2 - Hand Tool Cleaning 2018.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
 - 1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
 - 2. Design data: Submit drawings and supporting calculations, signed and sealed by a qualified professional structural engineer.
- C. Welders' Certificates: Submit certification for welders employed on the project, verifying AWS qualification within the previous 12 months.
- D. Designer's Qualification Statement.

E. Fabricator's Qualification Statement.

1.04 QUALITY ASSURANCE

- A. Design metal fabrications under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State in which the Project is located.
- B. Fabricator: Company specializing in performing the work of this section with minimum 5years of documented experience.

PART 2 PRODUCTS

2.01 MATERIALS - STEEL

- A. Steel Sections: ASTM A36/A36M.
- B. Steel Tubing: ASTM A500/A500M, Grade B, cold-formed or ASTM A501/A501M hot-formed structural tubing.
- C. Plates: ASTM A283/A283M.
- D. Pipe: ASTM A53/A53M, Grade B Schedule 40, black and hot-dip galvanized finish, as indicated.
- E. Slotted Channel Framing:
 - 1. Slotted Channel Framing: ASTM A653/A653M Grade 33.
 - a. Channel Size: 1-5/8 by 1-5/8 inches.
 - b. Thickness: 0.060 inch (16 gage), minimum.
 - c. Finish: Galvanized, G90 coating.
 - 2. Fittings and Fasteners: Manufacturer's standard fittings and fasteners; finished to match slotted channel framing.
- F. Bolts, Nuts, and Washers: ASTM A307, Grade A, galvanized to ASTM A153/A153M where connecting galvanized components.
- G. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- H. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
- I. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, complying with VOC limitations of authorities having jurisdiction.
- J. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.02 FABRICATION - GENERAL

- A. Fit and shop assemble items in largest practical sections, for delivery to site.
- B. Fabricate items with joints tightly fitted and secured.
- C. Continuously seal joined members by continuous welds.
- D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
- F. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.03 LOOSE STEEL LINTELS

- A. General:
 - 1. Fabricate loose steel lintels from steel angles, plates, and other shapes as indicated.
 - a. Weld adjoining members together to form a single unit.
 - 2. Size loose steel lintels to provide bearing length at each side of openings equal to 1/12 of clear span but not less than 8 inches, unless otherwise indicated.

3. Galvanize loose steel lintels located in exterior walls.
 4. Prime loose steel lintels located in interior walls.
 5. Provide lintels at openings for all equipment and ductwork.
- B. See Structural Drawings and/or Specifications for masonry and loose steel lintel schedules.

2.04 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
1. Fabricate units from slotted channel framing where indicated.
- C. Finish: Prime painted unless otherwise indicated or at an exterior location.
- D. Fabricate support for suspended toilet partitions as follows:
1. Beams: Continuous steel shapes of size required to limit deflection to L/360 between hangers, but use not less than C8x11.5 channels or another shape with equivalent structural properties.
 2. Hangers: Steel rods, 1/2 inch in diameter, spaced not more than 36 inches o.c.
 - a. Thread rods to receive anchor and stop nuts.
 - b. Fit hangers with wedge shape washers for full bearing on sloping flanges of support beam.
 3. Braces and Angles: Steel angles of size required to rigidly brace and support beams.
- E. Roof Openings: Unless otherwise indicated, provide steel support framing for roof openings as follows:
1. Provide steel support framing around entire perimeter of roof opening; span support framing between primary framing or purlins.
 2. Size steel framing not less than the following for spans indicated:
 - a. Up to 5 feet: C4x5.4 or L4x4x1/4.
 - b. 5 to 7 feet: C5x6.7 or L5x3-1/2x1/4 (LLV).
 - c. 7 to 10 feet: C6x8.2 or L6x3-1/2x5/16 (LLV).
 - d. Refer to Drawings for conditions other than those listed above.
 3. Limit deflection to L/240.

2.05 DOWNSPOUT BOOTS

- A. Downspout Boots: Smooth interior without boxed corners or choke points; include integral lug slots, integral cleanout, cleanout cover, and tamper proof fasteners.
1. Configuration: Angular.
 2. Material: Cast iron; ASTM A48/A48M; casting thickness 3/8 inch (9.5 mm), minimum.

2.06 MISCELLANEOUS

- A. Protective Coating: Zinc molybdate alkyd.
- B. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

2.07 FINISHES - STEEL

- A. Prepare surfaces to be primed in accordance with SSPC-SP2.
- B. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- C. Prime Painting: One coat.
1. Provide at all fabrications except at galvanized locations and where otherwise indicated.
- D. Where indicated, galvanizing of Structural Steel Members: Galvanize after fabrication to ASTM A123/A123M requirements. Provide minimum 1.7 oz/sq ft galvanized coating.
1. Locations: All exterior locations and elsewhere as indicated.
- E. Where indicated, galvanizing of Non-structural Items: Galvanize after fabrication to ASTM A123/A123M requirements. Provide minimum 1.7 oz/sq ft galvanized coating.
1. Locations: All exterior locations and elsewhere as indicated.

2.08 FABRICATION TOLERANCES

- A. Squareness: 1/8 inch maximum difference in diagonal measurements.
- B. Maximum Offset Between Faces: 1/16 inch.
- C. Maximum Misalignment of Adjacent Members: 1/16 inch.
- D. Maximum Bow: 1/8 inch in 48 inches.
- E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.03 INSTALLATION - GENERAL

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- C. Field weld components as indicated on shop drawings.
- D. Perform field welding in accordance with AWS D1.1/D1.1M.
- E. Obtain approval prior to site cutting or making adjustments not scheduled.
- F. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

3.04 MISCELLANEOUS FRAMING AND SUPPORTS

- A. Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

3.05 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.
- C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION

SECTION 06 1000 – ROUGH CARPENTRY

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Framing with dimension lumber.
 - 2. Framing with engineered wood products.
 - 3. Rooftop equipment bases and support curbs.
 - 4. Wood blocking[, cants,] and nailers.
 - 5. Wood furring[and grounds].
 - 6. Wood sleepers.

PART 2 PRODUCTS

2.01 WOOD PRODUCTS, GENERAL

- A. Maximum Moisture Content of Lumber: [19 percent] [15 percent for 2-inch nominal thickness or less; 19 percent for more than 2-inch nominal thickness] [19 percent for 2-inch nominal thickness or less; no limit for more than 2-inch nominal thickness] unless otherwise indicated.
- B. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.

2.02 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Application: Treat items indicated on Drawings, and the following:
 - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 - 2. Wood sills, sleepers, blocking, [furring,] [stripping,] and similar concealed members in contact with masonry or concrete.
 - 3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
 - 4. Wood floor plates that are installed over concrete slabs-on-grade.

2.03 DIMENSION LUMBER FRAMING

- A. Non-Load-Bearing Interior Partitions: Construction or No. 2 grade.
- B. Framing Other Than Non-Load-Bearing Partitions: No. 2 grade.
 - 1. Species:
 - 2. Hem-fir (north); NLGA.

2.04 ENGINEERED WOOD PRODUCTS

- A. Laminated-Veneer Lumber: Structural composite lumber made from wood veneers with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D5456 and manufactured with an exterior-type adhesive complying with ASTM D2559.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- B. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.
- C. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- D. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

- E. Do not splice structural members between supports unless otherwise indicated.
- F. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
- G. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code (IBC).
 - 2. ICC-ES evaluation report for fastener.

3.02 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet enough that moisture content exceeds that specified, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION

SECTION 06 1050 – TURF WOOD NAILER

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section is a part of the entire set of Contract Documents and shall be coordinated with the applicable provisions of the other parts.
- B. Related Sections:
 - 1. Section 03 3000 Cast In Place Concrete - Athletics
 - 2. Section 03 3053 Concrete Turf Anchor

1.2 SCOPE

- A. Provide all material, labor, and equipment necessary to install the timber and cleanup as detailed on the drawings and herein.

PART 2 - PRODUCTS

2.1 TIMBER EDGING

- A. Southern Pine or Douglas Fir pressure preservative treated with alkaline copper quaternary (ACQ) or Copper Azole (CA) preservatives in accordance with American Wood Preservers Associates (AWPA) standard C17 for ground contact use. Provide lumber sizes as indicated on drawings.
- B. All hardware shall meet a minimum requirement established ASTM standard A153 and ASTM standard A653 (Class G-185).

2.2 WOODEN NAILER FASTENERS

- A. Approved items for Wood Nailer Installation:
 - 1. Nails 16 d Hot Dipped Galvanized
 - 2. 1/4 x 2 3/4" Stainless Steel Tapcon Masonry Screws
 - 3. DEC-King Exterior Wood Screw with Climacoat
 - 4. Wood to-Metal TEKS with Grey Spex
 - 5. Tapcon Concrete Anchor with Blue Climaseal and White Ultrashield
 - 6. Roofgrip with Spex or Blue Climaseal
 - 7. GYP-FAST Nail with Climacoat
 - 8. Maxi-set Tapcon White UltraShield
 - 9. Ramguard Drive Pin

PART 3 - EXECUTION

3.1 DEMOLITION, EXCAVATION AND REMOVALS

- A. Strip all existing topsoil, infield mix, etc. from work area. Stockpile sufficient material for restoration of perimeter area. Legally dispose of excess material off site.

3.2 GRADING

- A. Grade area to elevations and slopes as indicated on the drawings. Grade shall be such that when finished grade is established, the work area and the perimeter shall be free of standing water.

3.3 INSTALLATION OF TIMBER EDGING

- A. Install wood nailer using only the specified fasteners listed in Section 2.2 above.
- B. Fasteners shall be placed in the middle (vertical) of nailer board. Fastener shall be no closer than 6" from end of board.
- C. Fasteners spacing shall not be more than 2.5'
- D. Contractor shall maximize use of treated lumber and minimize cuts to corners.

3.4 RESTORATION AND CLEAN UP

- A. Clean-up all excess materials and remove from site. Adjoining areas to be the same as prior to construction, and properly graded to allow water to drain away from surface.

END OF SECTION

SECTION 06 1600 – SHEATHING

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Roof sheathing.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product.

PART 2 PRODUCTS

2.01 WOOD PANEL PRODUCTS

- A. Emissions: Products shall meet the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.02 ROOF SHEATHING

- A. Plywood Sheathing: Exposure 1 sheathing.
- B. Oriented-Strand-Board Sheathing: DOC PS 2, Exposure 1 sheathing.

2.03 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 - 1. For roof sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
 - 2. For roof sheathing, provide fasteners with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.

PART 3 EXECUTION

3.01 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
 - 1. Table 2304.9.1, "Fastening Schedule," in the ICC's International Building Code.
 - 2. ICC-ES evaluation report for fastener.
- D. Coordinate roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

3.02 WOOD STRUCTURAL PANEL INSTALLATION

- A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.
- B. Fastening Methods: Fasten panels as indicated below:
 - 1. Wall and Roof Sheathing:
 - a. Nail to wood framing.
 - b. Screw to cold-formed metal framing.
 - c. Space panels 1/8 inch apart at edges and ends.

END OF SECTION

SECTION 06 1753 - SHOP-FABRICATED WOOD TRUSSES

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Wood roof trusses.

1.02 ACTION SUBMITTALS

- A. Product Data: For metal-plate connectors, metal truss accessories, and fasteners.
- B. Shop Drawings: Show fabrication and installation details for trusses.
 - 1. Show location, pitch, span, camber, configuration, and spacing for each type of truss required.
 - 2. Indicate sizes, stress grades, and species of lumber.
 - 3. Indicate locations of permanent bracing required to prevent buckling of individual truss members due to design loads.
 - 4. Indicate locations, sizes, and materials for permanent bracing required to prevent buckling of individual truss members due to design loads.
 - 5. Indicate type, size, material, finish, design values, orientation, and location of metal connector plates.
 - 6. Show splice details and bearing details.
- C. Delegated-Design Submittal: For metal-plate-connected wood trusses indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.03 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For metal-plate-connected wood trusses, signed by officer of truss-fabricating firm.
- B. Evaluation Reports: For the following, from ICC-ES:
 - 1. Metal-plate connectors.
 - 2. Metal truss accessories.

1.04 QUALITY ASSURANCE

- A. Metal Connector-Plate Manufacturer Qualifications: A manufacturer that complies with quality-control procedures in TPI 1 for manufacture of connector plates.
 - 1. Manufacturer's responsibilities include providing professional engineering services needed to assume engineering responsibility.
 - 2. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
- B. Fabricator Qualifications: Shop that participates in a recognized quality-assurance program that complies with quality-control procedures in TPI 1.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Handle and store trusses to comply with recommendations in SBCA BCSI, "Building Component Safety Information: Guide to Good Practice for Handling, Installing, Restraining, & Bracing Metal Plate Connected Wood Trusses."

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design metal-plate-connected wood trusses.
- B. Structural Performance: Metal-plate-connected wood trusses shall be capable of withstanding design loads within limits and under conditions indicated. Comply with requirements in TPI 1.
- C. Comply with applicable requirements and recommendations of TPI 1, TPI DSB, and SBCA BCSI.
- D. Wood Structural Design Standard: Comply with applicable requirements in AF&PA's "National Design Specifications for Wood Construction" and its "Supplement."

2.02 DIMENSION LUMBER

- A. Lumber: DOC PS 20 and applicable rules of any rules-writing agency certified by the American Lumber Standard Committee (ALSC) Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 - 1. Provide dry lumber with 19 percent maximum moisture content at time of dressing.
- B. Permanent Bracing: Provide wood bracing that complies with requirements for miscellaneous lumber in Section 061000 "Rough Carpentry."

2.03 METAL CONNECTOR PLATES

- A. General: Fabricate connector plates to comply with TPI 1.
- B. Hot-Dip Galvanized-Steel Sheet: ASTM A 653/A 653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G60 (Z180) coating designation; and not less than 0.036 inch (0.9 mm) thick.

2.04 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 - 1. Provide fasteners for use with metal framing anchors that comply with written recommendations of metal framing manufacturer.
 - 2. Where trusses are exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Nails, Brads, and Staples: ASTM F 1667.

2.05 METAL FRAMING ANCHORS AND ACCESSORIES

- A. Allowable design loads, as published by manufacturer, shall comply with or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency. Framing anchors shall be punched for fasteners adequate to withstand same loads as framing anchors.
- B. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 coating designation.

2.06 FABRICATION

- A. Assemble truss members in design configuration indicated; use jigs or other means to ensure uniformity and accuracy of assembly, with joints closely fitted to comply with tolerances in TPI 1. Position members to produce design camber indicated.
 - 1. Fabricate wood trusses within manufacturing tolerances in TPI 1.
- B. Connect truss members by metal connector plates located and securely embedded simultaneously in both sides of wood members by air or hydraulic press.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install wood trusses only after supporting construction is in place and is braced and secured.
- B. If trusses are delivered to Project site in more than one piece, assemble trusses before installing.
- C. Hoist trusses in place by lifting equipment suited to sizes and types of trusses required, exercising care not to damage truss members or joints by out-of-plane bending or other causes.
- D. Install and brace trusses according to TPI recommendations and as indicated.
- E. Anchor trusses securely at bearing points; use metal truss tie-downs or floor truss hangers as applicable. Install fasteners through each fastener hole in metal framing anchors according to manufacturer's fastening schedules and written instructions.
- F. Securely connect each truss ply required for forming built-up girder trusses.
- G. Install and fasten permanent bracing during truss erection and before construction loads are applied. Anchor ends of permanent bracing where terminating at walls or beams.
- H. Install bracing to comply with Section 061000 "Rough Carpentry."
 - 1. Install wood trusses within installation tolerances in TPI 1.
- I. Do not alter trusses in field. Do not cut, drill, notch, or remove truss members.
- J. Replace wood trusses that are damaged or do not comply with requirements.

END OF SECTION

SECTION 07 1113 - BITUMINOUS DAMPPROOFING**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Bituminous dampproofing.
- B. Protection boards.

1.02 REFERENCE STANDARDS

- A. ASTM D1187/D1187M - Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal 1997 (Reapproved 2018).
- B. ASTM D1227/D1227M - Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing 2013, with Editorial Revision (2019).
- C. ASTM D1227 - Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing 2013.
- D. NRCA (WM) - The NRCA Waterproofing Manual 2021.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide properties of primer, bitumen, and mastics.
- C. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this section with at least 5 years of documented experience.

1.05 FIELD CONDITIONS

- A. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application until dampproofing has cured.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Manufacturers:
 - 1. BASF Corp., Master Builders Solutions; www.master-builders-solutions.basf.us.
 - 2. Carlisle Coatings and Waterproofing; www.carlisleccw.com.
 - 3. The Euclid Chemical Company; www.euclidchemical.com.
 - 4. Henry Corp.; www.henry.com.
 - 5. Karnak Corp.; www.karnakcorp.com.
 - 6. Lambert Corp.; www.lambertusa.net.
 - 7. W. R. Meadows, Inc.; www.wrmeadows.com.
 - 8. Substitutions: See Section 01 6000 - Product Requirements.

2.02 BITUMINOUS DAMPPROOFING

- A. Bituminous Dampproofing: Cold-applied water-based emulsion; asphalt with mineral colloid or chemical emulsifying agent; with or without fiber reinforcement; asbestos-free; suitable for application on vertical and horizontal surfaces.
 - 1. Composition - Vertical Application: ASTM D1227/D1227M Type III or ASTM D1187/D1187M Type I.
 - 2. Composition - Horizontal and Low-Slope Application: ASTM D1227/D1227M Type II or III.
 - 3. VOC Content: Not more than permitted by local, State, and federal regulations.
 - 4. Applied Thickness: 1/16 inch, minimum, wet film.
- B. Primers, Mastics, and Related Materials: Type as recommended by dampproofing manufacturer.

2.03 ACCESSORIES

- A. Protection Board: 1/8 inch thick bitumen impregnated glass fiberboard.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify existing conditions are acceptable prior to starting this work.
- B. Verify substrate surfaces are durable, free of matter detrimental to adhesion or application of dampproofing system.
- C. Verify that items penetrating surfaces to receive dampproofing are securely installed.

3.02 PREPARATION

- A. Protect adjacent surfaces not designated to receive dampproofing.
- B. Clean and prepare surfaces to receive dampproofing in accordance with manufacturer's instructions.
- C. Do not apply dampproofing to surfaces unacceptable to manufacturer.
- D. Apply mastic to seal penetrations, small cracks, or minor honeycombs in substrate.

3.03 APPLICATION

- A. Perform this work in accordance with manufacturer's instructions and NRCA (WM) applicable requirements.
- B. Prime surfaces in accordance with manufacturer's instructions and NRCA (WM) applicable requirements.
- C. Prime surfaces at a rate approved by manufacturer for application indicated, and allow primer to dry thoroughly.
- D. Apply bitumen with roller or spray application; apply two coats.
- E. Seal items watertight with mastic, that project through dampproofing surface.
- F. Place protection board directly over dampproofing, butt joints, and adhere to tacky dampproofing.
- G. Scribe and cut boards around projections, penetrations, and interruptions.

END OF SECTION

SECTION 07 2119 - FOAMED-IN-PLACE INSULATION**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Foamed-in-place insulation.
 - 1. Insulation shall act as an air barrier and vapor retarder.
 - 2. In masonry cavity walls.
 - 3. In underside of roofs and ceilings.
- B. Thermal barrier overcoating.

1.02 REFERENCE STANDARDS

- A. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications 2023.
- B. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2023.
- C. ASTM C1338 - Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings 2019 (Reapproved 2022).
- D. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus 2021.
- E. ASTM D1621 - Standard Test Method for Compressive Properties of Rigid Cellular Plastics 2016 (Reapproved 2023).
- F. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension 2016 (Reapproved 2021).
- G. ASTM D6226 - Standard Test Method for Open Cell Content of Rigid Cellular Plastics 2021.
- H. ASTM E154/E154M - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover 2008a (Reapproved 2019).
- I. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2023c.
- J. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials 2022a, with Editorial Revision (2023).
- K. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials 2021a.
- L. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi 2015, with Editorial Revision (2021).
- M. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components 2023.
- N. SMACNA (ASMM) - Architectural Sheet Metal Manual 2012.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week prior to commencing work of this section.
- B. Product Coordination and Limitations: Provide products that when combined with materials and components of other sections, form exterior wall assemblies as detailed on Drawings, that comply with NFPA 285 testing and acceptance criteria.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide product description, insulation properties, overcoat properties, and preparation requirements.
- C. Shop Drawings: Show materials and details.
 - 1. Include:
 - a. Transition and flashing details.

- D. Submit documentation from manufacturers certifying compatibility of insulation, transition membranes and flashings, and overcoats.
- E. Qualifications: For manufacturer and applicator.
- F. Field Quality Control: Submit field inspection reports.
- G. NFPA 285 Documentation: For each product, submit documentation listing compatible materials and components that when used together in wall assemblies as detailed on Drawings, comply with NFPA 285 testing and acceptance criteria.
- H. ABAA Field Quality Control Submittals: Submit third-party reports of testing and inspection as required by ABAA QAP.
- I. ABAA Manufacturer Qualification: Submit documentation of current evaluation of proposed manufacturer and materials.
- J. Installer Qualification: Submit documentation of current contractor accreditation and current installer certification. Keep copies of all contractor accreditation and installer certification on site during and after installation. Present on-site documentation upon request.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with not less than 5 years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified,, with minimum 5 years of documented experience, and approved by manufacturer , and approved by manufacturer.
 - 1. Applicator shall be approved or certified by the insulation manufacturer.
- C. Air Barrier Association of America (ABAA) Quality Assurance Program (QAP); www.airbarrier.org/#sle:
 - 1. Installer Qualification: Use accredited contractor, certified installers, evaluated materials, and third-party field quality control audit.
 - 2. Manufacturer Qualification: Use evaluated materials from a single manufacturer regularly engaged in air barrier material manufacture. Use secondary materials approved in writing by primary material manufacturer.

1.06 MOCK-UPS

- A. Construct mock-up, 4 feet long by 8 feet wide; include insulation overcoat, wall construction, and typical transition and flashing details at openings such as windows and doors.
- B. Locate where directed.
- C. Mock-up may remain as part of the Work.

1.07 FIELD CONDITIONS

- A. Do not apply foam when temperature is below that specified by the manufacturer for ambient air and substrate.
- B. Do not apply foam when temperature is within 5 degrees F of dew point.
- C. Do not install foamed-in-place insulation during precipitation or when precipitation is imminent.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Foamed-In-Place Insulation:
 - 1. BASF Corporation; WALLTITE US Series Closed Cell: www.spf.basf.com/#sle.
 - 2. Carlisle Spray Foam Insulation; SealTite PRO HFO: www.carlislefsi.com/#sle.
 - 3. Henry Company; Permax 2.0X: www.henry.com/#sle.
 - 4. Johns Manville; JM Corbond III Closed Cell Spray Polyurethane Foam: www.jm.com/#sle.
 - 5. NCFI Polyurethanes; InsulBlock Smart SPF (11-036): www.ncfi.com/#sle.
 - 6. Substitutions: See Section 01 6000 - Product Requirements.

2.02 MATERIALS

- A. Foamed-In-Place Insulation: Medium-density, rigid or semi-rigid, open or closed cell polyurethane foam; foamed on-site, using blowing agent of water or non-ozone-depleting gas.
1. Regulatory Requirements: Comply with applicable code for flame and smoke, concealment, and overcoat limitations.
 - a. Insulation shall be an approved component of an NFPA 285 tested exterior wall assembly as detailed on Drawings; tested in accordance with and complying with the acceptance criteria of NFPA 285.
 2. Properties:
 - a. Core Density: 2.0 pcf, minimum; ASTM D1622/D1622M.
 - b. Closed Cell Content: Greater than 90 percent; ASTM D6226.
 - c. Thermal Resistance: 6.8 R, minimum, per inch; ASTM C518.
 - d. Compressive Strength: 27 psi, minimum; ASTM D1621.
 - e. Moisture Vapor Transmission: 1.3 perm at 1 inch, maximum; ASTM E96/E96M.
 - f. Air Permeance: 0.004 cfm per sq ft, maximum; ASTM E2178.
 - g. Surface Burning Characteristics: ASTM E84.
 - 1) Flame Spread Index: Less than or equal to 25 at 4 inches.
 - 2) Smoke Developed Index: Less than or equal to 450 at 4 inches.
 - h. Fungal Resistance: Negligible or No Growth; ASTM C1338 or ASTM G21.

2.03 ACCESSORIES

- A. Primer: As required by insulation manufacturer and accessory manufacturers.
- B. Thermal Barrier Overcoating: Spray-applied coating as recommended by foamed-in-place insulation manufacturer and as required to comply with applicable codes and Drawings. Subject to compliance with requirements and compatibility with foamed-in-place insulation provide one of the following products:
1. Intumescent:
 - a. Products:
 - 1) Flame Seal Products, Inc.; Flame Seal TB: www.flameseal.com.
 - 2) International Fireproof Technology, Inc.; DC315: www.painttoprotect.com.
 - 3) Johns Manville; Ignition Barrier Coating: www.jm.com.
 - 4) TPR2 Corporation; FireShell F10E; www.tpr2.com.
 - 5) Substitutions: See Section 01 6000 - Product Requirements.
 - b. Minimum Thickness: Thickness, in mils, as recommended by manufacturer.
 2. Cementitious:
 - a. Products:
 - 1) GCP Applied Technologies, Inc.; Monokote Z-3306: www.gcpat.com.
 - 2) Substitutions: See Section 01 6000 - Product Requirements.
 - b. Minimum Thickness: 3/4 inch.
 3. Other:
 - a. Products:
 - 1) International Cellulose Corp.; Ure-K: www.spray-on.com.com.
 - 2) Substitutions: See Section 01 6000 - Product Requirements.
 - b. Minimum Thickness: 1.25 inches.
- C. Transitions and Flashings:
1. General:
 - a. Products shall be compatible with foamed-in-place insulation and approved by foamed-in-place insulation manufacturer.
 - b. Maintain the continuity of the air and water barrier as it transitions to adjacent materials.
 - c. Materials shall be compatible with adjacent materials.
 - d. Transitions and flashings shall be an approved component of an NFPA 285 tested exterior wall assembly as detailed on Drawings; tested in accordance with, and complying with the acceptance criteria of NFPA 285.

2. Liquid-Applied Flashings and Sealants:
 - a. Non-asphaltic product: one part, fast curing, non-sag, elastomeric, gun grade, trowelable liquid flashing.
 - b. Available products include, but are not limited to, the following:
 - 1) The Dow Chemical Company; Dowsil 758 Silicone Weather Barrier Sealant: www.dow.com.
 - 2) Momentive Performance Materials, Inc./GE; Elemax 5000 Liquid Flashing: www.siliconeforbuilding.com.
 - 3) Prosoco Inc.; R-Guard FastFlash: www.prosoco.com.
 - 4) Tremco, Inc.; Spectrem 1: www.tremcosealants.com.
3. Silicone Sheet Transitions:
 - a. Pre-cured silicone rubber sheets and pre-molded corners.
 - b. Install using liquid-applied flashings and sealants as an adhesive.
 - c. Available products include, but are not limited to, the following:
 - 1) The Dow Chemical Company; Dowsil Silicone Transition Strip: www.dow.com.
 - 2) Momentive Performance Materials, Inc./GE; UltraSpan UST/USM Pre-Cured Silicone Transition Sheet and Molded Corners: www.siliconeforbuilding.com.
 - 3) Prosoco Inc.; R-Guard SureSpan EX: www.prosoco.com.
 - 4) Tremco, Inc.; ProGlaze ETA and Spectrem Simple Seal: www.tremcosealants.com.
4. Rubberized Asphalt Sheet
 - a. Self-adhering SBS rubberized asphalt sheet with polyethylene film top surface and a release liner; 40 mil total thickness.
 - 1) Properties:
 - (a) Water Vapor Permeance: Maximum 0.1 perms; ASTM E96/E96M, Method B.
 - (b) Air Permeance: Maximum 0.0002 cfm per sq ft at 75 Pa; ASTM E2178.
 - (c) Puncture Resistance: Minimum 40 lbf; ASTM E154/E154M.
 - (d) Elongation: Minimum 200 percent; ASTM D412.
 - 2) Available products include, but are not limited to, the following:
 - (a) Carlisle; CCW-705 XLT Air & Vapor Barrier; www.carlisleccw.com.
 - (b) GCP Applied Technologies; Perm-A-Barrier Detail Membrane; www.gcpat.com.
 - (c) Henry Company; Blueskin SA: www.henry.com.
 - (d) Tremco; ExoAir 110: www.tremcosealants.com.
 - (e) W. R. Meadows, Inc.; Air-Shield: www.wrmeadows.com.
5. Flexible Fabric Flashing - Self-Adhering: Self-adhering stainless steel/polymer fabric flashing. ASTM A240/A240M stainless steel sheet bonded with rubber-based adhesive to one sheet of polymer fabric. Flashing shall be self-adhering using a pressure-sensitive adhesive.
 - a. Type 304 stainless steel.
 - 1) Thickness: 2 mils, minimum.
 - b. Available products include, but are not limited to, the following:
 - 1) York Manufacturing, Inc.; York 304: www.yorkmfg.com.
 - 2) Momentive Performance Materials, Inc./GE; GE Elemax SS Flashing: www.siliconeforbuilding.com.
6. Flexible Fabric Flashing: Stainless steel/polymer fabric flashing. ASTM A240/A240M stainless steel sheet bonded with rubber-based adhesive to one sheet of polymer fabric.
 - a. Type 304 stainless steel.
 - 1) Thickness: 2 mils, minimum.
 - b. Available products include, but are not limited to, the following:
 - 1) York Manufacturing, Inc.; Multi-Flash SS: www.yorkmfg.com.
 - 2) Prosoco Inc.; R-Guard SS ThruWall: www.prosoco.com.
7. Metal Flashings:

- a. Stainless-steel sheet: ASTM A666 or ASTM A240/A240M, Type 304, 0.025 inch (24 gage) thick, minimum; smooth 2D (dull cold-rolled) finish..
 - 1) Fasteners: Stainless steel.
- b. Comply with SMACNA (ASMM) requirements and standard details, except as otherwise indicated.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify work within construction spaces or crevices is complete prior to insulation application.
- B. Verify that surfaces are clean, dry, and free of matter that may inhibit insulation or overcoat adhesion.

3.02 PREPARATION

- A. Mask and protect adjacent surfaces from over spray or dusting.
- B. Install transitions and flashings around corners of openings, around penetrations, and elsewhere as recommended by foamed-in-place insulation manufacturer and as indicated on Drawings.
- C. Coordinate detailing of transitions to other air barrier materials in order to maintain a continuous air barrier.
 1. Ensure that transition materials are compatible with adjacent air barrier materials.
 2. Notify Architect of any issues prior to installing foamed-in-place insulation. Do not proceed with foamed-in-place insulation installation until issues have been resolved and approved by Architect.
- D. At deflection, expansion, and control joints, provide accommodations to allow for anticipated movement as acceptable to foamed-in-place insulation manufacturer.
- E. At static gaps more than one inch wide make accommodations to allow foamed-in-place insulation to bridge gap.
 1. Mechanically fasten continuous metal flashing across gap to support insulation.
- F. Apply primer in accordance with manufacturer's instructions.

3.03 APPLICATION

- A. Apply insulation in accordance with manufacturer's instructions.
 1. Apply insulation in consecutive passes as recommended by manufacturer to achieve overall thickness and required R-Values.
 - a. Spray in multiple passes and allow each pass to fully cool before applying subsequent passes in order to prevent excessive overheating of foamed-in-place insulation and possible damage to transition membranes and flashings.
- B. Apply insulation by spray method, to a uniform monolithic density without voids.
 1. Finished surface of foamed-in-place insulation to be free of voids and fully sealed around embedded penetrating objects.
 2. Where applied in voids and gaps assure space for foam expansion to avoid pressure on adjacent materials that may bind operable parts, push out the adjacent material, or otherwise cause damage to the materials.
 3. Neatly trim and remove excess insulation that would interfere with the installation of adjacent construction.
 - a. In wall cavities ensure that indicated air spaces remain clear of insulation.

3.04 INSTALLATION

- A. Transition Strip Installation: Install air barrier accessories and closed cell, medium density spray polyurethane foam to provide continuity throughout the building envelope. Install materials in accordance with manufacturer's instructions and the following (unless manufacturer requires other procedures in writing based on project conditions or particular requirements of their recommended materials):

- B. Apply primer for transition membrane at rate recommended by material manufacturer. Allow primer to dry completely before membrane application. Apply as many coats as necessary for proper adhesion.
- C. Position subsequent sheets of membrane applied above so that it overlaps the membrane sheet below by a minimum of 2.0 inches (50 mm), unless greater overlap is recommended by material manufacturer. Roll into place with roller ensuring all transition membranes are free of fish-mouths, wrinkles, delaminations, bubbles and voids.
- D. Overlap horizontally adjacent pieces of membrane a minimum of 2.0 inches (50 mm), unless greater overlap is recommended by material manufacturer. Roll all areas of membrane including seams with roller.
- E. Seal around all penetrations with termination mastic, extruded silicone sealant, membrane counter-flashing or other procedure in accordance with material Manufacturer's recommendations.
- F. Connect air barrier in exterior wall assembly continuously to the air barrier of the roof, to concrete below-grade structures, to windows, curtain wall, storefront, louvers, exterior doors and other intersection conditions and perform sealing of penetrations, using accessory materials and in accordance with the manufacturer's recommendations.
- G. To bridge gaps >1/8" (3 mm) in wall construction at changes in substrate plane or changes in adjoining materials, provide transition membranes or other material recommended by spray polyurethane foam material manufacturer.
- H. Provide transition membrane, sealant, mastic, membrane counter-flashing or other material recommended by spray polyurethane foam manufacturer at 90 degree inside or outside corners. Follow spray polyurethane foam manufacturer's instructions for instructions on how to treat interlocked CMU or structurally-attached 90 degree cast-in place concrete corners.
- I. Provide mechanically fastened non-corrosive metal sheet to span gaps greater than 1.0 inch (25 mm) in substrate plane and to make a smooth transition from one plane to the other. Membrane shall be continuously supported by substrate.
- J. At through-wall flashings, provide an additional 6.0 inch (150mm) wide strip of manufacturer's recommended membrane counter-flashing to seal top of through-wall flashing to membrane. Seal exposed top edge of strip with bead of mastic or as recommended by manufacturer.
- K. At deflection and control joints, provide backup for the membrane to accommodate anticipated movement.
- L. At expansion and seismic joints provide transition to the joint assemblies.
- M. Apply a bead or trowel coat of mastic along membrane seams at reverse lapped seams, rough cuts, and as recommended by the manufacturer when membrane will be exposed to the elements.
- N. At end of each working day, seal top edge of self-adhered membrane to substrate with termination mastic if exposed.
- O. Do not allow materials to come in contact with chemically incompatible materials.
- P. Do not expose membrane to sunlight longer than as recommended by the manufacturer.
- Q. Ensure that membranes at terminations have a pull adhesive of 16 psi or greater.
- R. Inspect installation prior to enclosing assembly and repair damaged areas with closed cell, medium density spray polyurethane foam as recommended by manufacturer.

3.05 THERMAL BARRIER OVERCOATING APPLICATION

- A. Apply overcoat monolithically, without voids to fully cover foam insulation, to achieve fire rating required.

1. Apply overcoating only where exposed to the interior or otherwise indicated on the Drawings.

3.06 TOLERANCES

- A. Insulation Thickness: Maximum variation as follows:
 1. No more than 1/4 inch less than required thickness.
 2. No more than 1/2 inch greater than required thickness.

3.07 FIELD QUALITY CONTROL

- A. Field inspections and tests will be performed by an independent testing agency under provisions of Section 01 4000 - Quality Requirements.
- B. Inspection: Inspection will include the following:
 1. Verification of insulation and overcoat thickness and density.
 2. Verification that finished surface of foamed-in-place insulation is free of voids and continuous.
 3. Verification that insulation seals tightly around penetrations and against adjacent materials without any gaps.
- C. Do not cover installed insulation until inspections have been completed.
- D. Deficiencies shall be corrected by the Contractor at no additional cost to the Owner.
- E. Coordination of ABAA Tests and Inspections:
 1. Provide testing and inspection required by ABAA QAP.
 2. Notify in ABAA writing of schedule for air barrier work. Allow adequate time for testing and inspection.
 3. Cooperate with ABAA testing agency.
 4. Allow access to air barrier work areas and staging.
 5. Do not cover air barrier work until tested, inspected, and accepted.

3.08 PROTECTION

- A. Do not permit subsequent construction work to disturb applied insulation.
- B. If damage occurs, patch damaged areas in accordance with foamed-in-place manufacturer's instructions.

END OF SECTION

SECTION 07 2423 - DIRECT-APPLIED FINISH SYSTEMS**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Direct-Applied Finish System (DAFS) for exterior and interior soffits and ceilings.

1.02 ABBREVIATIONS

- A. DAFS: Direct-Applied Finish Systems.

1.03 REFERENCE STANDARDS

- A. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes 2021.
- B. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric) 2021.
- C. ASTM C150/C150M - Standard Specification for Portland Cement 2022.
- D. ASTM D968 - Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive 2022.
- E. ASTM D2247 - Standard Practice for Testing Water Resistance of Coatings in 100 % Relative Humidity 2015 (Reapproved 2020).
- F. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber 2021.
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2023c.
- H. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference 2000 (Reapproved 2023).
- I. ASTM G153 - Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials 2013 (Reapproved 2021).
- J. ASTM G155 - Standard Practice for Operating Xenon Arc Lamp Apparatus for Exposure of Materials 2021.
- K. ICC-ES AC219 - Acceptance Criteria for Exterior Insulation and Finish Systems 2009, with Editorial Revision (2022).
- L. ICC-ES AC235 - Acceptance Criteria for EIFS Clad Drainage Wall Assemblies 2015, with Editorial Revision (2022).

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on system materials, product characteristics, performance criteria, and system limitations.
- C. Shop Drawings: Indicate plans, details, joint patterns, joint details, and molding profiles.
- D. Verification Samples: Submit three actual samples of selected coating on specified substrate, minimum 12 inches square, illustrating project colors and textures.
- E. Manufacturer's Installation Instructions: Indicate preparation required, installation techniques, and jointing requirements.

1.05 QUALITY ASSURANCE

- A. Maintain copy of specified installation standard and manufacturer's installation instructions at project site during installation.
- B. Manufacturer Qualifications: Provide DAFS products from manufacturer with qualifications as follows:
 - 1. Member in good standing of EIMA (EIFS Industry Members Association).
 - 2. Manufacturer of DAFS products for not less than 5 years.

- C. Installer Qualifications: Company specializing in the type of work specified and with at least 5 years of documented experience and approved by manufacturer.

1.06 **MOCK-UP**

- A. Construct mock-up of typical DAFS application on specified substrate, size as required to include examples of all key conditions, and including flashings, joints, and edge conditions.
- B. Locate mock-up where directed.
- C. Mock-up may remain as part of the Work.

1.07 **DELIVERY, STORAGE, AND HANDLING**

- A. Delivery: Deliver materials to project site in manufacturer's original, unopened containers with labels intact. Inspect materials and notify manufacturer of any discrepancies.
- B. Storage: Store materials as directed by manufacturer's written instructions.
 - 1. Protect adhesives and finish materials from freezing, temperatures below 40 degrees F and temperatures in excess of 90 degrees F.
 - 2. Protect Portland cement based materials from moisture and humidity. Store under cover off the ground in a dry location.

1.08 **FIELD CONDITIONS**

- A. Do not prepare or install materials in conditions other than those described in the manufacturer's written instructions.
- B. Do not prepare or apply materials during inclement weather unless areas of installation are protected. Protect installed direct-applied finish system areas from inclement weather until dry.
- C. Do not install coatings or sealants when ambient temperature is below 40 degrees F.

1.09 **WARRANTY**

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide manufacturer's standard material warranty, covering a period of not less than 5 years.

PART 2 PRODUCTS

2.01 **MANUFACTURERS**

- A. Products:
 - 1. BASF Corp.; Synergy Direct Finish Systems for Soffits and Ceilings: www.basf.com.
 - 2. Dryvit Systems, Inc.; Direct Applied TAFs: www.dryvit.com.
 - 3. Parex USA, Inc.; ACF Soffit: www.parex.com.
 - 4. Sto Corp.; Or Equal: www.stocorp.com.
 - 5. Substitutions: See Section 01 6000 - Product Requirements.

2.02 **DIRECT-APPLIED FINISH SYSTEM**

- A. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/450, when tested in accordance with ASTM E84.
- B. Adhesion of Water-Resistive Coating to Substrate: For each combination of coating and substrate, minimum ensile bond strength of 15 psi, when tested in accordance with ASTM E2134 .
- C. Water Penetration Resistance: No water penetration beyond the plane of the base coat after 15 minutes, when tested in accordance with ASTM E331 at 6.24 psf differential pressure.
- D. Salt Spray Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating after 300 hours exposure in accordance with ASTM B117, using at least three samples matching intended assembly, at least 4 by 6 inches in size.
- E. Freeze-Thaw Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating when viewed under 5x magnification after 10 cycles, when tested in accordance with {rs#1} or 16 CFR 1201.

- F. Weathering Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating when viewed under 5x magnification after 2000 hours of accelerated weathering conducted in accordance with ASTM G153 Cycle 1 or ASTM G155 Cycles 1, 5, or 9.
- G. Water Degradation Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating after 14 days exposure, when tested in accordance with ASTM D2247.
- H. Mildew Resistance: No growth supported on finish coating during 28 day exposure period, when tested in accordance with ASTM D3273.
- I. Abrasion Resistance Of Finish: No cracking, checking or loss of film integrity when tested in accordance with ASTM D968 with 113.5 gallons of sand.

2.03 MATERIALS

- A. Finish Coating Top Coat: Water-based, air curing, acrylic or polymer-based finish with integral color and texture.
 - 1. Texture: Sand/Fine.
 - 2. Color: As selected by Architect from manufacturer's standard range.
- B. Base Coat: Acrylic- or polymer-modified, fiber reinforced Portland cement coating; compatible with substrate board and reinforcing mesh.
 - 1. Portland Cement: ASTM C150/C150M, Type I or II.
- C. Reinforcing Mesh: Balanced, open weave glass fiber fabric, treated for compatibility and improved bond with coating; weight, strength, and number of layers as required by base coat manufacturer.
- D. Substrate Board: Refer to Section 06 1000 - Rough Carpentry.

2.04 ACCESSORY MATERIALS

- A. Primer: Primer as recommended by DAFS manufacturer for substrate and project conditions.
- B. Trim: DAFS manufacturer's standard PVC trim accessories, as required for a complete project.
- C. Sealant Materials: Compatible with DAFS materials and as recommended by DAFS manufacturer.
- D. Exterior Soffit Vents: One piece, perforated, ASTM B221 AA DAF-45 6063 alloy, T5 temper, aluminum, with edge suitable for direct application to gypsum board and manufactured especially for soffit application. Provide continuous vent.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate is sound and free of oil, dirt, other surface contaminants, efflorescence, loose materials, or protrusions that could interfere with DAFS installation and is of a type and construction that is acceptable to DAFS manufacturer. Do not begin work until substrate and adjacent materials are complete and thoroughly dry.
- B. Verify that substrate surface is flat, with no deviation greater than 1/4 in when tested with a 10 ft straightedge.

3.02 PREPARATION

- A. Apply primer to substrate as recommended by DAFS manufacturer for project conditions.

3.03 INSTALLATION

- A. Install in accordance with DAFS manufacturer's instructions.
- B. Substrate Boards: Refer to Section 06 1000 - Rough Carpentry.
- C. Base Coat: Apply in thickness as necessary to fully embed reinforcing mesh, wrinkle free, including back-wrap at terminations of DAFS. Install reinforcing fabric as recommended by DAFS manufacturer.

1. Lap reinforcing mesh edges and ends a minimum of 2-1/2 inches.
 2. Allow base coat to dry a minimum of 24 hours before next coating application.
- D. Apply finish coat after base coat has dried not less than 24 hours and finish to a uniform texture and color.
- E. Finish Coat Thickness: As recommended by manufacturer.
- F. Seal control and expansion joints within the field of exterior finish and insulation system, using procedures recommended by sealant and finish system manufacturers.

3.04 CLEANING

- A. Clean DAFS surfaces and work areas of foreign materials resulting from DAFS operations.

3.05 PROTECTION

- A. Protect completed work from damage and soiling by subsequent work.

END OF SECTION

SECTION 07 2726 - FLUID-APPLIED MEMBRANE AIR BARRIERS**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Vapor-permeable, fluid-applied air barriers.

1.02 DEFINITIONS

- A. Weather Barrier: Assemblies that form either water-resistive barriers, air barriers, or vapor retarders.
- B. Air Barrier: Air tight barrier made of material that is relatively air impermeable but water vapor permeable, both to the degree specified, with sealed seams and with sealed joints to adjacent surfaces. Note: For the purposes of this specification, vapor impermeable air barriers are classified as vapor retarders.
- C. Vapor Retarder: Air tight barrier made of material that is relatively water vapor impermeable, to the degree specified, with sealed seams and with sealed joints to adjacent surfaces.
 - 1. Water Vapor Permeance: For purposes of conversion, $57.2 \text{ ng}/(\text{Pa s sq m}) = 1 \text{ perm}$.
 - a. Vapor Barrier: Has water vapor permeance of 0.1 perms maximum.
 - b. Vapor Permeable: Has water vapor permeance of 1 perms or greater.
- D. Water-Resistive Barrier: Water-shedding barrier made of material that is moisture resistant, to the degree specified, intended to be installed to shed water without sealed seams.

1.03 REFERENCE STANDARDS

- A. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications 2023.
- B. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection 2021.
- C. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-- Tension 2016 (Reapproved 2021).
- D. ASTM D4263 - Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method 1983 (Reapproved 2018).
- E. ASTM D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers 2022.
- F. ASTM E1186 - Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems 2017.
- G. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials 2021a.
- H. ASTM E2357 - Standard Test Method for Determining Air Leakage Rate of Air Barrier Assemblies 2023a.
- I. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2023c.
- J. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials 2022a, with Editorial Revision (2023).
- K. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components 2023.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week prior to commencing work of this section.
- B. Product Coordination and Limitations: Provide products that when combined with materials and components of other sections, form exterior wall assemblies as detailed on Drawings, that comply with NFPA 285 testing and acceptance criteria.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide product description and data on material characteristics, performance criteria, and limitations.
- C. Shop Drawings: For air barrier assemblies.
 - 1. Show locations and extent of air barrier materials, accessories, and assemblies specific to Project conditions.
 - 2. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
 - 3. Include details of interfaces with other materials that form part of air barrier.
- D. Product Certificates: From air barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with the barrier.
- E. Qualifications: For manufacturer and applicator.
- F. Field Quality Control: Submit field inspection reports.
- G. NFPA 285 Documentation: For each product, submit documentation listing compatible materials and components that when used together in wall assemblies as detailed on Drawings, comply with NFPA 285 testing and acceptance criteria.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with not less than 5 years of documented experience.
- B. Applicator Qualifications: Company specializing in performing work of the type specified, with minimum 5 years of documented experience and as follows:
 - 1. Applicator shall be approved or certified by the air barrier manufacturer.
 - 2. Applicator shall be an accredited installer under the Air Barrier Association of America's (ABAA) Quality Assurance Program.

1.07 MOCK-UP

- A. Construct mock-up, 4 feet long by 8 feet wide; include wall construction and door frame.
 - 1. Include junction with roofing membrane, building corner condition, and foundation wall intersection.
- B. Locate where directed.
- C. Mock-up may remain as part of the Work.

1.08 FIELD CONDITIONS

- A. Maintain temperature and humidity recommended by the materials manufacturers before, during and after installation.
- B. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

PART 2 PRODUCTS**2.01 MATERIALS**

- A. Source Limitations: Obtain primary air barrier materials and air barrier accessories from single source from single manufacturer.

2.02 PERFORMANCE REQUIREMENTS

- A. Air Barrier Performance: Air barrier assembly and seals with adjacent construction shall be capable of performing as a continuous air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, tie-ins to installed waterproofing, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

2.03 AIR BARRIER MATERIALS - VAPOR PERMEABLE AIR BARRIER

- A. Vapor Permeable Air Barrier Sheet, Fluid-Applied: Synthetic polymer membrane with an installed dry film thickness, according to manufacturer's written instructions, of 35 mils (0.9 mm) or thicker.
1. Physical and Performance Properties:
 - a. Dry Film Thickness: As recommended by weather barrier manufacturer.
 - b. Water Vapor Permeance: 15 perms, maximum; ASTM E96/E96M, Method B.
 - c. Air Permeance: 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. (0.02 L/sec per sq m, maximum, at 75 Pa); ASTM E2178.
 - d. Air Leakage - Assembly: Pass, less than 1 percent; ASTM E2357.
 - e. Elongation: 250 percent, minimum; ASTM D412.
 - f. Tensile Strength: 100 psi, minimum; ASTM D412.
 - g. Flame Spread Index: Less than 25, Class A; ASTM E84.
 - h. Smoke Developed Index: Less than 450, Class A; ASTM E84.
 - i. Nail Sealability: Pass, no leakage; ASTM D1970/D1970M.
 - j. VOC Content: 100 g/L, maximum.
 - k. Air barrier shall be an approved component of an NFPA 285 tested exterior wall assembly as detailed on Drawings; tested in accordance with, and complying with the acceptance criteria of NFPA 285.
 2. Products:
 - a. BASF; MasterSeal AWB 660: www.master-builders-solutions.basf.us
 - b. Carlisle Coatings & Waterproofing; Fire Resist Barritech VP: www.carlisleccw.com.
 - c. GCP Applied Technologies; Perm-a-Barrier VPL: www.gcpat.com.
 - d. Henry Company; Air-Bloc 17MR: www.henry.com.
 - e. Prosoco Inc.; R-Guard Spray Wrap MVP: www.prosoco.com.
 - f. Sto Corp.; StoGuard AirSeal: www.stocorp.com.
 - g. Tremco Inc.; EXOAIR 230: www.tremcosealants.com.
 - h. W.R. Meadows; Air-Shield LMP: www.wrmeadows.com.
 - i. Substitutions: See Section 01 6000 - Product Requirements.

2.04 ACCESSORY MATERIALS

- A. Primers: As recommended for substrate by air barrier material manufacturer and accessory manufacturers.
- B. Transitions and Flashings:
1. General:
 - a. Products shall be compatible with air barrier and approved by the air barrier manufacturer.
 - b. Maintain the continuity of the air and water barrier as it transitions to adjacent materials.
 - c. Materials shall be compatible with adjacent materials.
 - d. Transitions and flashings shall be an approved component of an NFPA 285 tested exterior wall assembly as detailed on Drawings; tested in accordance with, and complying with the acceptance criteria of NFPA 285.
 2. Silicone Sheet Transitions:
 - a. Pre-cured silicone rubber sheets and pre-molded corners.
 - b. Install using liquid-applied flashings and sealants as an adhesive.
 - c. Available products include, but are not limited to, the following:
 - 1) The Dow Chemical Company; Dowsil Silicone Transition Strip: www.dow.com.
 - 2) Momentive Performance Materials, Inc./GE; UltraSpan UST/USM Pre-Cured Silicone Transition Sheet and Molded Corners: www.siliconeforbuilding.com.
 - 3) Prosoco Inc.; R-Guard SureSpan EX: www.prosoco.com.
 - 4) Tremco, Inc.; ProGlaze ETA and Spectrem Simple Seal: www.tremcosealants.com.

3. Flexible Fabric Flashing - Self-Adhering: Self-adhering stainless steel/polymer fabric flashing. ASTM A240/A240M stainless steel sheet bonded with rubber-based adhesive to one sheet of polymer fabric. Flashing shall be self-adhering using a pressure-sensitive adhesive.
 - a. Type 304 stainless steel.
 - 1) Thickness: 2 mils, minimum.
 - b. Available products include, but are not limited to, the following:
 - 1) York Manufacturing, Inc.; York 304: www.yorkmfg.com.
 - 2) Momentive Performance Materials, Inc./GE; GE Elemax SS Flashing: www.siliconeforbuilding.com.
- C. Sealants: Provide non-sag, single component, silicone sealants compatible with air barrier and approved by the air barrier manufacturer.
- D. Miscellaneous Accessories:
 1. As recommended by air barrier manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces and conditions are ready to accept the work of this section.
 1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
 2. Verify that substrates have cured and aged for minimum time recommended in writing by air barrier manufacturer.
 3. Verify that substrates are visibly dry and free of moisture. Test concrete substrates for capillary moisture by plastic sheet method according to ASTM D4263.
 4. Verify that masonry joints are flush and completely filled with mortar.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.
- B. Mask and protect adjacent surfaces from over spray or dusting.
- C. Prepare static gaps and joints as recommended by air barrier manufacturer and as indicated on Drawings.
- D. Install transitions and flashings around corners of openings, around penetrations, and elsewhere as recommended by air barrier manufacturer and as indicated on Drawings.
 1. Use silicone sheet transitions and pre-molded corners adhered with liquid-applied flashings and sealants except where flexible fabric flashings or metal flashings are indicated on Drawings or recommended by air barrier manufacturer.
- E. Coordinate detailing of transitions to other materials in order to maintain a continuous air and water barrier.
 1. Ensure that transition materials are compatible with adjacent materials and substrates.
- F. When recommended by air barrier manufacturer, apply primer in accordance with manufacturer's instructions.
- G. Notify Architect of any issues prior to installing air barrier materials. Do not proceed with air barrier installation until issues have been resolved and approved by Architect.

3.03 INSTALLATION

- A. Apply primer to substrates as recommended by air barrier manufacturer.
- B. Ensure that all transitions, bridging of gaps and joints, corners, flashings, penetrations, and terminations are completed in accordance with the recommendations of the air barrier manufacturer and as indicated on Drawings.
- C. Apply air barrier material according to air barrier manufacturer's written instructions and details.
 1. Apply continuous unbroken air barrier material to substrates.

2. Apply air barrier material in full contact around protrusions such as masonry ties.
- D. Do not cover air barrier until it has been tested and inspected by testing agency.
- E. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air barrier components.
- F. Remove masking materials after installation.

3.04**FIELD QUALITY CONTROL**

- A. Field inspections and tests will be performed by an independent testing agency under provisions of Section 01 4000 - Quality Requirements.
 1. Owner will engage a qualified testing agency to perform tests and inspections.
- B. Inspections: Air barrier materials, accessories, and installation are subject to inspection for compliance with requirements. Inspections may include the following:
 1. Verification of substrate preparations. Do not cover until inspections are complete.
 2. Verification that transitions and flashing details are installed properly. Do not cover until inspections are complete.
 3. Continuity of air barrier system has been achieved throughout the building envelope with no gaps or holes.
 4. Air barrier dry film thickness.
 5. Site conditions for application temperature and dryness of substrates have been maintained.
 6. Maximum exposure time of materials to UV deterioration has not been exceeded.
 7. Compatible materials have been used.
 8. All penetrations have been sealed.
- C. Tests: As determined by testing agency from among the following tests:
 1. Air-Leakage-Location Testing: Air barrier assemblies will be tested for evidence of air leakage according to ASTM E1186, chamber pressurization or depressurization with smoke tracers.
 2. Adhesion Testing: Air barrier assemblies will be tested for required adhesion to substrate according to ASTM D4541 for each 600 sq. ft. (56 sq. m) of installed air barrier or part thereof.
- D. Air barriers will be considered defective if they do not pass tests and inspections.
 1. Deficiencies shall be corrected by the Contractor at no additional cost to the Owner.
- E. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.
- F. Prepare test and inspection reports.

3.05**PROTECTION**

- A. Protect air barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.
 1. Protect air barrier from exposure to UV light and harmful weather exposure as recommended by manufacturer.
 2. If exposed to these conditions for longer than recommended, remove and replace overexposed air barrier materials according to air barrier manufacturer's instructions.
- B. If damage occurs, patch damaged areas in accordance with air barrier manufacturer's instructions.

END OF SECTION

SECTION 07 4113 - METAL ROOF PANELS**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Architectural standing seam roofing system of preformed steel panels.
- B. Underlayment.
- C. Accessories.

1.02 RELATED REQUIREMENTS**1.03 REFERENCE STANDARDS**

- A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2022.
- B. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process 2022.
- C. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection 2021.
- D. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference 2000 (Reapproved 2023).
- E. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials 2022a, with Editorial Revision (2023).
- F. UL 2218 - Standard for Impact Resistance of Prepared Roof Covering Materials Current Edition, Including All Revisions.
- G. UL 580 - Standard for Tests for Uplift Resistance of Roof Assemblies Current Edition, Including All Revisions.
- H. UL 790 - Standard for Standard Test Methods for Fire Tests of Roof Coverings Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Storage and handling requirements and recommendations.
 - 2. Installation methods.
 - 3. Specimen warranty.
- C. Shop Drawings: Include layouts of roof panels, details of edge and penetration conditions, spacing and type of connections, flashings, underlayments, and special conditions.
- D. Verification Samples: For each roofing system specified, submit three samples of minimum size 12 inches square, representing actual roofing metal, thickness, profile, color, and texture.
 - 1. Include typical fastening detail.
- E. Warranty: Submit specified manufacturer's warranty and ensure that forms have been completed in Owner's name and are registered with manufacturer.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years of documented experience and approved by manufacturer.

1.06 MOCK-UPS

- A. See Section 01 4000 - Quality Requirements for additional requirements.
- B. Provide mock-up of 16 sq ft, including underlayment, shingles, eave protection membrane, and associated flashings.
- C. Locate as directed by Architect.

D. Mock-up may remain as part of the work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store roofing panels on project site as recommended by manufacturer to minimize damage to panels prior to installation.

1.08 FIELD CONDITIONS

A. Do not install metal roof panels, eave protection membrane or underlayment when surface, ambient air, or wind chill temperatures are below 45 degrees F.

1.09 WARRANTY

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
- B. Finish Warranty: Provide manufacturer's special warranty covering failure of factory-applied exterior finish on metal roof panels and agreeing to repair or replace panels that show evidence of finish degradation, including significant fading, chalking, cracking, or peeling within specified warranty period of twenty years from Date of Substantial Completion.
- C. Waterproofing Warranty: Provide manufacturer's warranty for weathertightness of roofing system, including agreement to repair or replace roofing that fails to keep out water within specified warranty period of five years from Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Standing Seam Metal Roof Panels:
1. AEP Span; Design Span HP: www.aepspan.com.
 2. Berridge Manufacturing Company; Cee-Lock Panel: www.berridge.com.
 3. Centria; SDP 175: www.centria.com.
 4. Elevate; Warranted Una-Clad UC- 4 Standing Seam Metal Roofing Panel : www.holcimelevate.com.
 5. Fabral; Thin Seam: www.fabral.com.
 6. MBCI, an NCI Building Systems company; Lokseam: www.mbc.com.
 7. Metal Sales Manufacturing Corp.; Vertical Seam: www.metalsales.us.com.
 8. Morin Corp., a Kingspan Group Company; SWL: www.morincorp.com.
 9. Petersen Aluminum Corporation; Snap-Clad Panel: www.pac-clad.com.
 10. Substitutions: See Section 01 6000 - Product Requirements.

2.02 ARCHITECTURAL METAL ROOF PANELS

- A. Architectural Metal Roof Panels: Provide complete engineered system complying with specified requirements and capable of remaining weathertight while withstanding anticipated movement of substrate and thermally induced movement of roofing system.
- B. Performance Requirements:
1. Water Penetration: No water penetration at 15 psf per ASTM E331.
 2. Wind Uplift: UL 580, Class 90.
 3. Hail Resistance: UL 2218, Class 4.
 4. Fire Resistance: UL 790, Class A.
- C. Architectural Metal Panels: Factory-formed panels with factory-applied finish.
1. Steel Panels:
 - a. Aluminum-zinc alloy-coated steel conforming to ASTM A792/A792M; minimum AZ50 coating. (Galvalume)
 - b. Steel Thickness: Minimum 22 gage (0.029 inch).
 2. Profile: Standing seam, with minimum 1.5 inch seam height; concealed fastener system with self-locking snap-together seams.
 3. Panel Coverage; Width: 16 inches.
- D. Metal Soffit Panels:
1. Profile: Style as indicated, with venting provided.
 2. Material: Precoated steel sheet, 22 gauge, 0.0299 inch minimum thickness.

3. Color: As selected by Architect from manufacturer's standard line.

2.03 ATTACHMENT SYSTEM

- A. Concealed System: Provide manufacturer's standard stainless steel or nylon-coated aluminum concealed anchor clips designed for specific roofing system and engineered to meet performance requirements, including anticipated thermal movement.

2.04 FABRICATION

- A. Panels: Provide factory fabricated panels with applied finish and accessory items, using manufacturer's standard processes as required to achieve specified appearance and performance requirements.
- B. Joints: Provide captive gaskets, sealants, or separator strips at panel joints to ensure weathertight seals, eliminate metal-to-metal contact, and minimize noise from panel movements.

2.05 FINISHES

- A. Fluoropolymer Coil Coating System: Polyvinylidene fluoride (PVDF) multi-coat superior performing organic coatings system complying with AAMA 2605, including at least 70 percent PVDF resin, and at least 80 percent of coil coated aluminum surfaces having minimum total dry film thickness (DFT) of 0.9 mil, 0.0009 inch.

1. Color: As selected from manufacturer's standards.

2.06 ACCESSORIES

- A. Miscellaneous Sheet Metal Items: Provide flashings, trim, closure strips, and similar sheet metal items of the same material, thickness, and finish as used for the roofing panels. Items completely concealed after installation may optionally be made of stainless steel.
- B. Rib and Ridge Closures: Provide prefabricated, close-fitting components of steel with corrosion resistant finish or combination steel and closed-cell foam.
- C. Sealants:
 1. Exposed Sealant: Elastomeric silicone as recommended by roof panel manufacturer, compatible with adjacent materials, and complying with requirements of Section 07 9200 - Joint Sealants.
 2. Concealed Sealant: Non-curing butyl sealant or tape sealant.
 3. Seam Sealant: Factory-applied, non-skinning, non-drying type.
- D. Underlayment: Self-adhering rubber-modified asphalt sheet complying with ASTM D1970/D1970M; 40 mil total thickness; with strippable release film and woven polypropylene sheet top surface.
 1. Water Vapor Permeance: 0.1 perm, maximum, when tested in accordance with ASTM E96/E96M using Desiccant Method (Method A).
 2. Designed to withstand temperatures up to 250 degrees F.
 3. Products:
 - a. Carlisle WIP Products, a division of Carlisle Construction Materials Inc.; WIP 300HT www.carlislewipproducts.com.
 - b. Firestone Building Products; Clad-Gard SA Metal Underlayment: www.firestonebpco.com.
 - c. GCP Applied Technologies Inc.; Grace Ice & Water Shield HT: www.gcpat.com.
 - d. Henry Company; Blueskin PE200HT : www.us.henry.com.
 - e. Polyguard Products, Inc.; Deckguard HT: www.polyguardproducts.com.
 - f. Soprema, Inc.; Lastobond Shield HT: www.soprema.us.
 - g. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin installation of preformed metal roof panels until substrates have been properly prepared.

- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A. Broom clean wood sheathing prior to installation of roofing system.
- B. Coordinate roofing work with provisions for roof drainage, flashing, trim, penetrations, and other adjoining work to ensure that completed roof will be free of leaks.
- C. Separate dissimilar metals by applying a bituminous coating, self-adhering rubberized asphalt sheet, or other permanent method approved by metal roof panel manufacturer.
- D. At locations where metal will be in contact with wood or other absorbent material subject to wetting, seal joints with sealing compound and apply one coat of heavy-bodied bituminous paint.

3.03 INSTALLATION

- A. Overall: Install roofing system in accordance with approved shop drawings and panel manufacturer's instructions and recommendations, as applicable to specific project conditions. Anchor all components of roofing system securely in place while allowing for thermal and structural movement.
 - 1. Install roofing system with concealed clips and fasteners, except as otherwise recommended by manufacturer for specific circumstances.
 - 2. Minimize field cutting of panels. Where field cutting is absolutely required, use methods that will not distort panel profiles. Use of torches for field cutting is absolutely prohibited.
- B. Accessories: Install all components required for a complete roofing assembly, including flashings, trim, closure strips, caps, rib closures, ridge closures, and similar roof accessory items.
- C. Underlayment:
 - 1. General: Install underlayment according to manufacturer's instructions and as specified.
 - a. Underlayments shall weather lap metal drip edges.
 - 2. Install self-adhering sheet underlayment with ends and edges weather lapped minimum 4 inches, stagger end laps of each consecutive layer.
 - a. Install without wrinkles; overlapping edges shall be sealed tightly without gaps.
 - b. Locations:
 - 1) Extend over entire roof area and return vertically against penetrating elements and sidewalls not less than 4 inches.
- D. Roof Panels: Install panels in strict accordance with manufacturer's instructions, minimizing transverse joints except at junction with penetrations.
 - 1. Incorporate concealed clips at panel joints, and snap panels together to provide weathertight joints.
 - 2. Provide sealant tape or other approved joint sealer at lapped panel joints.
 - 3. Install sealant or sealant tape, as recommended by panel manufacturer, at end laps and side joints.

3.04 CLEANING

- A. Clean exposed sheet metal work at completion of installation. Remove grease and oil films, excess joint sealer, handling marks, and debris from installation, leaving the work clean and unmarked, free from dents, creases, waves, scratch marks, or other damage to the finish.

3.05 PROTECTION

- A. Do not permit storage of materials or roof traffic on installed roof panels. Provide temporary walkways or planks as necessary to avoid damage to completed work. Protect roofing until completion of project.

- B. Touch-up, repair, or replace damaged roof panels or accessories before Date of Substantial Completion.

END OF SECTION

SECTION 07 6200 - SHEET METAL FLASHING AND TRIM**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Formed sheet metal items, including, but not limited to, the following:
 - 1. Flashings.
 - 2. Counterflashings.
 - 3. Drip edges.
 - 4. Gutters and downspouts.
 - 5. Precast splash blocks.
 - 6. Other items as indicated on Drawings.
- B. Manufactured reglets.

1.02 REFERENCE STANDARDS

- A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2022.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2023.
- C. ASTM B32 - Standard Specification for Solder Metal 2020.
- D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.
- E. FM DS 1-49 - FM Global Property Loss Prevention Data Sheet - Perimeter Flashing; 2016.
- F. NRCA (RM) - The NRCA Roofing Manual 2023.
- G. SMACNA (ASMM) - Architectural Sheet Metal Manual 2012.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week before starting work of this section.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.
- C. Samples:
 - 1. For each material and finish, submit three samples 4 by 4 inch in size illustrating metal finish color.
 - 2. Reglets: Submit three samples, 4 inches long, full size, of each type and finish.

1.05 QUALITY ASSURANCE

- A. Perform work in accordance with SMACNA (ASMM) requirements, except as otherwise indicated.
- B. Fabricator and Installer Qualifications: Company specializing in sheet metal work with 5 years of documented experience.

1.06 MOCK-UP

- A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Build mockup of typical wall flashing with counterflashing, approximately 10 feet long, including supporting construction cleats, seams, attachments and accessories.
 - 2. Locate where directed.
 - 3. Mock-up may remain as part of the Work.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
- B. Prevent contact with materials that could cause discoloration or staining.

PART 2 PRODUCTS**2.01 PERFORMANCE REQUIREMENTS**

- A. Perform work in accordance with SMACNA (ASMM) and NRCA (RM) requirements, unless more stringent requirements are indicated.
- B. Sheet metal flashing and trim shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction.
- C. Sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- D. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standards, and by Data Sheet FM DS 1-49: Perimeter Flashing, for application, but not less than thickness of metal being secured.
- E. Coordination:
 - 1. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.
 - 2. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

2.02 SHEET MATERIALS

- A. Pre-Finished Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24 gage, (0.0239) inch thick base metal, shop pre-coated with PVDF coating.
 - 1. PVDF (Polyvinylidene Fluoride) Coating: Superior Performance Organic Finish, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system.
 - 2. Color: As selected by Architect from manufacturer's standard colors.
- B. Pre-Finished Aluminum: ASTM B209 (ASTM B209M); 20 gage, (0.032 inch) thick, minimum; plain finish shop pre-coated with fluoropolymer coating.
 - 1. Fluoropolymer Coating: High Performance Organic Finish, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system.
 - 2. Color: As selected from manufacturer's standard line.

2.03 FABRICATION

- A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
- B. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes.
- C. Fabricate cleats of same material as sheet, interlocking with sheet.
- D. Form pieces in longest possible lengths.
- E. Hem exposed edges on underside 1/2 inch; miter and seam corners.
- F. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.
- G. Fabricate corners from one piece with minimum 18 inch long legs; seam for rigidity, seal with sealant.
- H. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.

2.04 GUTTER AND DOWNSPOUT FABRICATION

- A. Material: Pre-finished aluminum.
- B. Gutters: SMACNA (ASMM) Rectangular profile; matching Style A.
 - 1. Expansion Joints: Lap type.
- C. Downspouts: Rectangular profile.
- D. Gutters and Downspouts: Size for rainfall intensity determined by a storm occurrence of 1 in 10 years in accordance with SMACNA (ASMM), unless otherwise indicated.
- E. Anchorage Accessories: Profiled to suit gutters and downspouts.
 - 1. Anchorage Devices: In accordance with SMACNA (ASMM) requirements.
 - 2. Gutter Supports: Continuous cleat and straps.

- 3. Downspout Supports: Straps.
- F. Downspout Boots: Plastic, unless otherwise indicated.
- G. Seal metal joints.
- H. Accessories:
 - 1. Continuous, removable leaf screen; sheet metal frame and hardware cloth screen.
 - 2. Valley baffles.

2.05 ACCESSORIES

- A. General: Provide all related materials, fasteners, hardware and accessories for a complete installation.
- B. Fasteners: Same material and finish as flashing metal, with soft neoprene washers.
 - 1. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
 - 2. Exposed Fasteners: Heads matching color of sheet metal using factory-applied coating.
- C. Protective Backing Paint: Zinc molybdate alkyd.
- D. Concealed Sealants: Non-curing butyl sealant.
- E. Exposed Sealants: ASTM C920; elastomeric silicone sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; color to match adjacent material.
- F. Solder: ASTM B32; Sn96 type for stainless steel.

2.06 DRIP EDGES

- A. Material: Pre-finished aluminum.
- B. Provide L-shaped drip edges; extend horizontal leg 4 inches onto roof with vertical leg terminated with a 45 degree bent drip edge.
- C. At Contractor's option, provide manufactured drip edges of type and profile required.

2.07 REGLETS

- A. Manufactured Reglets: Units of type and profile required, formed to securely interlock with separate counterflashing pieces. Provide factory-mitered and welded corners and junctions.
 - 1. Material: Same material and finish as counterflashing metal.
 - 2. Surface Mounted Type: Provide slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
 - 3. Concrete Type: Provide temporary closure tape to keep reglet free of concrete materials, special fasteners for attaching reglet to concrete forms, and guides to ensure alignment of reglet section ends.
 - 4. Masonry Type: Provide with offset top flange for embedment in masonry mortar joint.
 - 5. Accessories:
 - a. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing's lower edge
 - 6. Manufacturers:
 - a. Cheney Flashing Company: www.cheneyflashing.com.
 - b. Fry Reglet Corporation: www.fryreglet.com.
 - c. Heckmann Building Products, Inc.: www.heckmannbuildingprods.com.
 - d. Hohmann & Barnard, Inc.: www.h-b.com.
 - e. Substitutions: See Section 01 6000 - Product Requirements.

2.08 PRECAST CONCRETE SPLASH BLOCKS

- A. Precast Concrete Splash Block:
 - 1. Size: Approximately 12 inches wide by 30 inches long by 4 inches deep.
 - 2. Color: Gray.
 - 3. Weight: Approximately 50 pounds.
 - 4. Manufacturers: Available manufacturer's include, but are not limited to, the following:
 - a. The Century Group: www.centurygrp.com.
 - b. Modern Pre-Cast, Inc.: www.modernprecast.com.

c. NuCast Precast Company: www.nucastprecast.com.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.
- B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.02 PREPARATION

- A. Install starter and edge strips, and cleats before starting installation.
- B. Install surface mounted reglets true to lines and levels, and seal top of reglets with sealant.
- C. To prevent galvanic action or corrosion, back paint concealed metal surfaces with protective backing paint, minimum dry film thickness of 3 mil, where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates.

3.03 INSTALLATION - GENERAL

- A. Install flashings and trim in accordance with SMACNA (ASMM) and NRCA (RM) requirements, unless more stringent methods are indicated.
- B. Unless otherwise indicated, provide pre-finished aluminum flashings and trim in areas exposed to public view; at all other areas provide stainless steel flashings.
- C. Insert flashings into reglets to form tight fit; secure in place with plastic wedges; seal flashings into reglets with sealant.
 - 1. Counterflashings shall lap base flashing 4 inches, minimum.
- D. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted.
- E. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.
- F. Seal metal joints watertight.
- G. For stainless steel, solder metal joints for full metal surface contact, and after soldering wash metal clean with neutralizing solution and rinse with water.
 - 1. Do not solder aluminum.

3.04 GUTTERS AND DOWNSPOUTS

- A. Secure gutters and downspouts in place with concealed fasteners.
 - 1. Gutter Supports: Space 30 inches on center, maximum.
 - 2. Downspout Supports: Locate at top and bottom of downspout and 60 inches on center, maximum.
- B. Slope gutters 1/4 inch per 10 feet, minimum, unless otherwise indicated.
- C. Where indicated, connect downspouts to downspout boots, and seal connection watertight.
- D. Where gutters spill on grade, provide precast concrete splash block at each downspout discharge.

3.05 DRIP EDGES

- A. Install at bottom edges of roof slopes, roof rakes, and elsewhere as indicated.
- B. Fasteners: Space 18 inches on center, maximum.

3.06 REGLETS

- A. Surface Mounted Type: Install according to manufacturer's instructions.
- B. Refer to Section 03 3000 - Cast-in-Place Concrete, for casting reglets in concrete.
- C. Refer to Section 04 2000 - Unit Masonry, for embedding reglets in masonry.

3.07 TOLERANCES

- A. Sheet Metal Flashing and Trim Tolerances:
 - 1. Install to tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings.

2. Install with 1/8 inch maximum offset of adjoining faces and of alignment of matching profiles.

3.08 CLEANING

- A. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended by sheet metal manufacturer. Maintain sheet metal flashing and trim in clean condition.
- B. Replace sheet metal flashing and trim damaged or deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 07 8400 - FIRESTOPPING**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Firestopping systems.
 - 1. Firestopping of joints and penetrations in fire resistance rated and smoke resistant assemblies, whether indicated on drawings or not, and other openings indicated.

1.02 REFERENCE STANDARDS

- A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems 2023a.
- B. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems 2015 (Reapproved 2019).
- C. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Firestop Systems 2020a.
- D. ASTM E2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers 2020a.
- E. ASTM E2307 - Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-story Test Apparatus 2023a.
- F. ASTM E2837 - Standard Test Method for Determining the Fire Resistance of Continuity Head-of-Wall Joint Systems Installed Between Rated Wall Assemblies and Nonrated Horizontal Assemblies 2023.
- G. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Schedule of Firestopping: List each type of penetration, each type of joint, fire rating of the penetrated assembly, firestopping test or design number, and illustration of each firestopping system.
- C. Product Data: Provide data on product characteristics, performance ratings, and limitations.
- D. Installer's qualification statement.

1.04 QUALITY ASSURANCE

- A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
 - 1. Listing in UL (FRD) will be considered as constituting an acceptable test report.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 5 years documented experience.
- C. Installer Qualifications: Company specializing in performing the work of this section and:
 - 1. Verification of minimum 5 years documented experience installing work of this type.

1.05 MOCK-UPS

- A. Install one firestopping assembly representative of each fire rating design required on project.
 - 1. Where one design may be used for different penetrating items or in different wall or floor constructions, install one assembly for each different combination.
 - 2. Where firestopping is intended to fill a linear opening, install at least 1 linear foot of firestopping.
- B. If accepted, mock-up will represent minimum standard for this work.
- C. If accepted, mock-up may remain as part of this work. Remove and replace mock-ups not accepted.

1.06 FIELD CONDITIONS

- A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.

- B. Provide ventilation in areas where solvent-cured materials are being installed.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Firestopping Manufacturers:
1. 3M Fire Protection Systems; www.3m.com.
 2. A/D Fire Protection Systems; www.adfire.com.
 3. Hilti Firestop; www.hilti.com.
 4. RectorSeal Firestop; www.rectorseal.com.
 5. Specified Technologies, Inc. (STI); www.stifirestop.com.
 6. Tremco Fire Protection Systems; www.tremcofirestop.com.
 7. Substitutions: See Section 01 6000 - Product Requirements.

2.02 MATERIALS

- A. Firestopping Materials: Any materials complying with firestopping assembly design requirements including, but not limited to, the following:
1. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer sleeve lined with an intumescent strip, a flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
 2. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.
 3. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
 4. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.
 5. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.
 6. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
 7. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.
 8. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.
 9. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
 10. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants
- B. Accessory Materials: For each firestopping assembly, provide all primers, forming/damming/backing materials, collars, sleeves, and related materials for a complete installation.

2.03 FIRESTOPPING ASSEMBLY REQUIREMENTS

- A. General:
1. Provide firestopping assemblies indicated, or, if not indicated, as required to comply with fire ratings indicated.
 2. Fire Ratings: As indicated on Drawings.
 3. Joint Firestopping:
 - a. Nominal Widths: As indicated on Drawings.
 - b. Movement Capabilities: Class 1, 50 percent compression or extension, unless otherwise indicated or required.

- B. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
1. Through Penetration Firestopping: Use system that has been tested according to ASTM E814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.
 - a. Temperature Rise: Provide systems that have been tested to show T Rating as indicated or required.
 - b. Air Leakage: Provide systems that have been tested to show L Rating as indicated, at Smoke Barriers, and elsewhere as indicated or required.
 - c. Watertightness: Provide systems that have been tested to show W Rating as indicated or required.
- C. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.
1. Perimeter Fire Containment Firestopping: Use system that has been tested according to ASTM E2307 to have fire resistance F Rating equal to required fire rating of floor assembly.
 - a. Movement: Provide systems that have been tested to show movement capability as indicated or required.
 - b. Temperature Rise: Provide systems that have been tested to show T Rating as indicated or required.
 - c. Air Leakage: Provide systems that have been tested to show L Rating as indicated or required..
 - d. Where floor assembly is not required to have a fire rating, provide systems that have been tested to show L Rating as indicated or required..
 2. Head-of-Wall Joint System Firestopping at Joints Between Fire-Rated Wall Assemblies and Non-Rated Horizontal Assemblies: Use system that has been tested according to ASTM E2837 to have fire resistance F Rating equal to required fire rating of floor or wall, whichever is greater.
 - a. Movement: Provide systems that have been tested to show movement capability as indicated or required.
 3. Floor-to-Floor, Wall-to-Wall, and Wall-to-Floor Joints, Except Perimeter, Where Both Are Fire-Rated: Use system that has been tested according to ASTM E1966 or UL 2079 to have fire resistance F Rating equal to required fire rating of the assembly in which the joint occurs.
 - a. Movement: Provide systems that have been tested to show movement capability as indicated or required.
 - b. Air Leakage: Provide systems that have been tested to show L Rating as indicated or required.
 - c. Watertightness: Provide systems that have been tested to show W Rating as indicated or required.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify openings are ready to receive the work of this section.

3.02 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.
- B. Remove incompatible materials that could adversely affect bond.

3.03 INSTALLATION

- A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.
- B. Do not cover installed firestopping until inspected by Owner's Independent Testing Agency.
- C. Do not cover installed firestopping until inspected by authorities having jurisdiction.

3.04 IDENTIFICATION

- A. General: Install labeling required by code.
- B. Wall Identification:
 - 1. Permanently label walls containing penetration firestopping systems with the words "FIRE /SMOKE BARRIER - PROTECT ALL OPENINGS."
 - a. Use lettering not less than 3 inches high and with minimum 0.375-inch strokes.
 - 2. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet from end of wall and at intervals not exceeding 30 feet.
- C. Penetration Identification:
 - 1. Identify each penetration firestopping system with legible metal or plastic labels.
 - 2. Attach labels permanently to surfaces adjacent to and within 6 inches of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems.
 - 3. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed.
 - 4. Include the following information on labels:
 - a. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 - b. Manufacturer's name.
 - c. Installer's name, address, and phone number.
 - d. Designation of applicable testing and inspecting agency.
 - e. Date of installation.

3.05 FIELD QUALITY CONTROL

- A. Independent Testing Agency: Inspection agency employed and paid by Owner, may examine penetration firestopping in accordance with ASTM E2174, and ASTM E2393.
- B. Repair or replace penetration firestopping and joints at locations where inspection results indicate firestopping or joints do not meet specified requirements.

3.06 CLEANING

- A. Clean adjacent surfaces of firestopping materials.

3.07 PROTECTION

- A. Protect adjacent surfaces from damage by material installation.

END OF SECTION

SECTION 07 9200 - JOINT SEALANTS**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Nonsag gunnable joint sealants.
- B. Self-leveling pourable joint sealants.
- C. Joint backings and accessories.

1.02 REFERENCE STANDARDS

- A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer 2015 (Reapproved 2022).
- B. ASTM C794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants 2018 (Reapproved 2022).
- C. ASTM C834 - Standard Specification for Latex Sealants 2017 (Reapproved 2023).
- D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.
- E. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems 2023.
- F. ASTM C1193 - Standard Guide for Use of Joint Sealants 2016 (Reapproved 2023).
- G. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants 2022.
- H. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants 2023.
- I. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints 2019 (Reapproved 2020).
- J. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness 2015 (Reapproved 2021).

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes the following.
 - 1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
 - 2. List of backing materials approved for use with the specific product.
 - 3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
 - 4. Substrates the product should not be used on.
 - 5. Substrates for which use of primer is required.
 - 6. Sample product warranty.
- C. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.
- D. Color Cards for Selection: Where custom colors are not specified, submit manufacturer's color cards showing standard colors available for selection.
- E. Samples for Verification: For each sealant color, submit at least three physical samples for color verification.
 - 1. Provide 1/2 inch wide joint sealant samples formed between two 4 inch long strips of material matching appearance of exposed surfaces adjacent to joint sealants.
- F. Preconstruction Laboratory Test Reports: Submit at least four weeks prior to start of installation.
- G. Field Quality Control Plan: Submit at least two weeks prior to start of installation.

- H. Field Quality Control Log: Submit filled out log for each length or instance of sealant installed, within 10 days after completion of inspections/tests; include bagged test samples and photographic records, if any.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 5 years documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section and with at least 5 years of documented experience.
- C. Preconstruction Laboratory Testing: Arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories.
 - 1. Adhesion Testing: In accordance with ASTM C794.
 - 2. Compatibility Testing: In accordance with ASTM C1087.
 - 3. Stain Testing: In accordance with ASTM C1248; required only for stone substrates.
 - 4. Allow sufficient time for testing to avoid delaying the work.
 - 5. Deliver to manufacturer sufficient samples for testing.
 - 6. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.
 - 7. Testing is not required if sealant manufacturer provides data showing previous testing, not older than 24 months, that shows satisfactory adhesion, lack of staining, and compatibility.
- D. Owner may employ an independent testing agency to perform the field quality control inspection and testing as referenced in PART 3 of this section and as follows, to prepare and submit the field quality control plan and log, and to provide recommendations of remedies in the case of failure.
 - 1. Contractor shall cooperate with testing agency and repair failures discovered.
 - 2. Otherwise, if Owner does not employ an independent testing agency, Contractor shall perform its own field quality control measures including the following:
 - a. Field Quality Control Plan and Log.
 - b. Field Adhesion Test Procedures.
- E. Field Quality Control Plan:
 - 1. Visual inspection of entire length of sealant joints.
 - 2. Non-destructive field adhesion testing of sealant joints, except interior acrylic latex sealants.
 - a. For each different sealant and substrate combination, allow for one test every 12 inches in the first 10 linear feet of joint and one test every 120 inches thereafter.
 - b. If any failures occur in the first 10 linear feet, continue testing at 48 inch intervals at no extra cost to Owner.
- F. Field Adhesion Test Procedures:
 - 1. Allow sealants to fully cure as recommended by manufacturer before testing.
 - 2. Have a copy of the test method document available during tests.
 - 3. Record the type of failure that occurred, other information required by test method, and the information required on the Field Quality Control Log.
 - 4. If any combination of sealant type and substrate does not show evidence of minimum adhesion or shows cohesion failure before minimum adhesion, report results to Architect.
 - 5. Non-Destructive Field Adhesion Test: Test for adhesion in accordance with ASTM C1521, using Nondestructive Spot Method.
 - a. Record results on Field Quality Control Log.
 - b. Repair failed portions of joints.

1.05 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective work within a five year period after Date of Substantial Completion.

- C. Warranty: Include coverage for installed sealants and accessories that fail to achieve watertight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.01 JOINT SEALANT APPLICATIONS

- A. Scope:
1. Exterior Joints: Seal open joints, whether or not the joint is indicated on drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to, the following items.
 - a. Wall expansion and control joints.
 - b. Joints between door, window, and other frames and adjacent construction.
 - c. Joints between different exposed materials.
 - d. Openings below ledge angles in masonry.
 - e. Other joints as indicated.
 2. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
 - a. Joints between door, window, and other frames and adjacent construction.
 - b. Other joints as indicated.
 3. Do not seal the following types of joints.
 - a. Intentional weepholes in masonry.
 - b. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.
 - c. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
 - d. Joints where installation of sealant is specified in another section.
 - e. Joints between suspended panel ceilings/grid and walls.
- B. Exterior Joints: Use non-sag non-staining silicone sealant, unless otherwise indicated.
1. Control and Expansion Joints in Concrete Paving: Self-leveling silicone traffic-grade sealant.
- C. Interior Joints: Use non-sag acrylic emulsion latex sealant, unless otherwise indicated.
1. Interior Sides of Aluminum Framing in Exterior Walls: Use non-sag non-staining silicone sealant, unless otherwise indicated.
 - a. Includes, but is not limited to, curtain walls, storefronts, and metal-framed skylights.
 2. Control Joints in Interior Concrete Slabs: Self-leveling silicone "traffic grade" sealant.
 3. Column Isolation Joints in Interior Concrete Slabs: Self-leveling silicone "traffic grade" sealant.
 4. Floor Joints in Wet Areas: Self-leveling silicone "traffic grade" sealant; not for continuous liquid immersion
 5. Joints between Fixtures in Wet Areas and Floors, Walls, and Ceilings: Mildew-resistant silicone sealant; clear, unless otherwise indicated.
 6. Joints between countertops and walls: Mildew-resistant silicone sealant; clear, unless otherwise indicated.
- D. Interior Wet Areas: Includes, but is not limited to, toilet rooms, showering areas, locker rooms, kitchens, and food service areas; fixtures in wet areas include plumbing fixtures, food service equipment, countertops, cabinets, and other similar items.

2.02 NONSAG JOINT SEALANTS

- A. Non-Staining Silicone Sealant: ASTM C920, Grade NS, Type S, Uses NT, A, G, M and O; not expected to withstand continuous water immersion or traffic.
1. Movement Capability: Plus and minus 50 percent, minimum.
 2. Non-Staining To Porous Stone: Non-staining to light-colored natural stone when tested in accordance with ASTM C1248.
 3. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
 4. Hardness Range: Comply with one of the following:

- a. 15 to 35, Shore A, when tested in accordance with ASTM C661.
- b. 25 to 35, Shore A, when tested in accordance with ASTM D2240.
5. Color: Custom color(s) to match Architect's sample(s).
6. Cure Type: Single-component, neutral moisture curing.
7. Service Temperature Range: Minus 40 to 250 degrees F.
8. Products:
 - a. Momentive Performance Materials, Inc./GE; SCS9000 SilPruf NB: www.siliconeforbuilding.com.
 - b. Pecora Corporation; 890NST: www.pecora.com.
 - c. Sika Corporation; Sikasil WS-295 FPS: www.usa.sika.com.
 - d. Tremco, Inc.; Spectrem 3: www.tremcosealants.com.
 - e. Dow Chemical Company; DOWSIL 790 Silicone Building Sealant: consumer.dow.com/en-us/industry/ind-building-construction.html/#sle.
 - f. Substitutions: See Section 01 6000 - Product Requirements.
- B. Traffic Grade Silicone Sealant: ASTM C920, Grade NS, Type S, Uses T, M, and O; not expected to withstand continuous water immersion.
 1. Movement Capability: Plus 100 percent, minus 50 percent, minimum
 2. Hardness Range: Comply with one of the following:
 - a. 5 to 15, Shore A, when tested in accordance with ASTM C661.
 - b. 85, Shore 00, when tested in accordance with ASTM C661.
 3. Color: To be selected by Architect from manufacturer's full range.
 4. Cure Type: Single-component, neutral moisture curing.
 5. Service Temperature Range: Minus 40 to 250 degrees F.
 6. Products:
 - a. Dow Corning; NS Parking Structure Sealant: www.dowcorning.com.
 - b. Pecora Corporation; 311NS: www.pecora.com.
 - c. Sika Corporation; Sikasil - 728 NS: www.usa.sika.com.
 - d. Tremco, Inc.; Spectrem 800: www.tremcosealants.com.
 - e. Substitutions: See Section 01 6000 - Product Requirements.
- C. Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Type S, Uses NT, A, G, and O; mildew resistant; not expected to withstand continuous water immersion or traffic.
 1. Movement Capability: Plus and minus 25 percent, minimum.
 2. Hardness Range: Comply with one of the following:
 - a. 15 to 35, Shore A, when tested in accordance with ASTM C661.
 - b. 25 to 35, Shore A, when tested in accordance with ASTM D2240.
 3. Color: Clear.
 4. Cure Type: Single-component, acetoxy or neutral moisture curing .
 5. Service Temperature Range: Minus 40 to 300 degrees F.
 6. Products:
 - a. Dow Corning; 786 Sealant M: www.dowcorning.com.
 - b. Momentive Performance Materials, Inc./GE; SCS1700 Sanitary: www.siliconeforbuilding.com.
 - c. Pecora Corporation; 898NST: www.pecora.com.
 - d. Sika Corporation; Sikasil - GP: www.usa.sika.com.
 - e. Tremco, Inc.; Tremsil 200 with fungicide: www.tremcosealants.com.
 - f. Substitutions: See Section 01 6000 - Product Requirements.
- D. Acrylic Emulsion Latex: Water-based; ASTM C834, single component, non-staining, non-bleeding, non-sagging; not intended for exterior use. Siliconized.
 1. Color: To be selected by Architect from manufacturer's full range.
 2. Grade: ASTM C834; Grade Minus 18 Degrees C (0 Degrees F).
 3. Products:
 - a. Franklin International Inc; Titebond Painter's Plus Caulk: www.titebond.com.
 - b. Pecora Corporation; AC-20 +Silicone: www.pecora.com.

- c. Sherwin Williams; 950A Siliconized Acrylic Latex Caulk: www.sherwin-williams.com.
- d. Tremco, Inc.; Tremflex 834: www.tremcosealants.com.
- e. Substitutions: See Section 01 6000 - Product Requirements.

2.03 SELF-LEVELING SEALANTS

- A. Self-Leveling Silicone Sealant: ASTM C920, Type S, Grade P, Uses T, M and O; single-component, explicitly approved by manufacturer for traffic exposure when recessed below traffic surface; not expected to withstand continuous water immersion.
 - 1. Movement Capability: Plus 100 percent, minus 50 percent, minimum.
 - 2. Hardness Range: Comply with one of the following:
 - a. 5 to 20, Shore A, when tested in accordance with ASTM C661.
 - b. 40 to 85, Shore 00, when tested in accordance with ASTM D2240.
 - 3. Color: To be selected by Architect from manufacturer's full range.
 - 4. Cure Type: Single-component, neutral moisture curing.
 - 5. Service Temperature Range: Minus 50 to 300 degrees F.
 - 6. Products:
 - a. Dow Corning; SL Parking Structure Sealant: www.siliconeforbuilding.com.
 - b. Pecora Corporation; 310SL: www.pecora.com.
 - c. Sika Corporation; Sikasil-728 SL: www.usa.sika.com.
 - d. Tremco, Inc.; Spectrem 900SL: www.tremcosealants.com.
 - e. Substitutions: See Section 01 6000 - Product Requirements.

2.04 ACCESSORIES

- A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
 - 1. Type for Joints Not Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type B - Bi-Cellular Polyethylene.
 - 2. Type for Joints Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type B - Bi-Cellular Polyethylene.
 - 3. Bi-Cellular: 25 to 33 percent larger in diameter than joint width.
- B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.
- C. Masking Tape: Self-adhesive, nonabsorbent, non-staining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.
- D. Primers: Type recommended by sealant manufacturer to suit application; non-staining.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that joints are ready to receive work.
- B. Verify that backing materials are compatible with sealants.
- C. Verify that backer rods are of the correct size.

3.02 PREPARATION

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.
- E. Concrete Floor Joints That Will Be Exposed in Completed Work: Test joint filler in inconspicuous area to verify that it does not stain or discolor slab.

3.03 INSTALLATION

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

- B. Perform installation in accordance with ASTM C1193.
- C. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer.
- D. Install bond breaker backing tape where backer rod cannot be used.
- E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
- F. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.
- G. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.
- H. Concrete Floor Joint Filler: After full cure, shave joint filler flush with top of concrete slab.
- I. Installation of Two-Stage Joints at Precast Architectural Concrete Units:
 - 1. Joint system consists of two back-to-back sealant joints at each precast architectural concrete unit joint with a weep at the bottom of the unit joint per Precast/Prestressed Concrete Institute (PCI) recommendations and as follows:
 - a. Inner (Secondary) Seal: Inner secondary backer rod and sealant joint is installed a minimum of 2 to 2-1/2 inches beyond the exposed face of the precast architectural concrete panels within the panel joint itself.
 - b. Exterior (Primary) Seal: Following the installation of the secondary joint, the outer primary backer rod and sealant joint is installed at the face of the precast architectural concrete panels with a weep at the bottom of the joint. Leave open continuous air space between the primary backer rod and inner secondary seal.
 - c. Install 3/8 inch minimum weep openings in the exterior seal to allow water penetrating the exterior seal and contained by the inner seal to exit the cavity between joint seals.
 - 1) Do not install weeps below finish grades.
 - d. Near the junction of horizontal and vertical joints, the inner seal must turn out to the plane of the exterior seal at regular intervals to force water out of the joint.

3.04 FIELD QUALITY CONTROL

- A. Owner may employ an independent testing agency to perform field quality control inspection and testing as specified in PART 1 under QUALITY ASSURANCE article.
- B. Non-Destructive Adhesion Testing: If there are any failures in first 100 linear feet, notify Architect immediately.
- C. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.

END OF SECTION

SECTION 08 1612 - FRP-FACED ALUMINUM DOORS AND FRAMES**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Flush aluminum doors with fiberglass reinforced plastic (FRP) face sheets.
- B. Aluminum frames.
- C. Aluminum insert framing.

1.02 ABBREVIATIONS

- A. FRP: Fiberglass reinforced plastic.

1.03 REFERENCE STANDARDS

- A. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document) 2015.
- B. AAMA 701/702 - Performance Specification for Pile Weatherstrips (AAMA 701) and Polymer Weatherseals (AAMA 702) 2023.
- C. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2022.
- D. ADA Standards - 2010 ADA Standards for Accessible Design 2010.
- E. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.
- F. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2014.
- G. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric) 2014.
- H. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes 2021.
- I. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric) 2021.
- J. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus 2021.
- K. ASTM D1621 - Standard Test Method for Compressive Properties of Rigid Cellular Plastics 2016 (Reapproved 2023).
- L. ASTM D2244 - Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates 2023.
- M. ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics 2023, with Editorial Revision.
- N. ASTM D4214 - Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films 2007 (Reapproved 2015).
- O. ASTM D570 - Standard Test Method for Water Absorption of Plastics 2022.
- P. ASTM D638 - Standard Test Method for Tensile Properties of Plastics 2022.
- Q. ASTM D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials 2017.
- R. ASTM D2583 - Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor 2013a.
- S. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2023c.
- T. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

- B. Product Data: Manufacturer's descriptive literature for each type of door and frame; include information on fabrication methods, hardware preparation, accessories, installation, and maintenance instructions.
- C. Shop Drawings: Include elevations of each opening type and details at each wall type.
 - 1. Include details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
- D. Selection Samples: Complete set of color and finish options, using actual materials, for Architect's selection.
- E. Verification Samples: Three actual pieces of products in each finish specified, not less than 4 inches square or 6 inches long for linear components.
- F. Manufacturer's Qualification Statement.
- G. Installer's Qualification Statement.
- H. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with not less than five years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of type specified and with at least five years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver aluminum components in manufacturer's standard protective packaging, palletted, crated, or banded together.
- B. Inspect delivered components for damage and replace. Repaired components will not be accepted.
- C. Store components in clean, dry, indoor area, under cover in manufacturer's packaging until installation.
- D. Protect materials and finish from damage during handling and installation.

1.07 FIELD CONDITIONS

- A. Do not begin installation of interior aluminum components until space has been enclosed and ambient thermal conditions are being maintained at levels consistent with final project requirements.

1.08 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide ten year manufacturer warranty for defects in workmanship and materials.
- C. Provide 25 year warranty on fiberglass reinforced plastic (FRP) face sheets covering delamination, bubbling, and panel corrosion.
- D. Provide 20 year warranty on aluminum finishes in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Flush Aluminum Doors with Fiberglass Reinforced Plastic (FRP) Face Sheets:
 - 1. Special-Lite, Inc.; SL-17 Door: www.special-lite.com.
 - 2. Substitutions: See Section 01 6000 - Product Requirements.

- B. Aluminum Frames:
 1. Special-Lite, Inc.; SL-245 Applied Stop Framing: www.special-lite.com.
 2. Substitutions: See Section 01 6000 - Product Requirements.
- C. Aluminum Inset Framing:
 1. Special-Lite, Inc.; 10-30 Series Inset Framing: www.special-lite.com.
 2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 DESIGN CRITERIA

- A. Provide door assemblies that have been designed and fabricated in compliance with specified performance requirements.
- B. Factory install door hardware to the greatest extent possible.
- C. Accessibility: Conform to ICC A117.1 and ADA Standards.
- D. Door and Frame Dimensions and Shapes: As indicated on Drawings; dimensions indicated are nominal.
 1. Provide the following clearances:
 - a. Hinge and Lock Stiles: 1/8 inch.
 - b. Between Meeting Stiles: 1/4 inch.
 - c. At Top Rail and Bottom Rail: 1/8 inch.

2.03 MATERIALS

- A. Aluminum Sheet: ASTM B209 (ASTM B209M), alloy 5005, temper H14, stretcher leveled.
- B. Extruded Aluminum: ASTM B221 (ASTM B221M), alloy 6063, temper T5, or alloy 6463, temper T5.
- C. Fiberglass Reinforced Plastic (FRP) Face Sheet Properties:
 1. Ultraviolet stabilized.
 2. Surface Burning Characteristics: Flame spread index (FSI) of 76 to 200, Class C, and smoke developed index (SDI) of 450 or less; when tested in accordance with ASTM E84.
 3. Izod Impact Resistance: ASTM D256, 12 ft lbf/inch of width, minimum, with notched izod.
 4. Tensile Strength at Break: ASTM D638, 13,000 psi, minimum.
 5. Water Absorption: ASTM D570, 0.20 percent, maximum, after 24 hours at 74 degrees F.
 6. Flexural Strength: ASTM D790, 21,000 psi, minimum.
 7. Barcol Hardness: ASTM D2583, minimum of 50 units.
- D. Foam Insulation Fill Material:
 1. Manufacturer's standard polystyrene or polyurethane foam.
 - a. Compressive Strength:
 - 1) Polystyrene: 25 psi; ASTM D1621
 - 2) Polyurethane: 60 psi; ASTM D1621.
 - b. Thermal Resistance:
 - 1) Polystyrene: R-value 5.0 per inch, minimum; ASTM C518.
 - 2) Polyurethane: R-value 6.8 per inch, minimum; ASTM C518.

2.04 DOORS

- A. Flush Aluminum Doors with Fiberglass Reinforced Plastic (FRP) Face Sheets:
 1. Overall Door Thickness: 1-3/4 inches.
 2. Internal Framing: Extruded aluminum tubing, 1/8 inch minimum thickness, with heavy-duty plated steel through bolts in rails.
 - a. Top and Bottom Rails: 6 inches wide.
 - b. Side Stiles: 2-1/2 inches wide.
 3. Provide manufacturer's standard aluminum and steel reinforcements for door hardware; 1/8 inch minimum thickness.
 4. Facing: Seamless laminated FRP sheet.
 - a. Sheet Thickness: 0.12 inch, minimum.
 - b. Texture - FRP: Pebble grain.
 - c. Color: As selected by Architect from manufacturer's standard line.

5. Perimeter Edges: Extruded aluminum caps or returns that capture and secure edges of FRP face sheets.
 - a. Door Edge Profile: Hinged edge square, and lock edge beveled.
6. Core: Foam insulation fill material.
7. Vision Lites: Extruded aluminum framed, gasket glazed.
 - a. Glazing: As specified in Section 08 8000 - Glazing.
8. Aluminum Finish: Superior performing organic coating.
 - a. Color: As selected by Architect from manufacturer's standard line.
9. Hardware:
 - a. Weatherstripping: Replaceable pile type; at jambs and head of exterior doors.
 - b. Bottom Sweep: Manufacturer's standard double brush sweep.
 - c. Door Pulls: Provide recessed flush door pulls, unless otherwise indicated.
 - 1) Products:
 - (a) Special-Lite, Inc.; SL-82: www.special-lite.com.
 - (b) Vale Doors; FP-8; www.valedoors.com.
 - (c) Substitutions: See Section 01 6000 - Product Requirements.
 - d. Balance of Hardware: Refer to Section 08 7100 - Door Hardware.

2.05 FRAMING

- A. Aluminum Frames for Doors, Sidelights, or Transoms: Extruded aluminum, thermally broken hollow or C-shaped sections.
 1. Frame Depth: 4-1/2 inches.
 2. Frame Width (Face): 2 inches.
 3. Extruded aluminum shapes, not less than 0.125 inch thick.
 4. Provide manufacturer's standard aluminum and steel reinforcements for door hardware; 1/8 inch minimum thickness.
 5. Finish: Same as doors.
 6. Weatherstripping: Replaceable pile type; at jambs and head.
 7. Glazing: As specified in Section 08 8000.
 8. Stops: Manufacturer's standard applied stops.
 - a. Height: 5/8 inch high.
 - b. Provide pressure gasket weather seals.

2.06 INSERT FRAMING

- A. Insert Framing: Extruded aluminum door framing designed for installation within existing door framing.
 1. Extruded aluminum shapes, not less than 0.125 inch thick.
 2. Includes integral door stop.
 3. Weatherstripping: Replaceable pile type.
 4. Corner Joints: Mitered.
 5. Finish: Same as doors.
- B. Flush Infill Panels:
 1. Panel Thickness: 1 inch overall thickness.
 2. Face Sheets: Laminated FRP sheet; finish and thickness same as doors without any visible seams.
 3. Core: Rigid insulating material matching door core.
- C. Louvers: Blades and frame of extruded aluminum, minimum 0.06 inch thick; size as indicated.
 1. Style: Sightproof inverted V or Y blades

2.07 FINISHES FOR ALUMINUM

- A. Superior Performing Organic Coatings: Multiple coats, thermally cured polyvinylidene fluoride (PVDF) system; AAMA 2605.
 1. Polyvinylidene fluoride (PVDF) multi-coat thermoplastic fluoropolymer coating system, with minimum 70 percent PVDF color topcoat and minimum dry film thickness 0.9 mil; color and gloss as indicated on drawings.

2. Color: Two-Coat Color Selected from Manufacturer's Standard Line.
- B. Touch-Up Materials: As recommended by coating manufacturer for field application.

2.08 ACCESSORIES

- A. Replaceable Weatherstripping: AAMA 701/702 wool pile.
- B. Fasteners: Aluminum, non-magnetic stainless steel, or other material warranted by manufacturer as non-corrosive and compatible with aluminum components.
 1. Provide concealed fasteners where possible.
 2. Exposed fasteners shall match finish of doors and frames.
- C. Brackets and Reinforcements: Manufacturer's high-strength aluminum units where feasible, otherwise, non-magnetic stainless steel or steel hot-dip galvanized in compliance with ASTM A123/A123M.
- D. Laminating Adhesive: Manufacturer's standard low-VOC materials.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that wall surfaces and openings are ready to receive frames and are within tolerances specified in manufacturer's instructions.
- B. Verify that frames installed by other trades for installation of doors of this section are in strict accordance with recommendations and approved shop drawings and within tolerances specified in manufacturer's instructions.
- C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A. Perform cutting, fitting, forming, drilling, and grinding of frames as required for project conditions.
- B. Replace components with damage to exposed finishes.
- C. Separate dissimilar metals to prevent electrolytic action between metals.

3.03 INSTALLATION

- A. Install doors and frames in accordance with manufacturer's instructions.
- B. Set frames plumb, square, level, and aligned to receive doors. Anchor frames to adjacent construction in strict accordance with manufacturer's recommendations and within specified tolerances.
- C. Where aluminum surfaces contact metals other than stainless steel, zinc, or small areas of white bronze, protect from direct contact by painting dissimilar metal with heavy coating of bituminous paint.
- D. Hang doors and adjust hardware to achieve specified clearances and proper door operation.
- E. Install door hardware as specified in Section 08 7100.
- F. Comply with glazing installation requirements of Section 08 8000.
- G. Coordinate installation of electrical connections to electrical hardware items.

3.04 FIELD QUALITY CONTROL

- A. Provide services of FRP door manufacturer's field representative to observe for proper installation of system and submit report.

3.05 TOLERANCES

- A. Tolerances: Install framing systems in accordance with the following tolerances:
 1. Variation from Plane: Do not exceed 1/8 inch in 12 feet of length or 1/4 inch in any total length.
 2. Offset from Alignment: Maximum offset from true alignment between 2 identical members abutting end to end in line shall not exceed 1/16 inch.

3. Diagonal Measurements: Maximum difference in diagonal measurements shall not exceed 1/8 inch.
4. Offset at Corners: Maximum out-of-plane offset of framing at corners shall not exceed 1/32 inch.

3.06 ADJUSTING

- A. Adjust for smooth and balanced door movement.

3.07 CLEANING

- A. Upon completion of installation, thoroughly clean door and frame surfaces in accordance with AAMA 609 & 610.
- B. Do not use abrasive, caustic, or acid cleaning agents.

3.08 PROTECTION

- A. Protect products of this section from damage caused by subsequent construction until Date of Substantial Completion.
- B. Replace damaged or defective components that cannot be repaired to a condition indistinguishable from undamaged components.

END OF SECTION

SECTION 08 3100 - ACCESS DOORS AND PANELS**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Wall- and ceiling-mounted access units.

1.02 DEFINITIONS

- A. Wet Areas: Includes the following:
 - 1. Exterior locations.
 - 2. Showers.
 - 3. Other areas as indicated.
- B. Non-Wet Areas: Areas that are not indicated or listed as wet areas including, but not limited to, the following:
 - 1. Kitchens.
 - 2. Locker rooms.
 - 3. Toilet rooms.
 - 4. Janitor closets.

1.03 REFERENCE STANDARDS

- A. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable 2021a.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2023.
- C. ITS (DIR) - Directory of Listed Products Current Edition.
- D. UL (FRD) - Fire Resistance Directory Current Edition.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.
- C. Shop Drawings: Indicate exact position of each access door and/or panel unit.
- D. Project Record Documents: Record actual locations of each access unit.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 5 years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least 5 years documented experience.

PART 2 PRODUCTS**2.01 MATERIALS**

- A. Steel: Sheet complying with the following:
 - 1. All areas except wet areas: ASTM A1008/A1008M.
 - 2. Wet areas: ASTM A653/A653M Grade 33; A40 galvannealed.

2.02 WALL- AND CEILING-MOUNTED ACCESS UNITS

- A. Manufacturers:
 - 1. Acudor; www.acudor.com.
 - 2. Babcock-Davis; www.babcockdavis.com.
 - 3. JL Industries/Activar Construction Products Group, Inc; www.activarcpg.com/jl-industries.
 - 4. Karp Associates, Inc; www.karpinc.com.
 - 5. Larsen's Manufacturing Company; www.larsenmfg.com.
 - 6. Milcor / Hart & Cooley Inc; www.milcorinc.com.
 - 7. MIFAB, Inc.; www.mifab.com.
 - 8. Nystrom; www.nystrom.com.

9. Substitutions: See Section 01 6000 - Product Requirements.
- B. General:
 1. Factory fabricate doors and frames.
 2. Fully assemble units with corner joints welded, filled and ground flush; square and without rack or warp.
 3. Coordinate requirements with type of installation assembly being used for each unit.
- C. Flush Access Doors with Exposed Flanges:
 1. Locations: Masonry.
 2. Material: Steel.
 3. Style: Exposed frame with door surface flush with frame surface.
 - a. Masonry Mounting Criteria: Provide masonry anchor straps.
 4. Door Style: Single thickness with rolled or turned in edges.
 5. Doors: 14 gage, 0.0747 inch, minimum thickness.
 6. Frames: 16 gage, 0.0598 inch, minimum thickness.
 7. Steel Finish: Primed; manufacturer's standard rust-inhibitive powder coat.
 8. Door/Panel Size: As indicated on the drawings.
 9. Hardware:
 - a. Hinges: Concealed, constant force closure spring type.
 - b. Handle: No handle.
 - c. Latch/Lock: Screw driver slot for quarter turn cam latch.
 - d. Number of Locks/Latches Required: As recommended by manufacturer for size of unit.
- D. Flush Access Doors with Concealed Flanges:
 1. Locations: Gypsum board.
 2. Material: Steel.
 3. Style: Concealed flange for drywall.
 - a. Gypsum Board Mounting Criteria: Use drywall bead type frame.
 4. Door Style: Single thickness with rolled or turned in edges.
 5. Doors: 14 gage, 0.0747 inch, minimum thickness
 6. Frames: 16 gage, 0.0598 inch, minimum thickness.
 7. Steel Finish: Primed; manufacturer's standard rust-inhibitive powder coat.
 8. Door/Panel Size: As indicated on the drawings.
 9. Hardware:
 - a. Hinges: Concealed, constant force closure spring type.
 - b. Handle: No handle.
 - c. Latch/Lock: Screw driver slot for quarter turn cam latch.
 - d. Number of Locks/Latches Required: As recommended by manufacturer for size of unit.
- E. Fire-Rated, Flush, Uninsulated, Access Doors with Exposed Flanges:
 1. Locations: Masonry.
 2. Material: Steel.
 3. Style: Exposed frame with door surface flush with frame surface.
 - a. Masonry Mounting Criteria: Provide masonry anchor straps.
 4. Door Style: Single thickness with rolled or turned in edges.
 5. Doors: 16 gage, 0.0598 inch, minimum thickness
 6. Frames: 16 gage, 0.0598 inch, minimum thickness.
 7. Fire-Rating: Fire rating as required by applicable code for fire-rated assembly that access doors are being installed.
 - a. Provide products listed by ITS (DIR) or UL (FRD) as suitable for purpose indicated.
 8. Steel Finish: Primed; manufacturer's standard rust-inhibitive powder coat.
 9. Door/Panel Size: As indicated on the drawings.
 10. Hardware: Automatic closing, self-latching, with interior latch release.
 - a. Hinges: Exposed, continuous piano hinge.

- b. Handle: No handle.
 - c. Latch/Lock: Cylinder lock-operated cam latch, two keys for each unit.
 - d. Number of Locks/Latches Required: As recommended by manufacturer for size of unit.
 - e. Inside Latch Release: Mechanism that allows door/panel to be opened from inside.
- F. Fire-Rated, Flush, Uninsulated, Access Doors with Concealed Flanges:
- 1. Locations: Gypsum board.
 - 2. Material: Steel.
 - 3. Style: Concealed flange for drywall.
 - a. Gypsum Board Mounting Criteria: Use drywall bead type frame.
 - 4. Door Style: Single thickness with rolled or turned in edges.
 - 5. Doors: 16 gage, 0.0598 inch, minimum thickness
 - 6. Frames: 16 gage, 0.0598 inch, minimum thickness.
 - 7. Fire-Rating: Fire rating as required by applicable code for fire-rated assembly that access doors are being installed.
 - a. Provide products listed by ITS (DIR) or UL (FRD) as suitable for purpose indicated.
 - 8. Steel Finish: Primed; manufacturer's standard rust-inhibitive powder coat.
 - 9. Door/Panel Size: As indicated on the drawings.
 - 10. Hardware: Automatic closing, self-latching, with interior latch release.
 - a. Hinges: Exposed continuous piano hinge.
 - b. Handle: No handle.
 - c. Latch/Lock: Cylinder lock-operated cam latch, two keys for each unit.
 - d. Number of Locks/Latches Required: As recommended by manufacturer for size of unit.
 - e. Inside Latch Release: Mechanism that allows door/panel to be opened from inside.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that rough openings are correctly sized and located.
- B. Begin installation only after substrates have been properly prepared, and if the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to proceeding with this work.
- B. Prepare surfaces using methods recommended by manufacturer for applicable substrates in accordance with project conditions.

3.03 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Install frames plumb and level in openings, and secure units rigidly in place.
- C. Position units to provide convenient access to concealed equipment when necessary.

3.04 ADJUSTING

- A. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION

SECTION 08 3613 - SECTIONAL DOORS**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Overhead sectional doors, manually operated.
- B. Operating hardware and supports.

1.02 REFERENCE STANDARDS

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2023.
- B. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference 2014 (Reapproved 2021).
- C. DASMA 102 - American National Standard Specifications for Sectional Doors 2018.
- D. ITS (DIR) - Directory of Listed Products Current Edition.
- E. UL (DIR) - Online Certifications Directory Current Edition.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate opening dimensions and required tolerances, connection details, anchorage spacing, hardware locations, and installation details.
 - 1. Include plans, elevations, sections, and installation details.
 - 2. Include diagrams for power, signal, and control wiring.
- C. Product Data: Show component construction, anchorage method, and hardware.
- D. Verification Samples: Three actual pieces of products in each finish specified, not less than 6 inches square or 6 inches long for linear components.
- E. Manufacturer's Qualification Statement.
- F. Installer's Qualification Statement.
- G. Operation Data: Include normal operation, troubleshooting, and adjusting.
- H. Maintenance Data: Include data for motor and transmission, shaft and gearing, lubrication frequency, spare part sources.
- I. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 5 years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of type specified and with at least 5 years documented experience.
- C. Products Requiring Electrical Connection: Listed and classified by ITS (DIR), UL (DIR), or testing firm acceptable to authorities having jurisdiction, as suitable for purpose specified.

1.05 WARRANTY

- A. See Section 01 7800 - Closeout Submittals for warranty requirements.
- B. Provide two year manufacturer warranty for defects in workmanship and materials from date of Substantial Completion.
- C. Provide 3 year manufacturer warranty against excessive degradation of finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Basis of Design: Model 422 manufactured by Overhead Door Corp..
- B. Other Acceptable Manufacturers - Sectional Doors:

1. C.H.I. Overhead Doors: www.chiohd.com/#sle.
2. Clopay Building Products: www.clopaydoor.com/#sle.
3. Raynor Garage Doors: www.raynor.com/#sle.
4. Wayne-Dalton, a Division of Overhead Door Corporation: www.wayne-dalton.com/#sle.
5. Substitutions: See Section 01 6000 - Product Requirements.

2.02 STEEL DOORS

- A. Steel Doors: Flush steel, insulated; standard lift operating style with track and hardware; complying with DASMA 102, Commercial application.
 1. Performance: Withstand positive and negative wind loads equal to 1.5 times design wind loads specified by local code without damage or permanent set, when tested in accordance with ASTM E330/E330M, using 10 second duration of maximum load.
 2. Door Nominal Thickness: 2 inches thick.
 3. Exterior Finish: Factory finished with polyester baked enamel; color as selected from manufacturers standard line.
 4. Manual Operation: Chain hoist.
- B. Door Panels: Steel construction; outer steel sheet of 20 gauge, 0.0359 inch minimum thickness, flush profile; inner steel sheet of 20 gauge, 0.0359 inch minimum thickness, flat profile; core reinforcement sheet steel roll formed to channel shape, rabbeted weather joints at meeting rails; polyurethane insulation.

2.03 COMPONENTS

- A. Track: Rolled galvanized steel, 0.090 inch minimum thickness; 2 inch wide, continuous one piece per side; galvanized steel mounting brackets 1/4 inch thick.
 1. Track Configuration: As indicated on Drawings.
- B. Hinge and Roller Assemblies: Heavy duty hinges and adjustable roller holders of stainless steel; floating hardened steel bearing rollers, located at top and bottom of each panel, each side.
- C. Lift Mechanism: Torsion spring on cross head shaft, with braided stainless steel lifting cables.
 1. For Manual Operation: Requiring maximum exertion of 25 lbs force to open.
- D. Sill Weatherstripping: Resilient hollow rubber strip, one piece; fitted to bottom of door panel, full length contact.
- E. Jamb Weatherstripping: Roll formed aluminum section full height of jamb, fitted with resilient weatherstripping, placed in moderate contact with door panels.
- F. Head Weatherstripping: EPDM rubber seal, one piece full length.
- G. Panel Joint Weatherstripping: Neoprene foam seal, one piece full length.
- H. Lock: Inside side mounted, adjustable keeper, spring activated latch bar with feature to retain in locked or retracted position; interior and exterior handle. Finish to match aluminum door framing.

2.04 MATERIALS

- A. Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G60/Z180 coating, plain surface.
- B. Insulation: Foamed-in-place polyurethane.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that wall openings are ready to receive work and opening dimensions and tolerances are within specified limits.

3.02 INSTALLATION

- A. Install door unit assembly in accordance with manufacturer's instructions.
- B. Anchor assembly to wall construction and building framing without distortion or stress.

- C. Securely brace door tracks suspended from structure. Secure tracks to structural members only.
- D. Fit and align door assembly including hardware.
- E. Install perimeter trim and closures.
- F. Test and adjust controls and safety devices

3.03 TOLERANCES

- A. Maximum Variation from Plumb: 1/16 inch.
- B. Maximum Variation from Level: 1/16 inch.
- C. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch from 10 ft straight edge.
- D. Maintain dimensional tolerances and alignment with adjacent work.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for general requirements for field quality control and inspection.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Operate doors to confirm proper operation and door performance.
 - 2. Test controls and safety devices.
 - 3. Prepare field inspection reports.
- C. Repair or replace installations where inspections indicate that they do not comply with specified requirements.
- D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

3.05 ADJUSTING

- A. Adjust door assembly for smooth operation and full contact with weatherstripping.

3.06 CLEANING

- A. Clean doors and frames and glazing.
- B. Remove temporary labels and visible markings.

3.07 PROTECTION

- A. Protect installed products from damage until Date of Substantial Completion.
- B. Do not permit construction traffic through overhead door openings after adjustment and cleaning.

3.08 DEMONSTRATION AND TRAINING

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

END OF SECTION

SECTION 08 7100 - DOOR HARDWARE**PART 1 – GENERAL****1.01 SUMMARY**

- A. Section includes furnishing, installation and commissioning of mechanical, electro-mechanical, battery-operated wireless and wire free door hardware for doors specified in “Hardware Sets” and required by actual conditions: including screws, bolts, expansion shields, electrified door hardware, and other devices including access and security requirements for proper application of hardware.
- B. Related Divisions:
 - 1. Division 03 Concrete
 - 2. Division 06 Rough & Finish Carpentry
 - 3. Division 07 Joint Sealants
 - 4. Division 08 Openings
 - 5. Division 09 Finishes
 - 6. Division 13 Special Construction
 - 7. Division 25 Integrated Automation
 - 8. Division 26 Electrical
 - 9. Division 27 Communications
 - 10. Division 28 Electronic Safety and Security

1.02 REFERENCES

- A. American National Standards Institute/Builders Hardware Manufacturers Association (ANSI):
 - 1. ANSI/BHMA A156.1 Butts & Hinges (2016)
 - 2. ANSI/BHMA A156.2 Bored & Preassembled Locks & Latches (2017)
 - 3. ANSI/BHMA A156.3 Exit Devices (2020)
 - 4. ANSI/BHMA A156.4 Door Controls – Closers (2019)
 - 5. ANSI/BHMA A156.5 Cylinders and Input Devices for Locks (2020)
 - 6. ANSI/BHMA A156.6 Architectural Door Trim (2015)
 - 7. ANSI/BHMA A156.7 Template Hinge Dimensions (2016)
 - 8. ANSI/BHMA A156.8 Door Controls – Overhead Stops and Holders (2015)
 - 9. ANSI/BHMA A156.13 Mortise Locks & Latches (2017)
 - 10. ANSI/BHMA A156.15 Closer Holder Release Devices (2015)
 - 11. ANSI/BHMA A156.16 Auxiliary Hardware (2018)
 - 12. ANSI/BHMA A156.18 Materials & Finishes (2020)
 - 13. ANSI/BHMA A156.21 Thresholds (2019)
 - 14. ANSI/BHMA A156.22 Door Gasketing Systems (2017)
 - 15. ANSI/BHMA A156.23 Electromagnetic Locks (2017)
 - 16. ANSI/BHMA A156.25 Electrified Locks (2018)
 - 17. ANSI/BHMA A156.26 Continuous Hinges (2017)
 - 18. ANSI/BHMA A156.28 Keying Systems (2018)
 - 19. ANSI/BHMA A156.31 Electric Strikes (2019)
 - 20. ANSI/BHMA A156.36 Auxiliary Locks (2020)
- B. International Code Council/American National Standards Institute (ICC/ANSI)/ADA:
 - 1. ICC/ANSI A117.1 Standards for Accessible and Usable Buildings and Facilities.
- C. Door and Hardware Institute (DHI):
 - 1. DHI Publication – Abbreviations and Symbols (2019).
 - 2. DHI Publication – Installation Guide for Doors and Hardware (2020).
 - 3. DHI Publication – Sequence and Format of Hardware Schedule (2019).
- D. National Fire Protection Agency (NFPA):
 - 1. NFPA 70 National Electrical Code.
 - 2. NFPA 80 Standard for Fire Doors and Other Opening Protectives.
 - 3. NFPA 105 Standard for the Installation of Smoke Door Assemblies.

1.03 SUBMITTALS

- A. Submit in accordance with Conditions of the Contract and Division 01 Administrative Requirements and Submittal Procedures Section.

- B. Shop Drawings:
1. Schedule hardware in vertical format using the DHI publication Sequence and Formatting for the Hardware Schedule.
 2. Include abbreviations and symbols page to include manufacturers' abbreviations, finish code descriptions, and fastener abbreviations including descriptions according to the DHI publication Abbreviations and Symbols.
 3. Detail headings referencing the Architect's heading, opening number, locations, fire rating, handing, degree of opening, and description of the opening elements. Include Voltage, amperage, and operational descriptions for openings that have electrified hardware.
 4. Coordinate final door hardware schedule with doors, frames, and related work listing proper sizing of hardware, addressing door thickness, handing, function, mounting accessories, and finish of hardware.
 5. List related door devices specified in other Sections for each opening.
 6. Architectural Hardware Consultant (AHC), as certified by DHI, who will affix seal attesting to completeness and correctness, including the review of the hardware schedule prior to submittal.
- C. Product Data:
1. Furnish manufacturers' catalog sheets on design, grade, and function of items listed in hardware schedule. Submit only relevant information and circle or highlight the technical information including: model numbers, sizing information, voltage and amperage requirements, options and accessories required, means of fastening, listings of fire-rated applications, and finishes.
- E. Templates:
1. Within fourteen days of receiving approved door hardware submittals submit complete list of templates for each hardware item to the opening manufacturers and the installers. Include detailed lists of the hardware location requirements for mortised and surface applied hardware.
- F. Wiring Diagrams: Detail a title block for each drawing that includes the project name, project address, architect name, architect's opening number, hardware set, date, and name of the author.
1. Elevation Riser Drawings:
 - a. Furnish one set of elevation drawings with each hardware schedule submittal for hardware sets that contain electrified hardware. Illustrate the openings with proportional representations of the opening and electrified hardware components and dimension their mounting locations as well as sizes of junction boxes and power supplies. Label the components, wire quantities and gauges, high voltage requirements, as well as other building interfaces. Create a legend that complements the drawings with brand names, model numbers, and include voltage and amperage requirements. Add an operational description that includes the normal state of the door, ingress, egress, and what happens in case of power loss or fire alarm activation and any special conditions.
 - b. Upon receipt of approved hardware correct and resubmit elevation drawings with the point-to-point and system drawings.
 2. Point-to-Point and System Drawings: Upon receipt of approved hardware schedule, submit point-to-point per hardware set and a system drawing. Cross-reference all wiring diagrams and the associated drawings to each other.
 - a. Point-to-Point Drawings: Draw each product in a realistic representation including each terminal including those not used, and lines representing wires from component to component, labeling wire colors and gauges.
 - b. System Drawing: illustrate all equipment and building interfaces required for the entire system. Include room labels and locations, opening numbers and locations.
- G. Closeout Submittals: Include the following information as well as highlight and flag fire rated openings for annual inspections:
1. Cover page with required information:
 - a. Project name
 - b. Hardware supplier's name and contact information.
 - c. Date of substantial completion.
 2. Final record hardware schedule.

3. Product Data.
4. Keying Schedule.
5. Record Wiring Diagrams.
 - a. System Drawing.
 - b. Elevations.
 - c. Point-to-Point Drawings with all final wire colors noted as terminated. (Include network IP and/or MAC addresses of field devices).
6. Operating and Maintenance Manual.
7. Warranty Information.
8. Maintenance service agreement(s).

1.04 QUALITY ASSURANCE

- A. The supplier/integrator will employ an Architectural Hardware Consultant (AHC) as certified by DHI and a member of the seal program who will be available at reasonable times during course of work for Project hardware consultation. The supplier/integrator must be an experienced factory authorized HASP 3 certified supplier/integrator who has completed projects with HS4 access and electrified security door hardware similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance. Mechanical hardware, electrified door hardware, access and electrified security hardware and peripheral equipment are required to be by one entity for the entire work scope in this Section. Work scope is to include all material supply, rough-in, cabling, installation, programming, commissioning and owner training as defined in Part 3.
- B. Where openings are required to be accessible door hardware shall conform to ICC/ANSI A117.1.
- C. Fire Rated Door Assemblies: Where fire-rated door assemblies are indicated, provide door hardware complying with NFPA 80 that are listed and/or labeled by a qualified testing agency for fire-protection ratings indicated.
- D. Smoke and Draft Control Door Assemblies: Where smoke and draft control doors are required, provide door hardware that meets requirements of assemblies in compliance with NFPA 105.
- E. Door hardware certified to ANSI/BHMA standards as noted, manufacturer must participate and be listed in BHMA Certified Products Directory.
- F. Substitution requests shall be submitted in compliance with Division 01: create a comparison chart that includes the testing information as well as the warranty for both the specified product and the proposed substitution. Include the reason for requesting the substitution, clear catalog copy highlighting the proposed product and options, compliance statement, technical data, product warranty and lead time, to show how the proposed can meet or exceed established level of design, function, and quality.
- G. Meetings: Comply with requirements in Division 01 Section "Project Meetings."
 1. Low-voltage Coordination Meeting
 - a. Prior to furnishing door hardware submittals, convene a low-voltage coordination meeting. Meeting participants should include all affected trades including the following, but not limited to: Contractor, installer, supplier, electrical contractor, security consultant and installer, Owner's IT representative, and fire alarm consultant.
 - b. Review sequence of operation for each opening with electrified hardware to ensure that every opening functions properly for the Owner's use.
 - c. Discuss the types of electrified door hardware, inspection, and electrical roughing-in and other preparatory work performed by other trades.
 - d. Verify wire quantities, wire types, wire sizes, conduit sizes, and locations including if the power supplies will be centrally located or if they will be located near each opening.
 - e. Coordinate the door hardware, power supplies, back-up power requirements, access control components, fire alarm interfaces, elevator controls, and related building systems have all proper and necessary components to interface and operate correctly.
 2. Keying Meeting
 - a. Within fourteen days of receiving approved door hardware submittals, contact Owner to establish a keying conference. Include keying meeting decisions into final keying schedule submittal after reviewing the following, but not limited to:
 - i. Function of the building, flow of traffic, individual area's purpose, and degree of security.
 - ii. Lock functions and operation.

- iii. Preliminary key system schematic diagram.
 - iv. Verify existing keyway(s), and/or proposed keyway(s)
 - v. Visual key and cylinder identification
 - vi. Quantity of keys required including master level keys, change keys, and keys per lock.
 - vii. Review the key control system.
 - viii. Determine the recipient and contact information for the delivery of keys and accessories.
3. Pre-installation Meeting
- a. Convene meeting within fourteen days of receiving approved door hardware submittals. Participants from all affected buildings trades shall attend. Minimum participants should include: Contractor, installer, material supplier, manufacturer representatives, electrical contractor, security consultant, and fire alarm consultant.
 - b. Inspect and discuss preparatory work performed by other trades.
 - c. Include in-conference decisions regarding proper installation methods and procedures for receiving and handling hardware.
 - d. Review all system, elevation, and point-to-point drawings to ensure that all necessary components are provided and detailed.
 - e. Review and finalize construction schedule and verify availability of materials, installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - f. Review required testing, inspecting, and certifying procedures.

1. Installer Qualifications: Refer to 1.04.A

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Pack each item complete with necessary parts and fasteners in manufacturer's original packaging.
- B. Mark hardware that is not bulk packed with architect's opening number, hardware set number, and item number for each type of hardware. Include keyset symbols and corresponding hardware component for keyed products. Mark hardware that is bulk packed with manufacturers' part number and reference all hardware sets associated.
- C. Deliver hardware to the job site according to the phasing agreed upon in the pre-installation meeting. Inventory the delivery with the supplier's assistance. Immediately note shortages and damages on the shipping receipts and bill of lading. Coordinate replacement or repair with the supplier.
- D. Deliver permanent keys, cores, access control credentials, software, and related accessories directly to Owner via registered mail or overnight package service. Establish the instructions for delivery to Owner at "Keying Conference."
- E. Provide a clean, dry, and secure room for hardware delivered. Shelve hardware off the floor and with larger items of hardware stored on pallets. Arrange locksets and keyed cylinders by opening number. Organize the balance of hardware by brand, model of hardware, and hardware set number. Leave the door markings of the hardware visible for installers.
- F. Waste Management and Disposal: Separate waste materials for use or recycling in accordance with Division 01.

1.06 WARRANTY

- A. General Warranty: Comply Division 01 for Warranty requirements.
- B. Special Warranty: Warranties specified in this article will not deprive Owner of other rights.
 - 1. Ten years for manual door closers.
 - 2. Five years for mortise, auxiliary and bored locks.
 - 3. Five years for exit devices.
 - 4. One year for electromechanical door hardware.
 - 5. All access and electrified security equipment and systems will be warranted for a period of one (1) year commencing with the filing date of the Notice of Completion, provided the system has been inspected and signed off by a factory authorized installer and the factory authorized commissioning agent.

1.07 MAINTENANCE

- A. Maintenance Tool and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, removal, and replacement of door hardware.

PART 2 – PRODUCTS**2.01 MATERIALS**

- A. General:
 - 1. Produce hardware units of basic metal and forming method using manufacturer's standard metal alloy, composition, temper, and hardness, but in no case of lesser (commercially recognized) quality than specified within this specification section for applicable hardware units for finish designations indicated.
- B. Fasteners:
 - 1. Furnish screws for installation with each hardware item. Use only fasteners that are furnished by the hardware manufacturer to meet the manufacturer's templating requirements, warranty and NFPA 80 requirements.
 - 2. Provide Phillips-head screws except as otherwise indicated.
 - 3. Finish exposed screws to match hardware finish or, if exposed in surfaces of other work, to match finish of this other work as closely as possible including "prepared for paint" surfaces to receive painted finish.
 - 4. Use machine screws with lead expansion shields at hardware mounting to masonry walls and floors.
 - 5. Wood screw with plastic anchors at drywall applications without reinforcement and wood screws at applications with reinforcements.
 - 6. Provide concealed fasteners for hardware units that are exposed when door is closed except to the extent no standard units of type specified are available with concealed fasteners.
 - a. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work unless their use is the only means of reinforcing the work adequately to fasten the hardware securely.
 - b. Where thru-bolts are used as a means of reinforcing the work, provide sleeves for each thru-bolt or use sex nut fasteners.
 - 7. At exterior openings furnish stainless-steel fasteners for exposed fasteners, for example thresholds and screw-applied weatherstripping.

2.02 ALUMINUM GEARED CONTINUOUS HINGES

- A. Continuous hinges of one manufacturer as listed for continuity of design and consideration of warranty.
- B. Standards: Products to be certified and listed by ANSI/BHMA A156.26 Grade 1.
- C. Determine final model numbers and accessories required using the following criteria:
 - 1. Door inset in relation to the frame face.
 - 2. Door thickness and weight.
 - 3. At fire rated openings provide hinges that carry a UL certification, up to and including 90-minute applications for wood doors and up to 3-hour applications for metal doors and provide studs as required by the manufacturer's listings.
 - 4. Provide heavy-duty hinges for high frequency and exterior applications.
 - 5. When full width of opening is required, use hinges that are designed to swing door completely from opening when door is opened to 95 degrees.
 - 6. Size length of hinge to equal the actual door height unless otherwise stated in hardware sets.
- D. Material and Design:
 - 1. Base material: Anodized aluminum manufactured from 6063-T6 material; unexposed working metal surfaces be coated with TFE dry lubricant.
 - 2. Bearings:
 - a. Continuous hinges are to have a minimum spacing between bearings of 2-9/16". Typical door from 80" to 84" in height to have a minimum of 32 bearings.
 - 3. Options:
 - a. Provide factory-cut preparations for concealed electric power transfers.
- E. Acceptable Manufacturers:
 - 1. Hager
 - 2. Owner approved equal

2.03 CYLINDERS AND KEYING

- A. Cylinders of one manufacturer as listed for continuity of design and consideration of warranty.

- B. Products to be certified and listed by the following:
 - 1. Auxiliary Locks: ANSI/BHMA A156.5
- C. Cylinders:
 - 1. Provide cylinders matched to the types required for hardware that has a locking function and for keyed electronic functions. Furnish with appropriate collars, cams, and tailpieces to fit and operate associated hardware. Stacking collars is not acceptable, a single collar of proper size is required.
 - 2. Provide concealed key control (CKC) at cylinder by stamping or permanently marking the keyset symbol in a location on the cylinder that is concealed when installed.
- D. Keying:
 - 1. Key into Owner's existing key system.
 - 2. All permanent keyed cores or cylinders are to be provided by the Owner.
 - 3. Keys to be shipped directly to the Owner's Representative as established during the keying conference.
 - a. Package the keys in individual envelopes, grouped by keyset symbol, and label envelopes with project name, factory registry number, and keyset symbol.
 - 4. Stamp large bow key blanks with visual key control (keyset symbol) and "Do Not Duplicate".
 - 5. Provide interchangeable cores with construction cores as required per the keying meeting.
 - 6. Provide construction keyed cylinders as required per the keying meeting.
- E. Acceptable Manufacturers:

Owner provided

2.04 PUSH PLATES

- A. Push/Pull plates and bars of one manufacturer as listed for continuity of design and consideration of warranty.
- B. Standards: Manufacturer to be certified by the following:
 - 1. Architectural Door Trim: ANSI/BHMA A156.6.
 - 2. Americans with Disabilities Act Accessibility Guidelines (ADAAG).
- C. Push plates: .050" thick, square corner and beveled edges with countersunk screw holes. Width and height as stated in hardware sets.
- D. Acceptable Manufacturers:

Hager	30S
Owner approved equal	

2.05 MORTISE DEADBOLTS

- A. Mortise deadbolts of one manufacturer as listed for continuity of design and consideration of warranty.
- B. Standards: Manufacturer to be certified by the following:
 - 1. ANSI/BHMA A156.13 Series 2000 Grade 1 Operational and Security.
 - 2. UL/cUL listed for functions up to 3 hours for "A" label.
 - 3. UL10C/UBC 7-2 Positive Pressure Rated.
 - 4. ADA – Thumb turn.
- C. Deadbolt function numbers and descriptions of manufacturer's series as listed in hardware sets.
- D. Material and Design:
 - 1. Latch bolt projection 1" throw.
 - 2. Case steel, zinc dichromate.
 - 3. Armor front 5-9/16". Case dimension 4-5/16" x 3-9/16' x 1".
- E. Acceptable Manufacturers:

Hager	3830 Series
Owner approved equal	

2.06 CLOSERS

- A. Closers of one manufacturer as listed for continuity of design and consideration of warranty, unless otherwise indicated on hardware schedule, comply with manufacturer's recommendations for size of closer, depending on width of door, frequency of use, atmospheric pressure, ADAAG requirement, and fire rating.

- B. Standards: Manufacturer to be certified and or listed by the following:
 - 1. BHMA Certified ANSI A156.4 Grade 1.
 - 2. ADA Complaint ANSI A117.1.
 - 3. UL/cUL Listed up to 3 hours.
 - 4. UL10C Positive Pressure Rated.
 - 5. UL10B Neutral Pressure Rated.
- C. Material and Design:
 - 1. Provide cast iron non-handed bodies with full plastic covers.
 - 2. Closers will have separated staked adjustable valve screws for latch speed, sweep speed, and backcheck.
 - 3. Provide Tri-Pack arms and brackets for regular arm, top jamb, and parallel arm mounting.
 - 4. One-piece seamless steel spring tube sealed in hydraulic fluid.
 - 5. Double heat-treated steel tempered springs.
 - 6. Precision-machined heat-treated steel piston.
 - 7. Triple heat-treated steel spindle.
 - 8. Full rack and pinion operation.
- D. Mounting:
 - 1. Out-swing doors use surface parallel arm mount closers except where noted on hardware schedule.
 - 2. In-swing doors use surface regular arm mount closers except where noted on hardware schedule.
 - 3. Provide brackets and shoe supports for aluminum doors and frames to mount fifth screw.
 - 4. Furnish drop plates where top rail conditions on door do not allow for mounting of closer and where backside of closer is exposed through glass.
- E. Size closers in compliance with requirements for accessibility (ADAAG). Comply with following maximum opening force requirements.
 - 1. Interior hinged openings: 5.0 lbs.
 - 2. Fire-rated and exterior openings use minimum opening force allowable by authority having jurisdiction.
- F. Fasteners: Provide self-reaming, self-tapping wood and machine screws, and sex nuts and bolts for each closer.
- G. Acceptable manufacturers:

Hager	5100 Series
Owner approved equal	

2.07 THRESHOLDS

- A. Thresholds of one manufacturer as listed for continuity of design and consideration of warranty.
- B. Set thresholds for exterior and acoustical openings in full bed of sealant with lead expansion shields and stainless-steel machine screws complying with requirements specified in Division 07 Section "Joint Sealants: Notched in field to fit frame by hardware installer. Refer to Drawings for special details.
- C. Standards: Manufacturer to be certified by the following:
 - 1. Thresholds: ANSI/BHMA A156.21.
 - 2. American with Disabilities Act Accessibility Guidelines (ADAAG).
- D. Acceptable Manufacturers:

Hager	520S
Owner approved equal	

2.08 FINISHES

- A. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if within range of approved samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within range of approved samples.
- B. Comply with base material and finish requirements indicated by ANSI/BHMA A156.18 designations in hardware schedule.

PART 3 – EXECUTION**3.01 EXAMINATION**

- A. Examine doors and frames, with installers present, for compliance with requirements for installation tolerances, labeled fire-rated construction, wall and floor construction, and other conditions affecting performance.
- B. Where hardware will be installed directly on walls inspect applications for blocking material of sufficient type and size for hardware.
- C. Examine roughing-in and cabling for electrical power systems to verify actual locations of wiring connections and wiring supplied matches the requirements as described in the wiring diagrams before electrified door hardware installation.
- D. Perform a site survey to determine proper mounting locations for all wirelessly communicating devices. Verify that the surrounding construction and equipment will not interfere with the communication between components.
- E. Where existing products will be reused, examine existing door and frame sizes, preps, swings, ratings, and compare to the specified hardware for compatibility and functionality. The hardware set specified should act as guide for design and function. Provide filler plates as needed to fill and repair existing materials. Test any existing to remain hardware for functionality and visually inspect for damage. Note any defective or damaged products as well as noting any code deficiencies and submit issues and estimated costs for direction of how to proceed with repair or replacement.
- F. Notify Architect via a prepared written report and endorsed by installer of any discrepancies between the door schedule, door types, drawings, and scheduled hardware. List conditions detrimental to application, to the proper and timely completion of the work and performance of the hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.02 INSTALLATION

- A. Install hardware using manufacturers' recommended fasteners and installation instructions, at height locations and clearance tolerances that comply with:
 - 1. NFPA 80
 - 2. NFPA 105
 - 3. ICC/ANSI A117.1
 - 4. DHI Publication – Installation Guide for Doors and Hardware
 - 5. Approved shop drawings
 - 6. Approved hardware schedule
- B. Install soffit mounted gaskets prior to other soffit mounted hardware ensuring a continuous seal around the perimeter of the opening without cutting or notching.
- C. Locate surface mounted door closers on stairwell side of stair doors, interior side of exterior openings, or on the room side of openings, unless it is a sterile room.
- D. Locate wall mounted bumper to contact the operating trim. Verify that pushbuttons of locksets do not contact the stop and inadvertently lock the door.
- E. Mount armor, mop, and kick plates flush with the bottom of the door and centered horizontally on the door.
- F. Notch thresholds with no larger than a 1/32-inch gap matching the frame profile. Set in a full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants" forming a tight seal between threshold and mounting surface. Caulk and seal the entire perimeter to prevent water leakage. Remove excess sealants immediately and clean the area thoroughly.
- G. Do not install surface mounted items until finishes have been completed on substrates involved. Set unit level, plumb and true to line location.
- H. Locate power supplies and junction boxes as directed and verified in the low-voltage coordination meeting.
- I. Install cables and wiring according to requirements in Division 28 Section "Conductors and Cables for Electronic Safety and Security" and with Division 26 Section "Grounding and Bonding for Electrical Systems." Cable installation shall comply with NECA 1, "Good Workmanship in Electrical Contracting" EIA/TIA-569, "Commercial Building Standard for Telecommunications Pathways and Spaces."
 - 1. RS-485 Cabling: Install at a maximum distance as directed by the component manufacturer.
 - 2. Card Readers and Keypads: Install number of conductor pairs and wire type as recommended by manufacturer for the functions specified.

3. Electromechanical Hardware: Install appropriate number of conductor pairs, in the wire gage (AWG) recommended by manufacturer, corresponding to the electronic locking functions specified, amperage draw, and distances covered between the power supplies, transfer hinges, electrified hardware and access control equipment.
 4. Ground cable shields, drain conductors, and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.
 5. Bond shields and drain conductors to ground at only one point in each circuit.
 6. Wiring color to be distinct and specific to the system. Coordinate cable colors with all other vendors to ensure color is not duplicated.
 7. Install wiring in raceway and cable tray except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Use NRTL-listed plenum cable in environmental air spaces, including plenum ceilings. Conceal raceway and cables except in unfinished spaces.
 8. Install LAN cables using techniques, practices, and methods that are consistent with Category 5E rating of components and that ensure Category 5E performance of completed and linked signal paths, end to end.
 9. Install cables without damaging conductors, shield, or jacket.
 10. Boxes and enclosures containing security system components or cabling, which are easily accessible to employees or to the public, shall be provided with a keyed lock. Boxes above ceiling level in occupied areas of the building will not be considered accessible. Junction boxes and small device enclosures below ceiling level and easily accessible to employees or the public will be covered with a suitable cover plate and secured with tamperproof screws.
- J. Perform final connections of the system components to match the approved operational narratives. Use cable markers to label wires at each termination or end to match the final wiring diagrams. Terminate wiring in accordance with the manufacturer's recommendations. Where quick-connects are seated correctly. Provide wire ties and adhesive pads to secure and organize wires in enclosures. Outside of enclosures seal terminations in waterproof connectors. Include record drawings of the point-point and the elevations in a plastic sleeve attached to the inside cover of the power supply/junction box enclosure for the Owner's use.

3.03 FIELD QUALITY CONTROL

- A. Schedule a final walk through to inspect hardware installation ten (10) business days before final acceptance of the Owner. Visually inspect for proper fasteners and verify that doors open, close, latch properly, and that openings are installed to meet NFPA 80 and ANSI A117.1 requirements. Correct deficiencies, including missing hardware immediately. Provide a written report detailing discrepancies of each opening within five (5) business days of the walk through.
- B. Prior to receiving certificate of occupancy have doors inspected by a Certified Fire and Egress Door Assembly Inspector (CFDAI), as certified by Intertek (ITS), submit a written report to the Owner and Contractor. Doors failing inspection must be adjusted, modified, or replaced to be within appropriate code requirements without delay.
- C. Test the functionality of electrified openings upon completion of the installation in accordance with the description of operation and the Owner's intent under the supervision of a factory authorized representative and an Owner's representative, verify that all features of the software are working correctly, including interfaces with any associated trades. Document the result of all tests and provide these results to the Owner and correct immediately.

3.04 ADJUSTMENT, CLEANING, AND DEMONSTRATING

- A. Prior to final adjustments, the HVAC system must be completed and balanced. Test that all openings meet ANSI A117.1 for closer opening pressure, closing speed, latching, and hardware operating forces. Replace items that cannot be adjusted to operate freely and smoothly or as intended for application.
- B. Prior to final walk-through inspection, clean adjacent surfaces soiled by hardware installation. Clean finish hardware per manufacturer's instructions after final adjustments have been made. Remove all protection and replace items that cannot be cleaned to manufacturer's level of finish quality.
- C. Demonstration and training will be conducted as per the following sessions. All sessions will be recorded and turned over to the Owner for future use.

1. Hardware Maintenance: Conduct a training class for building maintenance personnel demonstrating the adjustment, operation, and maintenance of mechanical and electrified hardware. Special tools for finish hardware to be turned over and demonstrated usage at the meeting.
2. Key control system: Train the Owner’s designated representative on the key control system demonstrating the permanent file keys, duplicate loaner keys, key receipts, key envelopes, key change identification sheets, bitting lists, tags, and labels. When key management software is provided training will be provided for the setup and usage of the software.

3.05 PROTECTION

- A. Leave manufacturer’s protective film intact and, protect exit devices, locks, and surface mounted hardware with kraft paper or bubble wrap. Cover fire labels at painted products that bear a label with magnetic or masking tape. Keep protection in place until time of final cleaning and adjustment.

3.06 HARDWARE SET SCHEDULE

- A. Door hardware items have been placed in sets which are intended to be a guide of design, grade, quality, function, operation, and performance.
 1. Review products that may require mounting accessories to meet door, frame, and swing conditions as these final details vary from manufacturer to manufacturer and provide as required.
 2. Where additional items of hardware are required for completion of the Work, a written statement of such omission, error, or other discrepancy is required to be submitted to the Architect, prior to bid date for clarification via an addendum.
 3. Abbreviations listed below do not appear in the manufacturer’s literature, for any other abbreviations refer to manufacturer’s literature.:
 - a. LDW = Less than Door Width
 - b. LAR = Length as Required
 - c. QTY = Quantity
 - d. CTC = Centerline to Centerline
 - e. BTB = Back-to-Back mounting

3.07 HARDWARE SCHEDULE

Manufacturer List

Code	Name
BYOT	By Others
HA	Hager
Hardware Sets	

Set #01.00

Doors: 101, 102

1	Hardware	By Door MFR./Supplier		BYOT
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Set #02.00

Doors: 103, 104

1	Continuous Hinge	780-112HD x LAR	CLR	HA
1	Deadlock	3833S Less Cyl	US26D	HA
1	Cylinder (as req'd)	By Owner		BYOT

Set #02.00

1	Recessed Pull	SL-86 (By the Door Mfr.)		BYOT
1	Push Plate	30S 6 X 16	US32D	HA
1	Closer	5100 HDCS	ALM	HA
1	Threshold	520S N x LAR	MIL	HA
1	Adj. Door Sweep	SL-301 x LAR (By the Door Mfr.)		BYOT
1	Gasketing	By the Door/Frame Mfr.		BYOT

END OF SECTION

SECTION 09 2900 - GYPSUM BOARD**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Gypsum wallboard.
- B. Finishing materials.
- C. Trim accessories.

1.02 REFERENCE STANDARDS

- A. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board 2017 (Reapproved 2022).
- B. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board 2020.
- C. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness 2022.
- D. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs 2022.
- E. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base 2019.
- F. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel 2018.
- G. ASTM C1396/C1396M - Standard Specification for Gypsum Board 2017.
- H. ASTM C1629/C1629M - Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels 2023.
- I. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber 2021.
- J. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials 2022.
- K. GA-216 - Application and Finishing of Gypsum Panel Products 2021.
- L. GA-226 - Application of Gypsum Board to Form Curved Surfaces 2019.
- M. GA-600 - Fire Resistance and Sound Control Design Manual 2021.
- N. UL (FRD) - Fire Resistance Directory Current Edition.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate special details associated with fireproofing and acoustic seals.
 - 1. Include locations of control joints. Coordination drawings for proposed control joint locations may be annotated copies of Construction Documents architectural floor plans, reflected ceiling plans, and interior elevations. Submit prior to commencement of framing installation. Coordinate with requirements specified in Section 09 2216.
- C. Product Data: Provide data on gypsum wallboard, shaft wall liner panels, tile backing panels, finishing materials, trim accessories, acoustical accessories, and fasteners and adhesives.
- D. Samples:
 - 1. Submit three samples of each board type, 4 inches square in size.
 - 2. Submit three samples of each type of special trim, 4 inches in length.
- E. Manufacturer's Qualification Statement.
- F. Installer's Qualification Statement.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least 5 years of documented experience.

- B. Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years documented experience.

1.05 FIELD CONDITIONS

- A. Ambient Condition (Environmental Limitations): Comply with ASTM C840 and GA-216 requirements or gypsum board manufacturer's written instructions, whichever are more stringent

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Provide completed assemblies complying with ASTM C840 and GA-216.
- B. Fire-Rated Assemblies: For fire-resistance-rated assemblies that incorporate gypsum board, provide materials and construction identical to those tested in assembly indicated, according to ASTM E119 and as follows:
 1. Provide construction equivalent to one of the following:
 - a. UL Assembly Numbers: Provide construction equivalent to that listed for the particular assembly in the current UL (FRD).
 - b. Gypsum Association File Numbers: Provide construction complying with requirements of GA-600 for the particular assembly.
- C. Horizontal Deflection: For wall assemblies, limit maximum deflection of wall framing to L/240 at 5 psf .
 1. Exception: Limit deflection of walls to receive hard tile surfaces to L/360 at 5 psf.

2.02 GYPSUM WALLBOARD

- A. Gypsum Wallboard: Paper-faced gypsum panels; ASTM C1396/C1396M.
 1. Thickness: 1/4 and 1/2 inch.
 2. Long Edges: Tapered with paper face wrapping edge.
 3. Short Edges: Square cut.
 4. Sized to minimize joints.
 5. Products:
 - a. CertainTeed Corp.; Regular Gypsum Board: www.certainteed.com.
 - b. Continental Building Products; Regular Drywall: www.continental-bp.com.
 - c. Georgia-Pacific Gypsum; ToughRock Gypsum Board: www.gp.com.
 - d. National Gypsum Company; Gold Bond Brand Gypsum Board: www.nationalgypsum.com.
 - e. USG Corporation; Sheetrock Brand Gypsum Panels: www.usg.com.
 - f. Substitutions: See Section 01 6000 - Product Requirements.
- B. Gypsum Wallboard - Type X: Paper-faced gypsum panels with fire-resistant core; ASTM C1396/C1396M.
 1. Thickness: 5/8 inch.
 2. Long Edges: Tapered with paper face wrapping edge.
 3. Short Edges: Square cut.
 4. Sized to minimize joints.
 5. Type: Fire resistance rated Type X, UL or WH listed.
 6. Products:
 - a. CertainTeed Corp.; Type X Gypsum Board: www.certainteed.com.
 - b. Continental Building Products; Firecheck Type X: www.continental-bp.com.
 - c. Georgia-Pacific Gypsum; ToughRock Fireguard X: www.gp.com.
 - d. National Gypsum Company; Gold Bond Brand Fire-Shield Gypsum Board: www.nationalgypsum.com.
 - e. USG Corporation; Sheetrock Brand Firecode X Panels: www.usg.com.
 - f. Substitutions: See Section 01 6000 - Product Requirements.
- C. Impact Resistant Gypsum Wallboard: Heavy paper-faced, mold and moisture resistant, gypsum panel with fire-resistant core; ASTM C1396/C1396M.

1. Thickness: 5/8 inch.
2. Long Edges: Tapered with paper face wrapping edge.
3. Short Edges: Square cut.
4. Sized to minimize joints.
5. Type: Fire resistance rated Type X, UL or WH listed.
6. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
7. Surface Abrasion: Level 2, minimum, when tested in accordance with ASTM C1629/C1629M.
8. Indentation: Level 1, minimum, when tested in accordance with ASTM C1629/C1629M.
9. Soft Body Impact: Level 3, minimum, when tested in accordance with ASTM C1629/C1629M.
10. Hard Body Impact: Level 3, minimum, when tested in accordance with ASTM C1629/C1629M.
11. Products:
 - a. CertainTeed Corp.; Extreme Impact Resistant Gypsum Board: www.certainteed.com.
 - b. Continental Building Products; Protecta HIR 300 Type X with Mold Defense: www.continental-bp.com.
 - c. National Gypsum Company; Gold Bond Brand Hi-Impact XP Gypsum Board: www.nationalgypsum.com.
 - d. USG Corporation; Sheetrock Brand Mold Tough VHI Firecode X Panels: www.usg.com.
 - e. Substitutions: See Section 01 6000 - Product Requirements.

2.03 TILE BACKING BOARDS

- A. Glass Mat Faced Board: Coated glass mat water-resistant gypsum backing panel as defined in ASTM C1178/C1178M.
 1. Thickness: 5/8 inch.
 2. Type: Fire resistance rated Type X, UL or WH listed.
 3. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 4. Locations: Non-wet areas and elsewhere as indicated on Drawings; including, but not limited to, the following:
 - a. Kitchens.
 - b. Laundry areas.
 - c. Locker rooms.
 - d. Toilet rooms.
 5. Products:
 - a. CertainTeed Corp.; GlasRoc Diamondback Tile Backer: www.certainteed.com.
 - b. Georgia-Pacific Gypsum; DensShield Tile Backer: www.gp.com.
 - c. National Gypsum Company; Gold Bond Brand eXP Tile Backer: www.nationalgypsum.com.
 - d. USG Corporation; Durock Brand Glass-Mat Tile Backerboard: www.usg.com.
 - e. Substitutions: See Section 01 6000 - Product Requirements.

2.04 FINISHING MATERIALS

- A. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
 1. Paper Tape: 2 inch wide, creased paper tape for joints and corners.
 - a. Exception: At tile backing board provide the following:
 - 1) Fiberglass Tape: 2 inch, coated glass fiber tape for joints and corners.
 - b. Manufacturers: Provide products from one of the specified gypsum wallboard manufacturers.
 2. Joint Compound: Drying and setting types, vinyl-based, ready-mixed or field-mixed.
 - a. Each coat shall be compatible with previously applied coats.
 - b. Manufacturers: Provide products from one of the specified gypsum wallboard manufacturers.

2.05 TRIM ACCESSORIES

- A. Trim Accessories: ASTM C1047, galvanized steel or rolled zinc, unless noted otherwise.
 - 1. Types: As detailed or required for finished appearance. Including, but not limited to, the following:
 - a. Corner beads.
 - b. Control joints.
 - c. LC or L bead at exposed edges.
 - 2. Products:
 - a. ClarkDietrich Building Systems: www.clarkdietrich.com.
 - b. Marino\WARE: www.marinoware.com.
 - c. Telling Industries; www.buildstrong.com.
 - d. Phillips Manufacturing Co: www.phillipsmfg.com.
 - e. USG Corporation: www.usg.com.
 - f. Substitutions: See Section 01 6000 - Product Requirements.

2.06 FASTENERS AND ADHESIVES

- A. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inch in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion resistant.
- B. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws, corrosion resistant.
- C. Screws for Fastening of Cementitious Backer Board Products to Steel Studs: Use screws of type and size recommended by panel manufacturer
- D. Anchorage to Other Substrates: Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.
- E. Laminating Adhesive: For directly adhering gypsum-base, face-layer panels to backing-layer panels in multi-layer construction. Provide one of the following types:
 - 1. Joint Compound: As recommended by gypsum board manufacturer.
 - 2. Adhesives:
 - a. Franklin International, Inc; Titebond GREENchoice Professional Drywall Adhesive; www.titebond.com.
 - b. PPG Architectural Coatings; Liquid Nails DWP-24 Drywall Construction Adhesive: www.liquidnails.com.
 - c. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify that project conditions are appropriate for work of this section to commence.
- B. Control Joint Layout: Prior to commencement of framing and gypsum board installation, submit coordination drawings indicating proposed control joint locations in metal-framed gypsum board-sheathed partitions, walls, ceilings, bulkheads, fasciae, and soffits, for review and acceptance of Architect. Coordinate with requirements of Section 09 2216.

3.02 GENERAL INSTALLATION

- A. Comply with ASTM C840, GA-216, and manufacturer's instructions.

3.03 BOARD INSTALLATION

- A. Install to minimize butt end joints, especially in highly visible locations.
 - 1. Use screws for attachment of gypsum board.
 - 2. Use screws for attachment of cementitious backing board.
- B. Single-Layer Non-Rated: Install gypsum board parallel to framing, with long edges occurring over framing.
 - 1. Stagger joints on opposite sides of partitions.

- C. Multi-Layer Non-Rated: Install first layer of gypsum board parallel to framing with long edges occurring over framing. Place second layer parallel to framing with long edges occurring over framing, and joints offset from joints of first layer.
 - 1. Offset face-layer joints at least one stud or furring member from base-layer joints.
 - 2. Stagger joints on opposite sides of partitions.
 - 3. Install additional layers beyond double layers similarly; maintain offset and staggered joints between layers.
 - 4. Apply laminating adhesive between layers of gypsum board for bonding of layers in addition to fasteners.
- D. Fire-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
- E. Curved Surfaces: Apply gypsum board to curved substrates in accordance with GA-226.

3.04 INSTALLATION OF TRIM AND ACCESSORIES

- A. Control Joints: Place control joints consistent with lines of building spaces and as follows:
 - 1. Not more than 30 feet apart on walls and ceilings, unless otherwise indicated.
 - 2. Submit control joint locations to Architect for approval prior to installation.
- B. Corner Beads: Install at external corners, using longest practical lengths.
- C. Edge Trim (LC or L Beads): Install at locations where gypsum board abuts dissimilar materials and as indicated, using longest practical lengths.

3.05 JOINT TREATMENT

- A. Paper Faced Gypsum Board: Use paper joint tape, embed with drying or setting type joint compound and finish with drying type joint compound.
- B. Tile Backing Panels: Use fiberglass joint tape, embed and finish with tile setting material.
 - 1. Refer to Section 09 3000 - Tiling for tile setting materials.
- C. Glass Mat Faced Gypsum Board other than Tile Backing Panels: Use fiberglass joint tape, embed and finish with setting type joint compound.
- D. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
 - 1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
 - 2. Level 2: In utility areas, behind cabinetry, and in similar locations that shall not be painted or finished, and at tile backing board to receive tile finish.
 - 3. Level 1: Wall areas above finished ceilings, whether or not accessible in the completed construction.
 - a. Exception: Fire-Rated Construction shall comply with requirements of assembly listing.
- E. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
 - 1. Feather coats of joint compound so that camber is maximum 1/32 inch.
 - 2. Taping, filling and sanding is not required at base layers of multi-layer applications.

3.06 TOLERANCES

- A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

END OF SECTION

SECTION 09 6513 - RESILIENT BASES AND ACCESSORIES**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Resilient base.

1.02 REFERENCE STANDARDS

- A. ASTM F1861 - Standard Specification for Resilient Wall Base 2021.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- C. Shop Drawings: Indicate seaming plans and floor patterns.
- D. Verification Samples:
 - 1. Resilient Base, Floor Moldings, and Stair Coverings: Submit 3 samples, 12 inches long illustrating color, pattern, and profile for each accessory specified.
- E. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Wall Base: Quantity equal to 2 percent of total installed, but not less than 8 linear feet of each type and color.
 - 3. Extra Stair Covering Materials: Quantity equal to 2 percent of total installed, but not less than 8 linear feet for each type and color.
 - 4. Extra Floor Moldings: Quantity equal to 2 percent of total installed, but not less than 8 linear feet of each type and color.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing specified resilient accessories with minimum 5 years documented experience.
- B. Installer Qualifications: Company specializing in installing specified resilient accessories with minimum 5 years documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.
- B. Store all materials off of the floor in an acclimatized, weather-tight space.
- C. Maintain temperature in storage area between 55 degrees F and 90 degrees F.
- D. Protect roll materials from damage by storing on end.
- E. Do not double stack pallets.

1.06 FIELD CONDITIONS

- A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

PART 2 PRODUCTS**2.01 RESILIENT BASE**

- A. RB-1 Resilient Base: ASTM F1861, Type TS rubber, vulcanized thermoset; top set Style B, Cove.
 - 1. Manufacturers: Provide products from one of the following:
 - a. Armstrong Flooring Inc.: www.armstrongflooring.com.
 - b. Burke Flooring: www.burkeflooring.com.
 - c. Johnsonite, a Tarkett Company: www.johnsonite.com.
 - d. Roppe Corp: www.roppe.com.

- e. Substitutions: See Section 01 6000 - Product Requirements.
- 2. Height: 4 inch.
- 3. Thickness: 0.125 inch.
- 4. Finish: Satin.
- 5. Length: Roll.
- 6. Colors: .
 - a. RB-1 Black.
 - b. RB-1B _____.
 - c. RB-1C _____.

2.02 ACCESSORIES

- A. Primers and Adhesives: Waterproof; types recommended by accessories manufacturer.
- B. Filler for Cove Base: Plastic.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are flat to tolerances acceptable to stair covering manufacturer, free of cracks that might telegraph through stair coverings, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of stair coverings to substrate.
- B. Verify that surfaces are flat, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of floor moldings to substrate.
- C. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.

3.02 PREPARATION

- A. Clean substrates.

3.03 INSTALLATION - GENERAL

- A. Install in accordance with manufacturer's written instructions.
- B. Adhesive-Applied Installation:
 - 1. Fully adhere resilient base, stair coverings, and floor moldings, to substrates using a full spread of adhesive completely covering substrate.
 - 2. Spread only enough adhesive to permit installation of materials before initial set.
 - 3. Fit joints and butt seams tightly.
- C. Install floor moldings at unprotected or exposed edges, where flooring terminates, and where indicated.
 - 1. Resilient Strips: Attach to substrate using adhesive.

3.04 INSTALLATION - RESILIENT BASE

- A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.
- B. Install with minimal amount of joints; tops of adjacent pieces shall be aligned.
- C. Miter internal corners. At external corners, 'V' cut back of base strip to 2/3 of its thickness and fold. At exposed ends, use premolded units.
- D. Install base on solid backing. Bond tightly to wall and floor surfaces.
- E. At masonry and other irregular substrates fill voids along top edge of resilient wall base with manufacturer's recommended adhesive filler material.
- F. Scribe and fit to door frames and other interruptions.

3.05 CLEANING

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.

3.06 PROTECTION

- A. Prohibit traffic on resilient stair coverings and floor moldings for 48 hours after installation.

END OF SECTION

SECTION 09 9123 - INTERIOR PAINTING**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Surface preparation.
- B. Field application of paints.
- C. Specification for Canyon Tone for clear block sealer is in Specification 07 1900 Water Repellent Acrylic Penetrating Sealer.
- D. Do Not Paint or Finish the Following Items:
 - 1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
 - 2. Items indicated to receive other finishes.
 - 3. Items indicated to remain unfinished.
 - 4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
 - 5. Stainless steel, anodized aluminum, bronze, terne-coated stainless steel, and lead items.
 - 6. Marble, granite, slate, and other natural stones.
 - 7. Floors, unless specifically indicated.
 - 8. Brick, architectural concrete, cast stone, integrally colored plaster, and stucco.
 - 9. Glass.
 - 10. Acoustical materials, unless specifically indicated.
 - 11. Concealed pipes, ducts, and conduits.

1.02 DEFINITIONS

- A. Comply with ASTM D16 for interpretation of terms used in this section.

1.03 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency current edition.
- B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications 2023.
- C. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials 2020.
- D. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association Current Edition.
- E. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual Current Edition.
- F. SSPC-SP 1 - Solvent Cleaning 2015, with Editorial Revision (2016).
- G. SSPC-SP 13 - Surface Preparation of Concrete 2018.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide complete list of products to be used, with the following information for each:
 - 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g., "alkyd enamel").
 - 2. MPI product number (e.g., MPI #47).
 - 3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
- C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
 - 1. Where sheen is specified, submit samples in only that sheen.
 - 2. Where sheen is not specified, discuss sheen options with Architect before preparing samples, to eliminate sheens not required.

- D. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.06 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Do not apply materials when relative humidity exceeds 85 percent, at temperatures less than 5 degrees F above the dew point, or to damp or wet surfaces.
- D. Minimum Application Temperatures for Paints: 50 degrees F for interiors unless required otherwise by manufacturer's instructions.
- E. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Provide paints and finishes used in any individual system from the same manufacturer; no exceptions.
- B. Provide paints and finishes from the same manufacturer to the greatest extent possible.
 - 1. If a single manufacturer cannot provide specified products; minor exceptions will be permitted provided approval by Architect is obtained using the specified procedures for substitutions.
 - 2. Substitution of MPI-approved products by a different manufacturer is preferred over substitution of unapproved products by the same manufacturer.
 - 3. Substitution of other products by the same manufacturer is preferred over substitution of products by a different manufacturer.
 - 4. Substitution of a different paint system using MPI-approved products by the same manufacturer will be considered.
- C. Paints:
 - 1. Sherwin-Williams Company: www.sherwin-williams.com/#sle.
- D. Primer Sealers: Same manufacturer as top coats.
- E. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PAINTS AND FINISHES - GENERAL

- A. Paints and Finishes: Ready-mixed, unless intended to be a field-catalyzed paint.
 - 1. Where MPI paint numbers are specified, provide products listed in Master Painters Institute Approved Product List, current edition available at www.paintinfo.com, for specified MPI categories, except as otherwise indicated.
 - 2. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.

3. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
 4. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.
 5. Supply each paint material in quantity required to complete entire project's work from a single production run.
 6. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.
- B. Volatile Organic Compound (VOC) Content:
1. Provide paints and finishes that comply with the most stringent requirements specified in the following:
 - a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
 - b. Architectural coatings VOC limits of the State in which the Project is located.
 2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.
- C. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.
- D. Colors: To be selected from manufacturer's full range of available colors.
1. Selection to be made by Architect after award of contract.
 2. Extend colors to surface edges; colors may change at any edge as directed by Architect.
 3. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling under which they are mounted.
 4. In utility areas, finish equipment, piping, conduit, and exposed duct work in colors according to the color coding scheme indicated.
 5. During bidding, price accent walls as low-hide colors. Include pricing for additional prep and coats as required.

2.03 PAINT SYSTEMS - INTERIOR

- A. Paint I-OP - Interior Surfaces to be Painted, Unless Otherwise Indicated: Including gypsum board, concrete, concrete masonry units, brick, wood, plaster, uncoated steel, shop primed steel, and galvanized steel.
1. Two top coats and one coat primer.
 2. Top Coat(s): Interior Latex; MPI #44, 53, 54.
 - a. Products:
 - 1) Sherwin-Williams ProMar 200 Zero VOC Interior Latex, Flat B30W12651 (MPI #53).
 - 2) Sherwin-Williams ProMar 200 Zero VOC Interior Latex, Semi-Gloss. (MPI #43)
 - 3) Sherwin-Williams ProMar 200 Zero VOC Interior Latex, Eggshell. (MPI #52)
 3. Top Coat Sheen:
 - a. Flat: MPI gloss level 1; use this sheen for ceilings and other overhead surfaces.
 - b. Eggshell: MPI gloss level 3; use this sheen at gypsum board, except at ceilings and wood.
 - c. Satin: MPI gloss level 4; use this sheen for items subject to frequent touching by occupants, including door frames and railings.
 - d. Semi-Gloss: MPI gloss level 5; use this sheen at masonry and metals .
 4. Primer: As recommended by top coat manufacturer for specific substrate.
- B. Paint I-OP-MD-DT - Medium Duty Door/Trim: For surfaces subject to frequent contact by occupants, including metals:
1. Medium duty applications include doors, door frames, railings, handrails, guardrails, and balustrades.
 2. Two top coats and one coat primer.

3. Top Coat(s): Interior Light Industrial Coating, Aluminum, Ferrous Metal Galvanized Steel except Steel Door and Frames Water Based; MPI #153.
 - a. Products:
 - 1) Sherwin-Williams Pro Industrial DTM Acrylic Semi-Gloss, B66W01150 Series. (MPI #153)
4. Top Coat Sheen:
 - a. Semi-Gloss: MPI gloss level 5; use this sheen at all locations.
- C. Paint I-OP-MD-WC - Medium Duty Vertical: Including Structural Glazed Facing Tile.
 1. Two top coats and one coat primer.
 2. Top Coat(s): High Performance Architectural Interior Latex; MP #141.
 - a. Products:
 - 1) Sherwin-Williams Pro Industrial Pre-Catalyzed Waterbased Epoxy, Eg-Shel. (MPI #139)
 - 2) Sherwin-Williams Pro Industrial Pre-Catalyzed Waterbased Epoxy, Semi-Gloss. (MPI #141)
- D. Paint I-OP-DF - Dry Fall: Metals; exposed structure and overhead-mounted services in utilitarian spaces, including shop primed steel deck, structural steel, metal fabrications, galvanized ducts, galvanized conduit, and galvanized piping.
 1. Shop primer by others.
 2. One top coat.
 3. Top Coat: Latex Dry Fall; MPI #118.
 - a. Products:
 - 1) Sherwin-Williams Waterborne Acrylic Dryfall, Flat. (MPI #118)
 - 2) Substitutions: Section 01 6000 - Product Requirements.
 4. Top Coat Sheen:
 - a. Flat: MPI gloss level 1; use this sheen at exposed ceiling.
 5. Primer: As recommended by top coat manufacturer for specific substrate.
- E. Paint I-TR-C - Solid Color Stain Finish on Concrete Floors.
 1. 1 coat stain.
 2. Stain: Solid Color Stain for Concrete.
 - a. Products:
 - 1) PPG Paints Perma-Crete Color Seal WB Interior/Exterior Acrylic Concrete Stain, 4-4210XI Series, Satin.
 - 2) H&C; Colortop Water-Based Solid Color Concrete Stain.
 - 3) Substitutions: Section 01 6000 - Product Requirements.
- F. Paint I-TR-F - Fire-Retardant Coating, Intumescent:
 1. One coat of fire-retardant primer sealer.
- G. Paint FI-OP-3A - Fabrics/Insulation Jackets, Alkyd, 3 Coat:
 1. Semi-gloss: Two coats of alkyd enamel.

2.04 PRIMERS

- A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.
 1. Alkali Resistant Water Based Primer - Structural Glazed Facing Tile and Hard Tile, Insulated Piping, Insulated Ductwork, Existing Brick, Previously Painted Surfaces, and Concrete; MPI #3.
 - a. Products:
 - 1) Sherwin-Williams Loxon Concrete and Masonry Primer Sealer (Existing Brick), LX02W50. (MPI #3)
 - 2) Sherwin Williams; PrepRite ProBlock Interior/Exterior Latex Primer/Sealer, B51-W60020 Series (MPI #3).
 - 3) Substitutions: Section 01 6000 - Product Requirements.
 2. Interior/Exterior Latex Block Filler; MPI #4.
 - a. Products:

- 1) Sherwin-Williams PrepRite Interior/Exterior Latex Block Filler, B25W00025. (MPI #4)
- 2) Substitutions: Section 01 6000 - Product Requirements.
3. Interior Rust-Inhibitive Water Based Primer (Aluminum and Non-Galvanized Ferrous Metals); MPI #107.
 - a. Products:
 - 1) Sherwin-Williams Pro-Cryl Universal Primer. (MPI #107)
 - 2) Substitutions: Section 01 6000 - Product Requirements.
4. Interior Water Based Primer Galvanized Metal; MPI #134.
 - a. Products:
 - 1) Sherwin-Williams Pro-Cryl Universal Primer. (MPI #134)
 - 2) Substitutions: Section 01 6000 - Product Requirements.
5. Stain Blocking Primer, Water Based; MPI #137.
 - a. Products:
 - 1) Sherwin Williams; Multi-Purpose Latex, B51W00450 (MPI #137.
 - 2) Substitutions: Section 01 6000 - Product Requirements.
6. Latex Primer for Interior Wood; MPI #39.
 - a. Products:
 - 1) Substitutions: Section 01 6000 - Product Requirements.
7. Bonding Primer, Water Based for Dryfall; MPI #17.
 - a. Products:
 - 1) Sherwin Williams, Multi-Purpose Latex Primer/Sealer B51W00450 (MPI #17).

2.05 CONCRETE STAINS AND SEALER

- A. General:
 1. Locations:
 - a. Use at following locations: Unless otherwise indicated, unfinished exposed concrete floors, equipment pads, ramps, steps, and stairs are to be finished using concrete stains.
- B. Concrete Stains:
 1. For traffic surfaces:
 - a. Water-based, film forming, solid color, acrylic concrete stain; two coats.
 - 1) Benjamin Moore; Insl-X Tuffcrete WB Acrylic Waterproofing Concrete Stain, CST-2XXX; DFT 1.0 mils.
 - 2) H&C; H&C Colortop Water-Based Solid Color Concrete Stain; DFT As recommended by manufacturer.
 - 3) PPG; Perma-Crete Color Seal WB Interior/Exterior Concrete Stain, 4-4210XI Series, DFT 1.5 mils.

2.06 ACCESSORY MATERIALS

- A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin application of paints and finishes until substrates have been adequately prepared.
- B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- E. Test shop-applied primer for compatibility with subsequent cover materials.

- F. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces is below the following maximums:
 - 1. Gypsum Wallboard: 12 percent.
 - 2. Plaster and Stucco: 12 percent.
 - 3. Masonry, Concrete, and Concrete Masonry Units: 12 percent.
 - 4. Interior Wood: 15 percent, measured in accordance with ASTM D4442.
 - 5. Concrete Floors and Traffic Surfaces: 8 percent.

3.02 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or repair existing paints or finishes that exhibit surface defects.
- D. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
- E. Seal surfaces that might cause bleed through or staining of topcoat.
- F. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- G. Concrete:
 - 1. Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
 - 2. Prepare surface as recommended by top coat manufacturer and according to SSPC-SP 13.
- H. Masonry:
 - 1. Remove efflorescence and chalk. Do not coat surfaces if moisture content, alkalinity of surfaces, or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.
 - 2. Prepare surface as recommended by top coat manufacturer.
- I. Concrete Floors and Traffic Surfaces: Remove contamination, acid etch and rinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.
- J. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.
- K. Plaster: Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high-alkali surfaces.
- L. Insulated Coverings: Remove dirt, grease, and oil from canvas and cotton.
- M. Aluminum: Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
- N. Galvanized Surfaces:
 - 1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
- O. Ferrous Metal - Non-galvanized:
 - 1. Solvent clean according to SSPC-SP 1.
 - 2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
 - 3. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.
 - a. Re-prime entire shop-primed item.
 - 4. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning." Protect from corrosion until coated.

- P. Wood Surfaces to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.
- Q. Wood Doors to be Field-Finished: Seal wood door top and bottom edge surfaces with clear sealer.
- R. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

3.03**APPLICATION**

- A. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
- B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- C. Apply each coat to uniform appearance in thicknesses specified by manufacturer.
- D. Sand wood and metal surfaces lightly between coats to achieve required finish.
- E. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- F. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04**FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for general requirements for field inspection.
- B. Owner will provide field inspection.
- C. Adhesion Test to be performed per ASTM D3359 Method A (5mils or less) or B (over 5mils)
- D. All coatings shall be inspected as follows:
 - 1. Coatings shall be rejected for the following:
 - a. Lacking minimum dry film thicknesses.
 - 1) Inspector may test for proper dry film thickness using methods as recommended by the inspector.
 - b. Poor coverage at rivet heads, plate edges, lap joints, crevices, pockets, and corners.
 - c. Damage from touching, or disturbing paint in any other manner, before sufficiently dry.
 - d. Damage from application to moist surfaces or damage caused by inadequate protection from the weather.
 - e. Damage or contamination of paint from blown contaminants including but not limited to dust.
 - 2. Coatings shall be rejected if any of the following are evident under natural lighting for exterior surfaces and final lighting source, including daylighting, for interior surfaces:
 - a. Visible defects are evident on vertical surfaces when viewed at normal viewing angles from a distance of not less than 48 inches.
 - b. Visible defects are evident on horizontal surfaces when viewed at normal viewing angles from a distance of not less than 48 inches.
 - c. Visible defects are evident on ceiling, soffit and other overhead surfaces when viewed at normal viewing angles from a distance of not less than 48 inches.
- E. Visible defects are defined as follows:
 - 1. Brush and roller marks, streaks, laps, runs, sags, drips, heavy stippling, hiding or shadowing by inefficient application methods, skipped or missed areas, and foreign materials in paint coatings.
 - 2. When the final coat on any surface exhibits a lack of uniformity of color, sheen, texture, and hiding across full surface area.
- F. Coatings rejected by the inspection shall be repaired or replaced at the expense of the Contractor.
- G. Small affected areas shall be touched up.

1. Large affected areas shall be repainted.
2. Small and large areas shall be as defined by the Architect.
3. Areas without sufficient dry film thickness shall be repainted.
4. Paint runs and sags shall be removed by scraper or sanding and repainted.

3.05 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.06 PROTECTION

- A. Protect finishes until completion of project.
- B. Touch-up damaged finishes after Substantial Completion.

3.07 SCHEDULE - PAINT SYSTEMS

- A. Concrete, Concrete Masonry Units (CMU), Concrete Block, Brick Masonry: Finish surfaces exposed to view.
 1. Interior: CI-OP-3L, semi-gloss.
- B. Gypsum Board: Finish surfaces exposed to view.
 1. Interior Ceilings and Bulkheads: GI-OP-3L, flat.
 2. Interior Walls: GI-OP-3A, semi-gloss.
- C. Wood: Finish surfaces exposed to view.
 1. Interior trim and frames: WI-OP-3A, semi-gloss.
- D. Steel Fabrications: Finish surfaces exposed to view.
 1. Interior: MI-OP-3L, semi gloss.
- E. Galvanized Steel: Finish surfaces exposed to view.
 1. Interior: Mgl-OP-3L.
- F. Shop-Primed Metal Items: Finish surfaces exposed to view.
- G. Pipe and Duct Insulation Jackets: Finish surfaces exposed to view; FI-OP-2L, flat.

3.08 COLOR SCHEDULE

- A. PT-1/EP
 1. Sherwin Williams, White Snow :SW954

END OF SECTION

SECTION 10 0100 - MISCELLANEOUS SPECIALTIES**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Knox Box.

1.02 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2023c.
- B. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate the installation of products specified in this section with size, location and installation of service utilities.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide general construction, material descriptions, finishes, dimensions and details.
- C. Shop Drawings: Indicate pertinent dimensioning, anchorage methods, and installation details.
 - 1. Include plans, elevations, sections, details, and attachments to other Work.
 - 2. Include wiring diagrams of electrical components.
- D. Operation Data: Include normal operation, troubleshooting, and adjusting.
- E. Maintenance Data: Include data on regular cleaning.
- F. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least 5 years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least 5 years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Package specified products as required to prevent damage before installation.

1.07 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide manufacturers' standard warranties for material and workmanship.

PART 2 PRODUCTS**2.01 KNOX BOX**

- A. Description: Recessed mounted with hinged door. Box and Lock to be UL Listed.
- B. Construction: 1/4 inch thick steel house, 1/2 inch thick steel door with interior gasket seal and stainless steel door hinge, Lock has a 1/8 inch thick stainless steel dust cover with tamper seal mounting capability.
- C. Exterior Dimensions: Body is Recessed 7 inches H by 7 inches W by 3-7/8 inches D.
- D. Lock: UL listed, double-action rotating tumblers and harden steel pins accessed by a biased cut key.
- E. Finish: Knox-Coat proprietary finish process.
- F. Color: Dark Bronze
- G. Accessories: Provide 3200 Hinged Door Recessed Mounting Kit
- H. Manufacturer: Knox Company, P/N: 3200 Series Knox-Box.

2.02 ACCESSORIES

- A. Mounting Hardware: Provide all related fasteners and hardware required for a complete installation at substrates indicated.
- B. Miscellaneous Trim and Accessories: Provide all trim and accessories required for a complete installation.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify that internal wall blocking is ready to receive work and positioning dimensions are as required by the specified products.
- C. Verify that electrical service requirements are correct and properly located for specified products.

3.02 INSTALLATION

- A. Install specified products in accordance with manufacturer's instructions.
- B. Install specified products in locations indicated.
- C. Install specified products level and plumb.
- D. Connect specified products to electrical service in accordance with manufacturer's instructions.

3.03 ADJUSTING

- A. Adjust operable elements for smooth operation.

3.04 CLEANING

- A. Clean specified products accordance with manufacturer's instructions

3.05 CLOSEOUT ACTIVITIES

- A. Demonstrate proper operation of equipment to Owner's designated representative.
 - 1. Briefly describe function, operation, and maintenance of each component.

3.06 PROTECTION

- A. Protect installed products from subsequent construction operations.

END OF SECTION

SECTION 10 1423 - PANEL SIGNAGE**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Panel signage.

1.02 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design 2010.
- B. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's product literature for each type of panel sign, indicating styles, font, foreground and background colors, locations, and overall dimensions of each sign.
- C. Shop Drawings:
 - 1. Include dimensions, locations, elevations, materials, text and graphic layout, attachment details, and schedules.
 - 2. Schedule: Provide information sufficient to completely define each panel sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
 - a. When room numbers to appear on signs differ from those on drawings, include the drawing room number on schedule.
 - b. When content of signs is indicated to be determined later, request such information from Owner through Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
 - c. Submit for approval by Owner through Architect prior to fabrication.
- D. Samples: Submit two samples of each type of sign, of size similar to that required for project, indicating sign style, font, and method of attachment.
- E. Selection Samples: Where colors, materials, and finishes are not specified, submit two sets of color selection charts or chips.
- F. Verification Samples: Submit samples showing colors, materials, and finishes specified.
- G. Manufacturer's Installation Instructions: Include installation templates and attachment devices.
- H. Manufacturer's qualification statement.
- I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements for additional provisions.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years of documented experience.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Package signs as required to prevent damage before installation.
- B. Package room and door signs in sequential order of installation, labeled by floor or building.
- C. Store under cover and elevated above grade.
- D. Store tape adhesive at normal room temperature.

1.06 FIELD CONDITIONS

- A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.
- B. Maintain minimum ambient temperature during and after installation.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Panel Signage:

1. ASI Signage Innovation: www.asisignage.com.
2. Foresight Supersign: www.foresightsupersign.net.
3. Inpro Corporation; _____: www.inprocorp.com/#sle.
4. Summit Advertising, Inc.: www.summit-signco.com
5. The Supersine Company: www.supersine.com.
6. Substitutions: See Section 01 6000 - Product Requirements.

2.02 REGULATORY REQUIREMENTS

- A. Accessibility Requirements: Comply with ADA Standards and ICC A117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most restrictive requirements.

2.03 PANEL SIGNAGE

- A. Panel Signage:
1. Application: Room and door signs.
 2. Description: Flat signs with engraved panel media, tactile characters and Braille shall be integral to sign face; separate adhesively-fixed characters are not permitted. Frameless.
 3. Sign Size: As indicated on drawings.
 4. Total Thickness: 1/8 inch.
 5. Sign Edges: As indicated.
 6. Letter Edges: As indicated.
 7. Corners: As indicated.
 8. Color and Font, unless otherwise indicated:
 - a. Character Font: Helvetica, Arial, or other sans serif font.
 - b. Character Case: Upper and lower case (title case).
 - c. Background Color: As scheduled.
 - d. Character Color: Contrasting color.
 9. Material: Laminated colored plastic engraved through face to expose core as background color.
 10. Profile: Flat panel without frame.
 - a. Clear Cover: For customer produced sign media, provide clear cover of polycarbonate plastic, glossy on back, nonglare on front.
 11. Tactile Letters: Raised 1/32 inch minimum.
 12. Braille: Grade II, ADA-compliant.
 13. One-Sided Wall Mounting: Concealed screws.

2.04 SIGNAGE APPLICATIONS

- A. Room and Door Signs:
1. Service Rooms: Identify with room names and numbers to be determined later, not those indicated on drawings.
 2. Rest Rooms: Identify with pictograms, the names "MEN" or "BOYS" and "WOMEN" or "GIRLS", and braille.
 3. Exits: Identify with text and braille.

2.05 ACCESSORIES

- A. Concealed Screws: Noncorroding metal; stainless steel, galvanized steel, chrome plated, or other.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.
- B. Notify Architect if conditions are not suitable for installation of signs; do not proceed until conditions are satisfactory.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install with horizontal edges level.

- C. Locate panel signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.
- D. Protect from damage until date of Substantial Completion; repair or replace damaged items.

END OF SECTION

SECTION 10 2113.18 - SOLID COMPOSITE TOILET COMPARTMENTS**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Solid composite toilet compartments.
- B. Urinal screens.

1.02 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design 2010.
- B. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2023.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2023c.
- D. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with placement of support framing and anchors in walls and ceilings.
 - 2. Coordinate the work with floor drain locations.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on panel construction, hardware, and accessories.
- C. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall and floor supports, door swings.
 - 1. Indicate reinforcement locations for partition-mounted grab bars and surface-mounted toilet accessories.
 - 2. Show floor drain locations.
- D. Samples:
 - 1. Submit 3 samples of partition panels, 6 by 6 inch in size illustrating panel finish, color, and sheen.
 - 2. Submit 3 sample sets of hardware and accessories indicating material and finish; each set to include door latch, hinge, and panel bracket.
- E. Selection Samples: Where colors and finishes are not specified, submit 3 sets of color and finish selection charts or chips.
- F. Test Reports: Show compliance to specified surface burning characteristics requirements.
- G. Maintenance Data: Include data on regular cleaning.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Door Hinges: Quantity equal to 2 percent of total installed, but not less than 4; including fasteners.
 - 3. Door Latch, Strike, and Keeper: Quantity equal to 2 percent of total installed, but not less than 4; including fasteners.
 - 4. Door Bumper: Quantity equal to 2 percent of total installed, but not less than 4; including fasteners.
 - 5. Door Pull: Quantity equal to 2 percent of total installed, but not less than 2; including fasteners.
 - 6. Fasteners: Quantity equal to 2 percent of each fastener type and size installed, but not less than 10 fasteners of each type and size.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 5 years of documented experience.
- B. Installer Qualifications: Company experienced in installing the products specified in this section with minimum 5 years documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Package partition panels and material as required to prevent damage before installation.

1.07 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide 25 year warranty against defects in workmanship and materials.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Solid Composite Toilet Compartments:
 1. Bobrick Washroom Equipment, Inc.; SierraSeries SCRC: www.products.bobrick.com.
 2. Substitutions: Section 01 6000 - Product Requirements.

2.02 SOLID COMPOSITE TOILET COMPARTMENTS

- A. Toilet Compartments: Factory fabricated doors, pilasters, and divider panels made of solid color reinforced composite (SCRC) panels, floor-mounted headrail-braced.
 1. Accessibility: Comply with ICC A117.1 and ADA Standards.
 2. Surface Burning Characteristics:
 - a. Class B per ASTM E84; flame spread 45, smoke developed 120.
 3. Color: Two standard colors as selected by Architect.
- B. Doors:
 1. Thickness: 3/4 inch.
 2. Width: 24 inch, unless otherwise indicated.
 3. Width for Handicapped Use: 36 inch, out-swinging, unless otherwise indicated. Solid Composite
 4. Height: 58 inch.
- C. Panels:
 1. Thickness: 1/2 inch.
 2. Height: 58 inch.
 3. Widths: As indicated.
- D. Pilasters:
 1. Thickness: 3/4 inch.
 2. Width: As required to fit space; minimum 3 inch.
- E. Urinal Screens: Wall mounted with continuous panel brackets.
 1. Construction: Same as panels.
 2. Width: 24 inches, unless otherwise indicated.
 3. Height: 42 inches, unless otherwise indicated.

2.03 ACCESSORIES

- A. Pilaster Shoes: Formed ASTM A666 Type 304 stainless steel with No. 4 finish, 3 inch high, concealing floor fastenings.
 1. Provide adjustment for floor variations with screw jack through steel saddles integral with pilaster.
- B. Head Rails: Hollow stainless steel, 1 inch by 1-1/2 inch size, with anti-grip profile and cast socket wall brackets.
- C. Wall, Pilaster, and Urinal Screen Brackets: Satin stainless steel; continuous type.
- D. Attachments, Screws, and Bolts: Stainless steel, tamper proof type.
 1. For attaching panels and pilasters to brackets: Through-bolts and nuts; tamper proof.
- E. Hardware: Satin stainless steel; heavy-duty type:
 1. Barrel hinges, gravity type, adjustable for door close positioning; two per door.
 2. Door Latch: Slide type with exterior emergency access feature.
 3. Door strike and keeper with rubber bumper; mounted on pilaster in alignment with door latch.
 4. Coat hook with rubber bumper; one per compartment, mounted on door.
 5. Provide door pull for outswinging doors.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify correct spacing of and between plumbing fixtures.
- C. Verify correct location of built-in framing, anchorage, and bracing.

3.02 INSTALLATION

- A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.
- B. Maintain 3/8 inch to 1/2 inch space between wall and panels and between wall and end pilasters.
- C. Align tops of doors and panels.
- D. Attach panel brackets securely to walls using anchor devices.
- E. Wall fasteners shall be located at masonry and tile joints; do not penetrate masonry or tile faces.
- F. Align wall brackets and pilaster brackets.
- G. Attach panels and pilasters to brackets. Locate head rail joints at pilaster center lines.
- H. Field touch-up of scratches or damaged finish will not be permitted. Replace damaged or scratched materials with new materials.

3.03 TOLERANCES

- A. Maximum Variation From True Position: 1/4 inch.
- B. Maximum Variation From Plumb: 1/8 inch.

3.04 ADJUSTING

- A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch.
- B. Adjust hinges to position doors in partial opening position when unlatched. Return out-swinging doors to closed position.
- C. Adjust adjacent components for consistency of line or plane.

END OF SECTION

SECTION 10 2800 - TOILET, BATH, AND LAUNDRY ACCESSORIES**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Commercial toilet accessories.
- B. Electric hand dryers.
- C. Diaper changing stations.
- D. Utility room accessories.

1.02 REFERENCE STANDARDS

- A. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service 2022.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2023.
- C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2023.
- D. ASTM B86 - Standard Specification for Zinc and Zinc-Aluminum (ZA) Alloy Foundry and Die Castings 2022.
- E. ASTM C1036 - Standard Specification for Flat Glass 2021.
- F. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror 2018.
- G. ASTM F2285 - Standard Consumer Safety Performance Specification for Diaper Changing Tables for Commercial Use 2022.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with the placement of internal wall reinforcement and reinforcement of toilet partitions to receive anchor attachments.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.
- C. Samples: When requested by Architect.
 - 1. Submit 3 sample for each color and finish, 2 by 2 inch in size.
- D. Selection Samples: Where colors and finishes are not specified, submit 3 sets of color and finish selection charts or chips.
- E. Operation and Maintenance Data: Include operating procedures and recommended cleaning methods.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Hand Dryer Filters: For units with filters, provide quantity equal to 2 filters per unit installed. .

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 5 years of documented experience.
- B. Installer Qualifications: Company experienced in installing the products specified in this section with minimum 5 years documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Package toilet, bath, and laundry accessories as required to prevent damage before installation.

1.07 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Mirrors: Provide 15 year warranty against silver spoilage.

- C. Electric Hand Dryers: Provide 5 year warranty against defects in workmanship and materials.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis-of-Design:

1. Commercial Toilet, Shower, and Bath Accessories, including Utility Room Accessories: Provide product indicated or a comparable product by one of the following:
 - a. American Specialties, Inc, (ASI): www.americanspecialties.com.
 - b. Bobrick Washroom Equipment, Inc.: www.bobrick.com.
 - c. Bradley Corporation: www.bradleycorp.com.
 - d. Substitutions: Section 01 6000 - Product Requirements.
2. Electric Hand Dryers: Provide product indicated or a comparable product by one of the following:
 - a. American Specialties, Inc, (ASI): www.americanspecialties.com.
 - b. Bobrick Washroom Equipment, Inc.: www.bobrick.com.
 - c. Bradley Corporation: www.bradleycorp.com.
 - d. Excel Dryer Inc.: www.exceldryer.com.
 - e. World Dryer Corp.: www.worlddryer.com.
 - f. Substitutions: Section 01 6000 - Product Requirements.
3. Diaper Changing Stations: Provide product indicated or a comparable product by one of the following:
 - a. American Specialties, Inc, (ASI): www.americanspecialties.com.
 - b. Bobrick Washroom Equipment, Inc.: www.bobrick.com.
 - c. Bradley Corporation: www.bradleycorp.com.
 - d. World Dryer Corp.: www.worlddryer.com.
 - e. Substitutions: Section 01 6000 - Product Requirements.

2.02 MATERIALS

- A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
- B. Keys: Provide 2 keys for each accessory to Owner; master key lockable accessories.
- C. Stainless Steel Sheet: ASTM A666, Type 304.
- D. Stainless Steel Tubing: ASTM A269/A269M, Grade TP304 or TP316.
- E. Galvanized Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating.
- F. Zinc Alloy: Die cast, ASTM B86.
- G. Mirror Glass: Annealed float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.
- H. Fasteners, Screws, and Bolts: Hot dip galvanized; tamper-proof; security type.
- I. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.

2.03 FINISHES

- A. Stainless Steel: Satin finish, unless otherwise noted.

2.04 COMMERCIAL TOILET ACCESSORIES

- A. Toilet Paper Dispenser - Owner provided AND installed.
- B. Waste Receptacle: Owner provided AND installed.
- C. Combination Towel Dispenser/Waste Receptacle - Semi-Recessed Type: Semi-recessed with projecting waste receptacle, stainless steel; seamless wall flanges, continuous piano hinges, and tumbler lock.
 1. Towel dispenser capacity: 600 C-fold or 800 multifold.
 2. Waste receptacle capacity: 12 gallons.

3. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; B-3944.
- D. Soap Dispenser - Wall Mounted: Owner provided AND installed.
- E. Mirrors: Stainless steel framed, 1/4 inch thick annealed float glass; ASTM C1036.
 1. Annealed Float Glass: Silvering, protective and physical characteristics in compliance with ASTM C1503.
 2. Size: As indicated on drawings.
 3. Frame: Angle shapes, with mitered and welded and ground corners, and tamperproof hanging system; satin finish.
 4. Backing: Full-mirror sized, minimum 0.03 inch galvanized steel sheet and nonabsorptive filler material.
 5. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; B-290.
- F. Grab Bars: Stainless steel, smooth surface.
 1. Standard Duty Grab Bars:
 - a. Push/Pull Point Load: 250 pound-force, minimum.
 - b. Dimensions: 1-1/2 inch outside diameter, minimum 0.05 inch wall thickness, concealed flange mounting, 1-1/2 inch clearance between wall and inside of grab bar.
 - c. Finish: Satin, slip-resistant surface.
 - d. Length and Configuration: As indicated on drawings.
 - e. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; B-6806 Series.
- G. Sanitary Napkin Disposal Unit: Stainless steel, surface-mounted, self-closing door, removable receptacle.
 1. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; B-270.

2.05**ELECTRIC HAND DRYERS**

- A. Electric Hand Dryers: Traditional fan-in-case type, with downward fixed nozzle.
 1. Operation: Automatic, sensor-operated on and off.
 2. Mounting: Surface mounted.
 - a. Maximum Projection From Wall: 4 inches.
 3. Cover: Chrome plated steel or die-cast zinc alloy.
 - a. Tamper-resistant screw attachment of cover to mounting plate.
 - b. Screened or shielded air intake.
 - c. Screen or shield to prevent access to motor/heater.
 4. Air Flow: 70 CFM, minimum.
 5. Air Velocity: 7,000 linear feet per minute, maximum.
 6. Noise: 70, maximum, 39 inches from unit; with hands under nozzle.
 7. Total Wattage: 1000 W, maximum.
 8. Runtime: 60 to 90 seconds, maximum.
 9. Supply Voltage: 120 V, single phase, 60 Hz, nominal, unless otherwise indicated.
 10. Warranty: 10 years.
 11. Basis-of-Design Product: Bobrick Washroom Equipment Inc.; QuietDry Series Terra Dry B-7188: www.bobrick.com. Provide the basis-of-design product or one of the following:
 - a. American Specialties, Inc, (ASI) ; Model 0185: www.americanspecialties.com.
 - b. Bobrick Washroom Equipment, Inc.; B-7188: www.bobrick.com.
 - c. World Dryer Corp.; SLIMdri: www.worlddryer.com.
 - d. Substitutions: Section 01 6000 - Product Requirements.

2.06**DIAPER CHANGING STATIONS**

- A. Diaper Changing Station: Wall-mounted, horizontal, folding diaper changing station for use in commercial toilet facilities, meeting or exceeding ASTM F2285.
 1. Material: Polyethylene.
 2. Mounting: Surface.
 3. Color: Standard color as selected by Architect.
 4. Minimum Rated Load: 250 pounds.
 5. Include an integral bed liner dispenser; 50 liner capacity.

6. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; KB200

2.07 UTILITY ROOM ACCESSORIES

- A. Combination Utility Shelf/Mop and Broom Holder: 0.05 inch thick stainless steel, Type 304, with 1/2 inch returned edges, 0.06 inch steel wall brackets.
 - 1. Drying rod: Stainless steel, 1/4 inch diameter.
 - 2. Hooks: Three, 0.06 inch stainless steel rag hooks at shelf front.
 - 3. Mop/broom holders: Four spring-loaded rubber cam holders at shelf front.
 - 4. Length: 36 inches.
 - 5. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; B-224.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify exact location of accessories for installation.
- C. For electrically-operated accessories, verify that electrical power connections are ready and in the correct locations.

3.02 INSTALLATION

- A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.
- B. Install plumb and level, securely and rigidly anchored to substrate.
- C. Mounting Heights: As indicated and as required by accessibility regulations.
- D. Where possible, locate wall fasteners at masonry and tile joints; do not penetrate masonry or tile faces.

3.03 PROTECTION

- A. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION

SECTION 10 4400 - FIRE PROTECTION SPECIALTIES**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Fire extinguishers.
- B. Fire extinguisher cabinets.

1.02 REFERENCE STANDARDS

- A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems 2023a.
- B. NFPA 10 - Standard for Portable Fire Extinguishers 2022.
- C. UL (DIR) - Online Certifications Directory Current Edition.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide extinguisher operational features, extinguisher ratings and classifications, color and finish, and anchorage details.
- C. Shop Drawings: Indicate locations of cabinets, cabinet physical dimensions, rough-in measurements for recessed cabinets, locations of individual fire extinguishers, mounting measurements for wall bracket, and accessories required for complete installation.
- D. Samples: When requested by Architect.
 - 1. Submit 3 sample for each color and finish, 2 by 3 inch in size.
- E. Selection Samples: Where colors and finishes are not specified, submit 3 sets of color and finish selection charts or chips.
- F. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 5 years of documented experience.
- B. Installer Qualifications: Company experienced in installing the products specified in this section with minimum 5 years documented experience.

1.05 FIELD CONDITIONS

- A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

1.06 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Fire Extinguishers: 5 year warranty against defects in workmanship and materials.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Fire Extinguishers:
 - 1. Activar Construction Products Group, Inc. - JL Industries: www.activarcpg.com.
 - 2. Croker Division of Fire-End and Croker Corp.: www.croker.com.
 - 3. Larsen's Manufacturing Co: www.larsensmfg.com.
 - 4. Nystrom, Inc: www.nystrom.com.
 - 5. Potter-Roemer: www.potterroemer.com.
 - 6. Substitutions: See Section 01 6000 - Product Requirements.
- B. Fire Extinguisher Cabinets and Accessories:
 - 1. Activar Construction Products Group, Inc. - JL Industries: www.activarcpg.com.
 - 2. Croker Division of Fire-End and Croker Corp.: www.croker.com.
 - 3. Larsen's Manufacturing Co: www.larsensmfg.com.
 - 4. Nystrom, Inc: www.nystrom.com.
 - 5. Potter-Roemer: www.potterroemer.com.
 - 6. Substitutions: See Section 01 6000 - Product Requirements.

2.02 FIRE EXTINGUISHERS

- A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
 - 1. Provide extinguishers labeled by UL (DIR) or testing firm acceptable to authorities having jurisdiction for purpose specified and as indicated.
- B. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gauge.
 - 1. Class: A:B:C type.
 - 2. Size: 10 pound.
 - a. UL Rating: 4A-60B:C.
 - 3. Finish: Baked polyester powder coat, red color.
 - 4. Minimum Operational Temperature: Minus 65 degrees F.

2.03 FIRE EXTINGUISHER CABINETS

- A. Fire Rating: Listed and labeled in accordance with ASTM E814 requirements for fire resistance rating of walls where being installed.
- B. Cabinet Construction: Non-fire rated.
 - 1. Formed primed steel sheet; minimum 0.036 inch (20 gage) thick base metal.
- C. Fire Rated Cabinet Construction: Fire rating equal to wall in which installed.
 - 1. Primed steel; double wall or outer and inner boxes with 5/8 inch thick fire barrier material.
 - a. Minimum Thickness: 0.036 inch (20 gage).
- D. Cabinet Configuration: Recessed and semi-recessed type.
 - 1. Size to accommodate fire extinguisher.
 - 2. Trim - Recessed Cabinets: Flat square edge, with minimum 1-3/4 inch wide face. Stainless steel.
 - 3. Projected Trim - Semi-Recessed Cabinets: Returned to wall surface, with 2-1/2 inch rolled-edge projection, and 1-3/4 inch wide face. Stainless steel.
 - 4. Provide cabinet enclosure with right angle inside corners and seams, and with formed perimeter trim.
- E. Door: 0.036 inch metal thickness, reinforced for flatness and rigidity with roller type catch. Hinge doors for 180 degree opening with continuous piano hinge.
 - 1. Metal: Stainless steel.
- F. Door Glazing: Tempered glass, clear, 1/8 inch thick, and set in resilient channel glazing gasket.
 - 1. Style: Vertical duo panel glazing.
- G. Door Pull: Manufacturer's standard flush/recessed pull handle.
- H. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.
- I. Fabrication: Weld, fill, and grind components smooth.
- J. Finish of Cabinet Exterior Trim and Door: No. 4 - Brushed stainless steel.
- K. Finish of Cabinet Interior: White; powder coat.

2.04 ACCESSORIES

- A. Extinguisher Brackets: Formed steel, painted black. Sized for fire extinguishers specified.
- B. Lettering: "FIRE EXTINGUISHER" diecut self-adhering black, equally spaced, lettering; provide in accordance with authorities having jurisdiction (AHJ).
 - 1. Locations: Unless otherwise indicated:
 - a. Fire Extinguisher Cabinets: Locate on door.
 - 1) Lettering shall be applied at the factory.
 - b. Wall brackets: Locate above fire extinguisher and bracket.
 - 2. Orientation: Vertical.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify rough openings for cabinet are correctly sized and located.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install cabinets and fire extinguisher brackets plumb and level at mounting heights indicated and in accordance with authorities having jurisdiction (AHJ).
- C. Secure rigidly in place.
- D. Place extinguishers in cabinets and on wall brackets.
- E. Apply fire extinguisher lettering to walls above wall bracket mounted fire extinguishers in accordance with authorities having jurisdiction (AHJ).
- F. Adjust cabinet doors for smooth operation.

3.03 PROTECTION

- A. Protect installed fire protection specialties from damage due to subsequent construction operations.

END OF SECTION

SECTION 10 7516 – FLAGPOLE

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section is a part of the entire set of Contract Documents and shall be coordinated with the applicable provisions of the other parts.
- B. Related Sections:
 - 1. Section 03 3000 Cast In Place Concrete - Athletics
 - 2. Section 31 2000 Earthwork - Athletics

1.2 SCOPE

- A. Provide and install one (1) 40' aluminum flagpole as specified with accessories, foundation construction and lightning protection as required for a complete and proper installation.
- B. Installation shall include (1) 8'x12' American Flag per flagpole.

1.3 QUALITY ASSURANCE

- A. Manufacturer's Standards: Provide each pole as a complete unit produced by a single manufacturer, including fittings, accessories, bases and anchorage devices.
- B. Design Criteria: Provide flagpole and installation constructed to withstand an 80 mph wind velocity minimum when flying flag of appropriate size.
- C. Pole Construction: Construct pole and ship to site in one piece, if possible. If more than one piece is necessary, provide snug-fitting precision joints with self-aligning, internal splicing sleeve arrangement for weather-light, hairline field joints.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's technical data and installation instructions for each type of flagpole and flagpole component as specified.
- B. Shop Drawings: Submit shop drawings of poles and bases, including connections to structure showing general layout jointing and complete anchoring and supporting systems, with all pertinent dimensional information in a clear and concise manner.

1.5 DELIVERY

- A. Spiral wrap each flagpole with heavy draft paper and pack in hard fiber tube prior to shipment.
- B. Deliver flagpole complete with accessories and installation instructions clearly identified, and store unwrapped and protected from weather, and moisture.

PART 2 - PRODUCTS

2.1 FLAGPOLE SHAFT

- A. Style of flagpole: Grounded
- B. Materials: Aluminum alloy 6063-T6 from seamless extruded tubing complying with ASTM B-241.
- C. Taper Type: Cone Tapered uniform straight line rate of taper of 1" every 5'6" of pole (aluminum)
- D. Shaft Finish:
 - 1. Aluminum: Clear anodized finish, AA-M32-C22-A41
- E. Mounting Classifications:
 - 1. Groundset: Corrugated Steel Sleeve
- F. Dimensions: Flagpole to be 40 feet exposed length, with base diameter of 6 inches and butt wall thickness of .188 inches, minimum.
- G. Workmanship: Fabricate all joints and seams to be inconspicuous. Grind all exposed welds smooth, and finish to match pole shaft.

2.2 METHOD OF HOISTING THE FLAG

- A. Internal Halyard:
 - 1. Groundset Flagpoles
 - a. Truck, Winch and Halyard: System to include heavy duty cast aluminum revolving truck and hood with a heavy duty stainless steel direct drive winch with a removable handle. Winch is manually operated and has a spring loaded friction brake to lock the flag at any position on the pole. Winch is accessible through a flush pivot access door with cylinder lock and continuous aluminum piano hinge. Flag descent system consists of a plastic beaded sling, that encircles the pole and is attached to a neoprene coated counterweight at

the halyard end. The flag is attached to two (2) brass snap hooks that are attached to the 1/8" diameter 7 x 19 construction stainless steel aircraft cable halyard. The cable is routed through the revolving truck down the pole shaft and is held in place by the winch for raising, lowering, and displaying the flag at any position on the flagpole.

- b. Flash Collar: Spun aluminum flash collar

PART 3 - EXECUTION

3.1 PREPARATION

- A. At time of erection, remove all protective wrappings.

3.2 INSTALLATION

- A. Install all flagpoles, base assemblies and fittings in compliance with approved shop drawings and manufacturer's instructions.
- B. Provide proper lightning ground for each flagpole.
- C. Installation shall be done by a crew experienced in this type of flagpole installation.

3.3 ADJUSTMENTS

- A. Check and adjust all installed fittings for smooth and proper operation.

END OF SECTION

SECTION 11 6826 – NET TENSION SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section is a part of the entire set of Contract Documents and shall be coordinated with the applicable provisions of the other parts.
- B. Related Sections:
 - 1. Section 03 3800 Post-Tension Concrete
 - 2. Section 31 2010 Earthwork - Athletics

1.2 SCOPE

- A. The work under this section of the specifications shall consist of furnishing all labor, materials and equipment necessary for installation of a complete net tension system. Work to include but not limited to, excavation and concrete for post footings and net posts and accessories.

1.3 QUALITY ASSURANCE

- A. Warranty Guarantee: The Contractor and any Sub-contractor hereunder guarantee their respective work against defective materials or workmanship for a period of two (2) years from the date of filing notice of completion and an acceptance by the Owner.
- B. Product Testing: All material installed under this specification shall be subject to testing by Owner at his expense. Any material so inspected and found to be not in strict conformance with this specification shall be promptly removed and replaced by the Contractor at his expense.

1.4 SUBMITTALS

- A. Submit manufacturer literature, identifying the particular item to be installed. Manufacturer information should include photographs, and applicable technical information.

PART 2 - PRODUCTS

2.1 NET TENSION SYSTEM - TENNIS

- A. Net posts shall be seven gauge (7ga.) galvanized steel having an outside diameter of not less than three inches (3") and shall be equipped with self locking re-coiless tension system. Posts and sleeves shall be located where indicated on the drawings or details. Post shall be set plumb and true so as to support the net at a height of forty-two inches (42") above the court surface at each post. Post shall be selected by Owner from standard manufacturer's colors. All tennis products shall be from Douglas Industries (Phone: 800-553-8907).
 - 1. Posts and sleeves shall conform to the following:
 - a. Net Posts: Model# DTP-37 Phone
 - b. Ground Sleeves: Model# GS-24
- B. One set of ground sleeve plugs shall be included with each set of net posts. T-Plugs shall be powder-coated black.
 - 1. T-Plug: Model# 63418 for 3" OD or approved equal
- C. Tennis nets shall be a polypropylene netting system with three millimeter (3mm) black braided thickness. The headband shall be double stitched vinyl with a cable system not less than forty-seven feet (47') long and with three thousand pounds (3000 lbs) tensile strength. The cable shall be five millimeters (5mm) in diameter galvanized steel cable PVC coated, with looped ends and clamps for three thousand pounds (3000 lbs) test tensile strength.
- D. Each net must be accompanied by a two inch (2") wide white nylon center strap with adjustable swivel hook. Nets and straps supplied by:
 - 1. Douglas Tennis Net: Model# TN-45 or approved equal
 - 2. One center strap anchor shall be installed for each court.

2.3 CONCRETE

- A. Concrete shall conform to Section 03 3010 Portland Cement Concrete.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Do not install net tension system until leveling course has been installed.
- B. Coordinate ground sleeve installation with finished concrete surface installation.

3.2 INSTALLATION - TENNIS

- A. Net tension system post foundations shall not be less than fifteen inches (15") in diameter at the top, not less than thirty inches (30") in diameter at the bottom and not less than forty-eight inches (48")

deep. Posts shall be set to have forty-two feet (42') on center. Posts and sleeves shall be located where indicated on the drawings or details. Posts shall be set plumb and true so as to support the net at a height of forty-two inches (42") above the court surface at each post. Center strap anchors shall be positioned as shown on the details as set in concrete footings as shown on the drawings and/or details.

3.4 CLEAN UP AND DISPOSAL

- A. Remove from the site all equipment, materials, and debris resulting from construction work including this section. Leave work area neat and clean and in a condition acceptable by the Landscape Architect and Owner. All work shall be complete, ready for use, at the time of final acceptance.

END OF SECTION

SECTION 11 6833 – ATHLETIC FIELD EQUIPMENT

PART 1- GENERAL

1.1 RELATED DOCUMENTS

- A. This Section is a part of the entire set of Contract Documents and shall be coordinated with the applicable provisions of the other parts.
- B. Related Sections:
 - 1. Section 03 3000 Cast In Place Concrete – Athletics
 - 2. Section 31 2010 Earthwork - Athletics
 - 3. Section 32 3100 Chainlink Fence – Galvanized

1.2 SCOPE

- A. The work under this section of the specifications shall consist of furnishing all labor, materials and equipment necessary for the installation of the following:
 - 1. Tension Ball Safety Netting System and Accessories
 - 2. Protective Safety Net System
 - 3. Field Wall Protective Padding and Accessories
 - 4. Pre-Fabricated On-Deck Circles

1.3 REFERENCES

- A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.
 - 1. National Federation of State High School Associations (NFHS)
 - 2. National Collegiate Athletic Association (NCAA)
 - 3. International Association of Athletics Federations (IAAF)
 - 4. American Sports Builders Association (ASBA)
 - 5. Manufacturers Data and Recommended Installation Requirements

1.4 SUBMITTALS

- A. Manufacturers Product Data
 - 1. Provide manufacturers product data prior to actual field installation work, for Architects or Owners representatives review.
 - 2. Stamped and Sealed Drawings and Calculations by a Licensed Professional Engineer of Record in the State of Project Location for all Tension Backstop Net Systems and Protective Safety Net Systems.
- B. Shop Drawings
 - 1. Provide drawings of the manufacturers recommended installation and foundation requirements prior to actual field installation work, for Architects or Owners representatives review.
 - 2. Manufacturer is responsible to provide signed and sealed engineered drawings of backstop system and protective safety net system, including support pole design, concrete footings design/requirements, and other pertinent information for a complete installation.
 - 3. Provide color renderings as necessary, complete with dimensions of proposed padding and pre-fabricated on-deck circles, to attain a final approval package from the Owner.

1.5 QUALITY ASSURANCE

- A. Manufacturers warranties shall pass to the Owner and certification made that the product materials meet all applicable grade trademarks or conform to industry standards and inspection requirements.
- B. Soil Conditions: The design criteria for these specifications are based on soil conditions with 2,000 psf or greater lateral load.

1.6 PRODUCT DELIVERY AND STORAGE

- A. Net System Warranty Guarantee: The Contractor and any Sub-contractor hereunder shall guarantee their respective work against defective materials or workmanship for a minimum period of two (2) year from the date of filing notice of completion or acceptance by Owner, unless noted otherwise in the Contract Documents or manufacturer's warranty is greater.
- B. Wall Padding Warranty Guarantee: The Contractor and any Sub-contractor hereunder shall guarantee their respective work against defective materials or workmanship for a minimum period of three (3) years from the date of filing notice of completion or acceptance by Owner, unless

noted otherwise in the Contract Documents. Refer to specific Manufacturer's Limited Warranty.

PART 2 - PRODUCTS

2.1 INTEGRATED WALL PAD BACKSTOP

A. BASIS OF DESIGN:

Sportsfield Specialties, Inc.
P.O. Box 231
41155 State Highway 10
Delhi, NY 13753
p. 888-975-3343
f. 607-746-8481
www.sportsfieldspecialties.com

B. COMPONENTS:

1. Upright Support Posts – Fabricated, Sized and Configured as Required:
 - a. Height Above Finish Grade as Noted. Netting System manufacturer is responsible for sizing of posts and footings as required for Delegated Design.
 - b. Powder Coated Finish (Black)
 - c. Direct embedded post installation
 - d. Stainless Steel or Hot Dipped Galvanized Assembly Hardware - Quantities, Sizes and Configurations as Required
2. Wall Pad Backstop Rail Support Structure and Mounting Brackets:
 - a. Quantity and Configuration as Required
 - b. 2 ½" SQ. x 11 Gauge Wall Thickness Steel Rail Support Structure
 - c. 7 Ga. Steel Bracketry for Rail Mounting
 - d. Super Durable Powder Coated Black Finish with Enhanced Resistance to UV and Fade
3. Wall Pads and Backer Board:
 - a. Length, Height, and Configuration as Required
 - b. 18 oz. Exterior Vinyl – Color to be selected by Owner
 - c. Padding to be placed on BOTH sides of the wall
 - d. ¾" Advantech® Water Resistant Sheathing Panel, Sealed and Stained with Exterior Grade Black Finish
 - e. Graphics to include: School Name, Mascot Name and (2) logos. Logos to be provided to Contractor in .eps format upon Contract Award
 - f. Aluminum Z-Clip Style Mounting Brackets, (2) Sets per Pad
 - g. 11 Ga. Steel U-Bracket for Backer Board Mounting, Super Durable Powder Coated Black Finish with Enhanced Resistance to UV and Fade
4. Included Accessories:
 - a. Hot Dipped Galvanized Attachment and Assembly Hardware - Quantities, Sizes and Configurations as Required
 - b. Black Rope for Net Binding Attachment to Wire Rope Support Structure – Quantities and Configurations as Required
 - c. Stamped and Sealed Drawings and Calculations by a Licensed Professional Engineer of Record in the State of Project Location
 - d. Model Specific Hardware Kit and Installation Instructions
 - e. One (1) Year Limited Manufacturer's Product Warranty

2.2 STRAIGHT POLE SAFETY NETTING SYSTEM (Multi-Purpose Field)

- A. Basis of Design: Model # BSS420 – Pre-Engineered 20 Foot Straight Pole Safety Netting System and Accessories as Manufactured and/or Supplied by Sportsfield Specialties, Inc. (www.sportsfieldspecialties.com).
- B. COMPONENTS:
 1. BSS420 StormGuard® Professionally Pre-Engineered Break-Away Ball Safety Netting System Straight Poles:
 - a. Height Above Finish Grade as Noted.

- b. 4.0" Schedule 40 Aluminum Pipe, length as noted on plans. Posts shall be factory applied powder coated Black finish.
 - c. Direct embedded post installation. Netting System manufacturer is responsible for sizing of footings as required for Delegated Design.
 - 2. Net with Perimeter Rope Binding
 - a. General dimensions shall be as noted on plans. Contractor is responsible for field verifying site conditions before ordering netting.
 - b. Mesh Size: 1-3/4 inches square mesh, #36 Nylong
 - c. Sewn 1/4" diameter braided rope binding on perimeter edges
 - d. Color: Black
 - 3. Accessories
 - a. Stainless Steel and/or Galvanized Steel Assembly Hardware
 - b. Fixed Welded Upper Tab & Adjustable Lower Bracket with Tensioned Vertical Slide Cable System
 - c. Secure Snap Clips for Net Attachment
 - d. 3/16" Diameter Galvanized Wire Rope Black Vinyl Coated to 1/4" Diameter
 - e. Aluminum Ground Sleeve Caps
- 2.2 STRAIGHT POLE SAFETY NETTING SYSTEM (Track / Baseball Field)**
 - A. Basis of Design: Model # BSS640 – Pre-Engineered 40 Foot Straight Pole Safety Netting System and Accessories as Manufactured and/or Supplied by Sportsfield Specialties, Inc. (www.sportsfieldspecialties.com).
 - B. COMPONENTS:
 - 1. BSS640 StormGuard® Professionally Pre-Engineered Break-Away Ball Safety Netting System Straight Poles:
 - a. Height Above Finish Grade as Noted.
 - b. 6.625" Schedule 40 Aluminum Pipe, length as noted on plans. Posts shall be factory applied powder coated Black finish.
 - c. Direct embedded post installation. Netting System manufacturer is responsible for sizing of footings as required for Delegated Design.
 - 2. Net with Perimeter Rope Binding
 - a. General dimensions shall be as noted on plans. Contractor is responsible for field verifying site conditions before ordering netting.
 - b. Mesh Size: 1-3/4 inches square mesh, #36 Nylong
 - c. Sewn 1/4" diameter braided rope binding on perimeter edges
 - d. Color: Black
 - 3. Accessories
 - a. Stainless Steel and/or Galvanized Steel Assembly Hardware
 - b. Fixed Welded Upper Tab & Adjustable Lower Bracket with Tensioned Vertical Slide Cable System
 - c. Secure Snap Clips for Net Attachment
 - d. 3/16" Diameter Galvanized Wire Rope Black Vinyl Coated to 1/4" Diameter
 - e. Aluminum Ground Sleeve Caps
- 2.3 CHAINLINK FENCE PROTECTIVE PADDING AND ACCESSORIES**
 - A. Chainlink Fence Padding and Accessories as Manufactured and/or Supplied by:
Sportsfield Specialties, Inc.
P.O. Box 231
41155 State Highway 10
Delhi, NY 13753
p. 888-975-3343
f. 607-746-8481
www.sportsfieldspecialties.com
 - B. COMPONENTS:
 - 1. BCLPPSG Chainlink Fence Protective Padding:

- a. Dimensions: 6"W x Variable Length x 3" Thick
- b. Outdoor Vinyl Encasement:
 1. High UV Resistance
 2. Total Weight: 18 oz./yd² (ASTM D3776)
 3. Construction: 84% Vinyl Coating, 16% Polyester Fabric (ASTM D751)
 4. Tongue Tear: Warp 93 lbs., Fill 68 lbs. (ASTM D751)
 5. Grab Tensile: Warp 232 lbs., Fill 213 lbs. (ASTM D751)
 6. Adhesion: Warp 28 lbs/in, Fill 40 lbs/in (ASTM D751)
 7. Abrasion: > 1000 Cycles (ASTM D3389-94)
 8. Cold Crack: -49° F (ASTM D2136)
 9. Rot, Mildew and Fungus Resistant: Yes
 10. Flame Resistance: None
 11. Colors to be selected by Owner from Manufacturer standard colors.
- c. 3" Thick High Impact 1580 Polyurethane Foam
 1. Density: 1.45 – 1.55 pcf (ASTM D3574)
 2. Impression Load Deflection (4" x 25" x 25" Sample)
 - a. 25%: 75 – 85 (ASTM D3574)
 - b. 65%: 128 – 145 (ASTM D3574)
 - c. Support Factor 65/25: 1.7 min (ASTM D3574)
 3. Resilience (% Rebound): 40 – 48 (ASTM D3574)
 4. Tear Resistance: 1.5 – 2.5 lbs/in (ASTM D3574)
 5. Static Fatigue:
 - a. % Loss @ 25% ILD: Less than 35 (ASTM D3574)
 - b. % Loss in Thickness: Less than 10 (ASTM D3574)
 6. Flammability: Passes with Class 1 Fabric (California TB 117-2013)
 - a. Vinyl Seams Double Stitched Using 6 lb. Bonded Polyester Black Thread
 - b. Includes Two (2) 1.5"W Vinyl Flaps with #2 Stainless Steel Grommets 12" On-Center
 7. Secured to Chain-Link Fence Using 14"L x 120 lb. Break Strength UV Resistant Nylon Zip-Ties
 - a. 1-Year Manufacturer's Limited Product Warranty

2.4 PRE-MANUFACTURED ON-DECK CIRCLES

- A. BASIS OF DESIGN: "Power Deck On-Deck Circles" – as Manufactured and/or Supplied by Big Signs (www.bigsigns.com).
- B. COMPONENTS:
 1. Size: 6'-0" diameter, constructed of high-density foam and PVC surface.
 2. Quantity: Two (2) pairs: (1) pair provided for baseball, (1) pair provided for softball
 3. Colors and Graphics: On-deck circles shall include custom graphics, with final layout and colors to be selected by Owner. Manufacturer shall include graphic design services necessary to achieve final Owner Selection. Precedence images are as follows:



Baseball On-Deck Circle – Qty: (2)



Softball On-Deck Circle – Qty: (2)

PART 3 - EXECUTION

3.1 INSTALLATION OF EQUIPMENT

- A. Coordinate installation with other trades.
- B. All equipment shall be installed as recommended per manufacturer's written instructions and as indicated on the drawings. Concrete anchoring foundations to be determined by others based on local soil conditions and building codes. Installer should have a minimum of five (5) installations of the specified products or similar experience in the previous three (3) years.

3.2 CLEAN UP AND DISPOSAL

- A. Remove from the site all equipment, materials, and debris resulting from construction work including this section. Leave work area neat and clean and in a condition acceptable by the Landscape Architect and Owner. All work shall be complete, ready for use, at the time of final acceptance

END OF SECTION

SECTION 11 6834 – FOOTBALL GOAL POSTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This section includes the following:
 - 1. Furnish all labor, materials, and equipment necessary to install to install new football goal posts.
- B. Related Sections include the following:
 - 1. Specification Section 03 3000 Cast In Place Concrete - Athletics
 - 2. Specification Section 31 2010 Earthwork - Athletics

1.3 QUALITY ASSURANCE

- A. Manufacturers shall warrant that the product or materials specified herein meet all applicable grade trademarks or conform to industry standards and inspection requirements.
- B. Installer Experience:
 - 1. Installer should have a minimum of five (5) football goal post installations of similar experience in the last three (3) years.
- C. Warranty Guarantee:
 - 1. The completed system shall be guaranteed to be free from all defects for a period of one (1) year from the date of final acceptance, or the manufacturer's specific warranty related to the product or service, whichever is greater. Any defects or system malfunctions identified shall be immediately corrected at no cost to the Owner for the warranty/guarantee period.
- D. Product Testing:
 - 1. All material installed under this specification shall be subject to testing by Owner at his expense. Any material so inspected and found to be not in strict conformance with this specification shall be promptly removed and replaced by the Contractor at his expense.
- E. General: Comply with NCAA and NFHS specifications.

1.4 SUBMITTALS

- A. Manufacturer's Product Data:
 - 1. Provide manufacturers literature, identifying the particular item to be installed. Manufacturer information should include catalog cut sheets, applicable technical information.
 - 2. Provide manufacturers cut sheets, color samples, and digital artwork data related to the football goalpost pad.
- B. Shop Drawings
 - 1. Provide drawings of the manufacturers recommended installation and foundation requirements prior to actual field installation work

1.5 PRODUCT DELIVERY AND STORAGE

- A. Materials delivered to the site shall be examined for damage or defects in shipping. Any defects shall be noted and reported to the Owner's representative. Replacements, if necessary, shall be immediately re-ordered. Sound materials shall be stored above ground under protective cover or indoors for proper protection.

PART 2 - PRODUCTS

2.1 FOOTBALL GOAL POSTS

- A. Football goal posts shall be anchor bolt style conforming to the following:
 - 1. Be formed with an aluminum pipe capable of supporting the horizontal cross bar 8'-0" in front of the vertical upright. Cross bar shall be an aluminum structural tube 10'-0" above field level.
 - 2. Upright shall be supported in a concrete footing and secured with an anchor pin or anchor bolts. Concrete footing size and depth shall be determined by goalpost manufacturer.
 - 3. Uprights shall be 4" O.D. aluminum structural tube extending 20'-0" above horizontal cross bar. Uprights and cross bar shall be capped with zinc plated formed metal caps. Upright metal caps shall incorporate nylon wind directional flags, manufacturer's standard in color.
 - 4. Goalpost shall be powder-coated with color to be selected by Owner from manufacturer standard colors.
- B. Goal posts shall be from one of the following manufacturers:

- 1. AAE - No. ASG-HS/8, (800) 523-5471

2. Sportsfield Specialties - No. GP820HS, (888) 975-3343
- C. Provide one (1) set of "professional" style goalpost pads made from 6" thick high-impact polyurethane foam. Foam cylinder shall have a rear cut-out and be completely covered in a polyester reinforced vinyl cover concealed with a factory sewn hook and loop velcro closure flaps for ease of installation and removal.
 1. Goalpost Pad Minimum Requirements:
 - a. Dimensions: 18" Outside Diameter, 7" Inside Diameter, 6'-0" height
 - b. Vinyl material shall allow for high UV Resistance
 - c. Total Weight: minimum 16 oz./yd²
 - d. Rot, Mildew and Fungus Resistant: Yes
 - e. Color to be selected by Owner from manufacturers standard colors.
 2. Manufacturer shall include custom high-resolution graphics on the goalpost pads.
 - a. Letters shall be digitally printed onto the vinyl goalpost pad with a maximum of ten (10) letters and (1) 10"x10" logo per pad. Refer to plans for lettering and logo details and colors.
 - b. The Contractor shall supply a color sample or swatch to the Owner for color selection for the pads and lettering.
 - c. Custom font styles can be provided to manufacturer in vector format if required.
- D. Goal post pads shall be from one of the following manufacturers:
 1. AAE - No. GP6R
 2. Sportsfield Specialties - No. GPPR
- f. Pre-manufactured goalpost access box shall be from one of the following manufacturers:
 1. Sportsfield Specialties – Model No.: GPAGITR
 2. AAE – No. FBC-GA

2.2 CONCRETE

- A. Concrete shall conform to Section 03 3000 Cast In Place Concrete - Athletics
- B. Concrete reinforcement materials and concrete foundation sizes, to be determined by manufacturer. Concrete foundation design shall be the responsibility of the manufacturer based on local soil conditions and building codes or manufacturer's standard footing design, whichever is more stringent.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Do not install goal posts until site grading is complete.

3.2 INSTALLATION

- A. All goalposts and accessories shall be installed as recommended per the manufacturer's written instructions and as indicated on drawings. Refer to Manufacturer's installation cut sheets for exact location bolt template.
- B. Posts shall be set and centered to the lines shown on the drawings, with the posts centered in the concrete bases.
- C. Holes shall be filled with concrete to 6" below grade. See detail sheet as per installation of the remaining 6" to grade.
- D. Concrete shall cure a minimum of 72 hours prior to installation of goal post.
- E. All posts shall be set plumb.

3.3 CLEAN UP AND DISPOSAL

- A. Remove from the site all equipment, materials, and debris resulting from construction work including this section. Leave work area neat and clean and in a condition acceptable by the Landscape Architect and Owner. All work shall be complete, ready for use, at the time of final acceptance.

END OF SECTION

SECTION 11 6836 – SOCCER & LACROSSE GOALS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section is a part of the entire set of Contract Documents and shall be coordinated with the applicable provisions of the other parts.

1.2 SCOPE

- A. The work under this section of the specifications shall consist of furnishing all labor, materials and equipment necessary to furnish and install complete portable soccer and lacrosse goals. Includes, but not limited to goal nets, wheel kits, and safety anchoring system.

1.3 QUALITY ASSURANCE

- A. Portable soccer goals shall be part of a combination package with the football goal posts. All football and soccer goals and accessories shall be from one manufacturer.
- B. Warranty Guarantee: The Contractor and any Sub-contractors hereunder guarantee their respective work against defective materials or workmanship for a period of two (2) years from the date of filing notice of completion and an acceptance by the Owner.
- C. Product Testing: All material installed under this specification shall be subject to testing by Owner at his expense. Any material so inspected and found to be not in strict conformance with this specification shall be promptly removed and replaced by the Contractor at his expense.
- D. General: Comply with NCAA and NFHS specifications.

1.4 SUBMITTALS

- A. Submit manufacturer literature, identifying the particular items to be installed. Manufacturer information should include photographs, and applicable technical information, and other data required to demonstrate compliance with specified requirements for all athletic equipment.

PART 2 - PRODUCTS

2.1 SOCCER GOALS

- A. Full size round soccer goals complete with nets, wheel kits and safety anchoring system, shall be from one of the following manufacturers:

- 1. Aluminum Athletic Equipment Co. (AAE) 800-523-5471
- 2. Sportsfield Specialties 888-975-3343

- B. Components:

- 1. Frame: 8'H x 24'W x 4'B x 10'D.
 - a. 4" Round aluminum tubing.
 - b. White powder coat finish.
- 2. Ground Bar: Aluminum
- 3. For Infill Turf Fields: Include safety anchor system to attach to football goal gooseneck.
- 4. Nets: 4mm braided polypropylene, 5.5" square mesh.

Manufacturer	Product	Model No.	Type
1. AAE	Goal	SGR-P/I	Round
	Net	Included	Net Color: TBD
	Wheels	Included	
	Safety Anchor	SGAB-GP	
2. Sportsfield Specialties	Goal	SG824R	Round
	Net	Standard	Net Color: TBD
	Wheels	SGMKR	
	Safety Anchor	SG2SGP	

5. Contractor shall provide a minimum two sets of four (4) sand bag weights by the selected manufacturer for temporary anchoring. Sand bags are to be provided in addition to the manufacturer's safety anchoring system.

2.2 PORTABLE SOCCER FLAGS (1 Set)

- A. BASIS OF DESIGN – Champion Brand Model# SCF60

2.3 LACROSSE GOALS

- B. BASIS OF DESIGN – Model# LG-50 (1 Set)
Jaypro Sports
Waterford, CT
p. 800-243-0533

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Do not install goals until site grading is complete.

3.2 INSTALLATION

- A. Assembled as per manufacturer's cut sheets.

3.3 CLEAN UP AND DISPOSAL

- A. Remove from the site all equipment, materials, and debris resulting from construction work including this section. Leave work area neat and clean and in a condition acceptable by the Landscape Architect and Owner. All work shall be complete, ready for use, at the time of final acceptance.

END OF SECTION

SECTION 11 6837 – SHADED DUGOUT STRUCTURE

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section is a part of the entire set of Contract Documents and shall be coordinated with the applicable provisions of the other parts.
- B. Related Sections:
 - 1. Section 03 3005 Cast In Place Concrete - Athletics
 - 2. Section 31 2010 Earthwork - Athletics

1.2 SCOPE

- A. The work under this section of the specification shall consist of furnishing all labor, materials and equipment to install 9' x 32' pre-manufactured dugout structures.

1.3 QUALITY ASSURANCE

- A. Manufacturer shall comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.
 - 1. National Federation of State High School Associations (NFHS)
 - 2. National Collegiate Athletic Association (NCAA)
 - 3. International Association of Athletics Federations (IAAF)
 - 4. American Sports Builders Association (ASBA)
 - 5. Manufacturers Data and Recommended Installation Requirements

1.4 SUBMITTALS

- A. Product Data:
 - 1. Dugout manufacturer shall supply cut sheets showing conformance to drawings and requirements to applicable ASTM standards listed in specifications. Producer shall certify that products meet such ASTM standards.
 - 2. Dugout manufacturer shall provide standard plans and informative literature upon request. Supporting calculations and design details shall also be available. Manufacturer shall warrant that such products perform the intended task.
- B. Shop Drawings:
 - 1. Manufacturer shall provide shop drawings for the dugout units for approval by the Owner or Landscape Architect. Drawings shall show complete design, installation, and construction information in such detail as to enable the Owner to determine the capability of the proposed unit. Details of steel reinforcement (size and placement) as well as supporting design calculations to be included.
 - 2. Dugout units shall be produced in accordance with the approved drawings.

1.5 DELIVERY, HANDLING AND STORAGE

- A. Handling: Products intended for job shall be stored, handled, shipped, and unloaded in a manner to minimize damage. Lifting holes or inserts shall be consistent with industry standards.
- B. Acceptance at Site: Owner's representative shall make a final inspection and acceptance of the dugout products upon arrival at the jobsite.
- C. Storage: Materials shall be stored above ground under protective cover or indoors as to provide proper protection.

1.6 WARRANTY

- A. Manufacturer shall provide a warranty against defects in material or workmanship for a period of five (5) years on all concrete components. If found defective, manufacturer shall repair or replace any concrete component of the building at the manufacturer's expense.
- B. Non-concrete components are defined as items not manufactured by the concrete manufacturer. Items include, but not limited to: steel doors, aluminum windows, aluminum, interior finishing, air circulation, and security. Non-concrete components shall be covered under the manufacturer's standard warranty. If found defective, manufacturer shall repair or replace any component at the manufacturer's expense.

PART 2 - PRODUCT

2.1 MANUFACTURERS

A. Manufacturers (or approved equal):

Sportsfield Specialties, Inc.
41155 State Highway
Delhi, NY 13753
Phone: (607) 746-1460
www.sportsfieldspecialties.com

Dugouts USA
6565 W Norvell Bryant Hwy
Crystal River, FL 34429
Phone: (352) 527-7500
www.dugoutsusa.com

B. DESIGN CRITERIA

1. Building Code: ASCE 7-10
2. Maximum Wind Speed Rating: 140mph, Exposure Category C
3. Maximum Ground Snow Load: 60psf
4. Seismic Design: Category E, $S_s=1.5g$, $S_1=0.75g$
5. Roof Pitch: 2" Rise Back-to-Front

C. COMPONENTS

1. Overall Dimensions: 8'W x 30'L
2. Structural Columns Fabricated of:
 - a. 3-1/2" x 3-1/2" x 3/16" (0.1875") Structural Steel Tube with Factory Pre-Drilled 9" x 9" x 5/8" (0.625") A36 Steel Base Mounting Plates and 9" x 9" x 5/8" (0.625") A36 Steel Roof and Column Cap Plates
 - b. Fully Welded Construction
 - c. Maximum Allowable Spacing Between Structural Steel Columns is Fifteen (15') On-Center
3. Roof Frame Fabricated of:
 - a. 5" x 2" x 3/16" (0.1875") Structural Steel Rectangular Perimeter, Transverse, and Longitudinal Roof Tubes
 - b. Fully Welded Construction
4. Structural Steel Columns and Roof Frame shall receive a powder coated primer and coated finish
5. Roofing Material shall be 29 Gauge, Classic Rib® Style Corrugated Metal with J-Channel Drip Cap Installed on Front and Sides
6. Structural Columns shall be attached to roof structure with galvanized hardware
7. Dugout package shall include carbon steel anchoring hardware, epoxy and lifting eye bolts
8. Dugout package shall include model specific hardware kit and installation instructions
9. Dugout package shall include Stamped and Sealed Drawings and Calculations by a Licensed Professional Engineer of Record in the State of Michigan.

- D. Colors of support posts and roof structure to be selected by Owner from manufacturer's standard colors.

PART 3 - EXECUTION

2.1 PREPARATION

Prepare concrete anchoring foundation as shown in the drawings.

2.2 ASSEMBLY

All dugouts shall be installed per manufacturer's written instructions and as indicated on the drawings.

3.3 CLEAN UP AND DISPOSAL

The contractor shall remove from site all equipment, materials, and debris resulting from construction work, including this section. Restore area to a condition acceptable by the Landscape Architect. All work shall be complete and ready for use at the time of the final

TMP Architecture, Inc.
Foresite Design, Inc.

TMP22103D & 22104E

acceptance.

END OF SECTION

SECTION 11 6838 – BASEBALL EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. This Section is a part of the entire set of Contract Documents and shall be coordinated with the applicable provisions of the other parts.
- B. Related Sections:
 - 1. Section 31 2010 Earthwork - Athletics

1.2 SCOPE

- A. The work under this section of the specifications shall consist of furnishing all labor, materials and equipment necessary for the installation of the following:
 - 1. Baseball bases, pitcher’s pads, home plates, and base anchors

1.3 QUALITY ASSURANCE

- A. Warranty Guarantee: The Contractor and any Sub-Contractors hereunder guarantee their respective work against defective materials or workmanship for a period of two (2) years from the date of filing notice of completion and an acceptance by the Owner.
- B. Product Testing: All material installed under this specification shall be subject to testing by Owner at his expense. Any material so inspected and found to be not in strict conformance with this specification shall be promptly removed and replaced by the Contractor at his expense.

1.4 SUBMITTALS

- A. Submit manufacturer literature, identifying the particular item to be installed. Manufacturer information should include photographs, and applicable technical information.

PART 2 - PRODUCTS

2.1 BASEBALL/SOFTBALL ITEMS

A.

ITEM	MANUFACTURER	MODEL NO.	QUANTITY
Pitcher’s Plate (Fields)	Schutt	Pro Pitching Rubber	(4) Total
Pitcher’s Plate (Fields)	Schutt	Pro Pitching Rubber	(8) Total
Home Plate	Schutt	MLB Hollywood Pro	(2) Total
Bases	Schutt	MLB Hollywood	(4) Sets
Base Ground Stakes	Beacon Athletics	CH Anchors 1.5” HD	(4) Sets
Base Plugs	Schutt	Foam Plug w/ Bristle	(4) Sets
Home Plate Form System (Includes Home Plate) SYN TURF ONLY	Sportsfield Specialties	HPFS	(2) Units

- 1. Schutt Sports, Litchfield, IL (800) 426-9784
- 2. Beacon Athletics, Middleton WI (800) 747-5985

2.2 CONCRETE

- A. Concrete shall conform to Section 03 3000 Cast In Place Concrete - Athletics

2.3 BATTING CAGES

- A. Provide new poles for the Beacon TUFFframe Elite Outdoor Batting Cage Systems at baseball and softball fields. Hardware and netting shall be reinstalled from salvaged systems.
- B. Batting cages shall be from the following provider:
 - 1. Beacon Sports Products Inc. (800) 747-5985

2.4 PROTECTIVE FENCE CAP

- A. Fence cap shall be pre-slit polyethylene, UV protected tubing measuring 4 ½” in diameter. Fence cap to be attached to fencing using UV-resistant “zip-ties” matching the color of the cap being installed. Fence cap shall be supplied by:
 - 1. Beacon Sports Products Inc., (800) 747-5985
 - a. Color: Provide color options to be selected by Owner.

2.5 DUGOUT BENCHES

- A. Beacon Elite Two-Tier Dugout Bench or approved equal.

1. Upper and lower level seating
2. Spike-resistant composite decking and backrest
3. Team colors on fascia and end panels
4. Logo on end panels
5. Size: Varsity Dugouts = 27'-0", JV Dugouts = 21'-0"
6. Benches shall be surface mounted to dugout floor.

2.6 DUGOUT ACCESSORIES

- A. BASIS OF DESIGN: Manufactured and/or Supplied by www.baseballracks.com
1. "Explorer Combo" – Varsity Fields, Home Dugouts
 - a. Quantity: (2)
 2. "Dugout King" – Varsity Fields, Visitor Dugouts
 - a. Quantity: (2)

2.7 FOUL POLES

- A. Pre-manufactured poles can be provided by:

MANUFACTURER	MODEL NO.	COLOR	QUANTITY
Beacon Sports Products	130-380-209	Yellow	(8) Total
BSN Sports	SKU# BSFOUL	Yellow	(8) Total
Douglas Sports	36652	Yellow	(8) Sets
Sportsfield Specialties	FPW420-Yellow	Yellow	(8) Sets

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Do not install equipment until site grading is complete.

3.2 INSTALLATION

- A. Baseball Items shall be installed as indicated on the drawings. This installation shall be in conformance of the National Federation High School Association specifications.
- B. Install baseball and softball items per manufacturer's written instructions.

3.3 CLEAN UP AND DISPOSAL

- A. Remove from the site all equipment, materials, and debris resulting from construction work including this section. Leave work area neat and clean and in a condition acceptable by the Landscape Architect and Owner. All work shall be complete, ready for use, at the time of final acceptance.

END OF SECTION

SECTION 11 6840 – FIELD EVENT CONSTRUCTION

PART 1 - GENERAL

1.1 SUMMARY

A. This section is a part of the entire set of Contract Documents and shall be coordinated with the applicable provisions of the other parts.

B. Related Sections:

1. Section 03 3000 Cast In Place Concrete - Athletics

1.2 SCOPE

A. The work under this section of the specifications shall consist of furnishing all labor, materials and equipment for the installation of the field event equipment according to the drawings and specifications. (See Plans & Details for quantity).

1.3 QUALITY ASSURANCE

A. Warranty Guarantee: The Contractor and any Sub-Contractors hereunder guarantee their respective work against workmanship for a period of two (2) years. Standard manufacturer's warranty shall apply to products being provided. Warranty period begins on the date of filing notice of completion and an acceptance by the Owner.

1.4 SUBMITTALS

A. Submit manufacturer literature, identifying the particular item to be installed. Manufacturer information should include photographs, and applicable technical information.

PART 2 - PRODUCT

2.1 MANUFACTURERS

- | | |
|--|----------------|
| A. SportsEdge. | (800) 334-6057 |
| B. Gill Athletics, Inc | (800) 637-3090 |
| C. Aluminum Athletic Equipment Co. (AAE) | (800) 523-5471 |
| D. Sportsfield Specialties, Inc. | (888) 975-3343 |

2.2 SHOT PUT

- | | |
|--|---|
| A. Shot put toe board
(Flush mounted) | AAE #ATB
Gill #364 (combo ring and toe board)
Sportsfield Specialties SPTBCALHS
SportsEdge SE364 |
| B. Shot put throwing circle
(Flush mounted) | AAE #SC
Gill #373 Steel Shot Circle
Sportsfield Specialties SSI373
SportsEdge SE372 |

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install all equipment as per the manufacturer's recommendations.
- B. Contractor shall verify with Owner and Landscape Architect the pole vault cushion(s) to be purchased prior to installation of vault box and surrounding pad (See Plans & Details).

3.2 CLEAN UP AND DISPOSAL

- A. Remove from the site all equipment, materials, and debris resulting from construction work including this section. Leave work area neat and clean and in a condition acceptable by the Landscape

TMP Architecture, Inc.
Foresite Design, Inc.

TMP22103D & 22104E

Architect and School District. All work shall be complete, ready for use, at the time of final acceptance.

END OF SECTION

SECTION 11 6842 - SCOREBOARD

PART 1 – GENERAL

1.1 SUMMARY

- A. This Section is a part of the entire set of Contract Documents and shall be coordinated with the applicable provisions of the other parts.
- B. Related Sections:
 - 1. Section 03 3000 Cast In Place Concrete - Athletics
 - 2. Division 26 Electrical

1.2 SCOPE

- A. The work under this section of the specifications shall consist of furnishing all labor, materials and equipment necessary for the relocation of existing scoreboards, installation of (2) single-sided LED multi-sport scoreboard(s) and steel supports, and installation of (2) single-sided LED baseball & softball scoreboards.
- B. Base Bid: Relocate existing baseball and softball scoreboards to new Varsity Fields.
- C. Alternate No. 3: Install new scoreboards at Varsity Baseball and Varsity Softball fields. Relocate and re-install existing scoreboards to JV Baseball & Softball Fields.

1.3 QUALITY ASSURANCE AND WARRANTY GUARANTEE

- A. Reference Standards:
 - 1. Standard for Electric Signs, UL-48, 13th Edition
 - 2. Standard for Control Centers for Changing Message Type Signs, UL-1433, 1st Edition
 - 3. Standard for CAN/CSA C22.2
 - 4. Federal Communications Commission Regulation Part 15
 - 5. NEC Compliant
 - 6. FCC Compliant
- B. Scoring equipment and accessories shall be through one source from a single manufacturer.
- C. Structural Performance: Provide post and panel signs capable of withstanding the effects of gravity loads and the following loads and stresses within the limits and under conditions indicated determined according to local code requirements:
 - 1. Wind Loads: Determine loads based on a uniform pressure of 30psf wind pressure of 80 mph, acting in any direction.
- D. Thermal Movements: provide post and panel signs that 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 connections and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sk loss.
 - 1. Temperature Change (Range): 120 degrees F, ambient 180 degrees F, material surfaces.
- E. Warranty: Scoreboard shall be guaranteed for a period of five (5) years from the date of acceptance against defects in the workmanship, material or labor and shall be replaced or repaired without cost to the Owner provided the equipment or parts (which include LED segments) are returned to the Manufacturer.

1.4 SUBMITTALS

- A. Product data: Submit manufacturer's product illustrations, data and literature that fully describe the scoreboards and accessories proposed for installation. Manufacturer shall provide a colored rendering of proposed scoreboard for Owner approval. Guarantee shall be void if any alteration or service, other than unplugging modules or controls, is performed without Manufacturer's factory authorization; or if the equipment shall have been connected to incorrect power, or is improperly grounded or improperly installed. Equipment which is subjected to accident, neglect, abuse, misuse or other natural disasters, including but not limited to: fire, wind, lightning, flood, is not covered by the guarantee.
- B. Shop drawings: Submit mechanical and electrical drawings.
- C. Maintenance Data: Manufacturer's installation, operation, and maintenance manuals.

1.5 DELIVERY AND HANDLING

- A. Deliver post and scoreboard signs in protective covering and crating to protect sign components and surfaces against damage.

PART 2 - PRODUCTS

2.1 SCOREBOARD

- A. Acceptable Manufacturers (or approved equal):
 - 1 Daktronics (or approved equal)
- B. Provide two (2) units as follows:
 - 1. Scoreboard: 8' high x 18' wide multi-sport scoreboards
 - a. Color: To be chosen by Owner from manufacturer's standard colors.
 - b. Digits: Shall be TS AllnGaP Light Emitting Diodes (LEDs) with seven bar segments per digit. Digit panels shall be fastened with screws and allow for easy access and removal. Rivets are not an acceptable fastening method. All LED digits shall be White in color
 - i. Game Clock = 30" in height
 - ii. Score/Down/To Go/Ball On/Qtr = 24" in height
 - iii. Time Outs Left (T.O.L.) = 15" in height
(Note: LED dots in lieu of numerical digits will not be accepted)
 - c. Caption (Fixed):
 - i. "HOME" for home side
 - ii. "GUEST" for Visitor side
 - iii. Manufacturer standard White in color
 - 2. Architectural Accent Truss
 - a. 4' high x 25' wide nominal dimensions
 - b. Screen backed lettering and logos shall include:
 - i. "SCHOOL NAME & LOGO"
 - ii. Graphics can be provided electronically upon award
- C. Alternate No. 3: Provide two (2) units as follows:
 - 1. Scoreboard: 6.5' high x 16' wide baseball & softball scoreboards
 - a. Color: To be chosen by Owner from manufacturer's standard colors.
 - b. Digits: Shall be TS AllnGaP Light Emitting Diodes (LEDs) with seven bar segments per digit. Digit panels shall be fastened with screws and allow for easy access and removal. Rivets are not an acceptable fastening method. All LED digits shall be White in color
 - i. Game Clock = 30" in height
 - ii. Score/Down/To Go/Ball On/Qtr = 24" in height
 - iii. Time Outs Left (T.O.L.) = 15" in height
(Note: LED dots in lieu of numerical digits will not be accepted)
 - c. Caption (Fixed):
 - i. "HOME" for home side
 - ii. "GUEST" for Visitor side
 - iii. Manufacturer standard White in color
 - 2. Architectural Accent Truss
 - a. 4' high x 16' wide nominal dimensions
 - b. Screen backed lettering and logos shall include:
 - i. "SCHOOL NAME & LOGO"
 - ii. Graphics can be provided electronically upon award
- D. Relocate two (2) units to baseball & softball fields as follows (Base Bid and Alternate No. 3):
 - 1. Manufacturer:
 - Spectrum Scoreboards
 - 10050 Easthaven Blvd.
 - Houston, TX 77075
 - Phone: (713) 234-1397
 - 2. Scoreboard: 6' high x 14' wide baseball & softball scoreboards
 - 3. Architectural Accent Truss (Base Bid only)
 - a. 4' high x 16' wide nominal dimensions
 - b. Screen backed lettering and logos shall include:

- i. "SCHOOL NAME & LOGO"
- ii. Graphics can be provided electronically upon award

2.3 CONTROL CENTER

- A. Model shall be capable of scoring football, soccer and track through keyboard inserts. Construction is to be of a gray, highly break-resistant plastic. Control center shall include remote hand-held time switch, 25 feet of cable with connectors, and a keyboard overlay. The controller will have the following features: bright travelling alpha-numeric dot matrix LED display, lithium cell battery backup to retain memory, self test mode, power on/off switch, alternate time switch, internal beeper which acknowledges each entry, multiple scoreboard control capability, and soft sided carry case.

2.4 WIRELESS CAPABILITY

- A. Controller shall include wireless capability with 2.4Ghz radio transmission so as not to interfere with other radio frequencies.

2.5 TIMING

- A. The scoreboard shall have bi-directional timing, UP or DOWN count. The timer shall have the ability to enter any number of minutes or seconds directly. The timer range shall be timed to the second.

2.6 HORN

- A. A loud solid-state trumpet horn shall be located in the multi-sport scoreboards. The horn shall automatically sound at 0:00 for a minimum of 2 seconds. Operator must have the capability of sounding the horn manually or to omit the automatic horn.

2.7 SUPPORT SYSTEM

- A. Scoreboard manufacturer is required to provide signed and sealed engineering plans, which include but not limited to, steel size, concrete footing size/depth, and wind loads.
- B. Steel supports and concrete foundations shall be furnished and installed by the manufacturer. Steel shall be primed and painted black.
- C. All electrical work including electrical final connections to be completed by Others, unless noted otherwise.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Verify that mounting structure is ready to receive scoreboard and that concrete has cured adequately according to specifications. Installer shall also verify placement of conduit and junction boxes are as specified and indicated on plans.
- B. All power and control cables shall be routed in conduit. Scoreboard control wiring will be the responsibility of the contractor furnishing and installing the scoreboard.
- C. Install scoreboard and applicable exterior displays in accordance with manufacturer's instructions. Installed scoreboard unit shall be plumb and level.
- D. Provide boxes, cover plates and jacks in locations shown on plans. Installer shall test connect control unit to all jacks and check for proper operation of control unit, scoreboard and all features. Control unit in carrying case, manuals and operational information shall be turned over to Owner's Representative.
- E. Upon installation, contractor shall provide Owner tutorial on proper operation of all scoreboard/message display functions.

END OF SECTION

SECTION 13 3400 – PRECAST CONCRETE STRUCTURE

PART 1 – GENERAL

1.1 SUMMARY

- A. This Section is a part of the entire set of Contract Documents and shall be coordinated with the applicable provisions of the other parts.
- B. Related Sections:
 - 1. Section 08 7100 Door Hardware
 - 2. Section 31 2010 Earthwork - Athletics

1.2 SCOPE

- A. The work under this section of the specification shall consist of furnishing all labor, materials and equipment to install (2) 8' x 40' precast dugout units, (2) 8'x30' dugout units, (1) 12'x20' precast building unit and (2) 10'x10' precast building units.
- B. Dugout and Building units shall be provided by manufacturer with all necessary openings as specified by contractor in conformance with manufacturer's structural requirements.
- C. The Dugouts and 12'x20' Building Structures shall be Base Bid as noted on the drawings.
- D. The (2) 10'x10' Building Structures shall be Alternate No. 4 – Refer to Contract Documents.

1.3 QUALITY ASSURANCE

- A. Comply with the provisions of the following codes, specifications, and standards except where more stringent requirements are shown on the drawings or specified herein.
 - 1. ACI-318-02, "Building Code Requirements for Reinforced Concrete". Concrete Reinforcing Institute, "Manual of Standard Practice".
 - 2. ANSI/ASCE-7-02 "Building Code Requirement for Minimum Design Loads in Buildings and Other Structures".
 - 3. Michigan Building Code, current edition.
 - 4. Concrete Reinforcing Institute, "Manual of Standard Practice".
 - 5. Fabricator must be a producer/member of Precast/Prestressed Concrete Institute (PCI) and be certified in categories A1, B1, and C3.
 - 6. Building fabricator must have a minimum of 5 years experience manufacturing and setting transportable precast concrete buildings.
 - 7. American Society For Testing Materials (ASTM).

1.4 SUBMITTALS

- A. Submit manufacturer's literature including material description, installation instructions, and cleaning and maintenance instructions.
- B. Submit shop drawings: Provide plans, elevations and sections of structure at scale of not less than 1/8 inches per 12 inches, indicating basic dimensions of structure, details of design, including details of any openings, cutouts and accessories required.
 - 1. Show details of interfaces with work of other trades, including electrical work.
- C. Show dimensions, installation and erection details, including all points of connection.
- D. Submit copy of standard warranty.
- E. Delegated-Design Submittal: Submit engineering calculations for Architects review to comply with performance requirements and design criteria, including analysis data and shop drawings signed and sealed by the qualified professional engineer responsible for their preparation registered in the State of Michigan.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver product to the project site clearly marked for proper identification of components.
- B. Deliver hardware materials to the project site in manufacturer's unopened containers, fully identified with trade name, color, size and type.
- C. Store in accordance with manufacturer's instructions, above ground, and protected from weather, construction activities, and other possible causes of damage or loss.
- D. Materials shall be handled at the job site in such a manner so as to prevent damage. All damaged or otherwise unsuitable material, when so ascertained, shall be immediately removed from the job site.

1.6 WARRANTY

A. The manufacturer shall warrant in writing, that the precast concrete structure shall be free of faults or defects in accordance with the general conditions; such warranty shall be for a period of five (5) years. All other appurtenances will carry a one year warranty.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Bids from manufacturers other than companies listed will not be considered unless written approval is obtained a minimum of 10 days prior to date of bid receipt.
- B. Easi-Set Buildings as manufactured by a licensed producer:
Norwalk Concrete Industries
PO Box 563
Norwalk, OH 44857
(800) 733-3624

2.2 STANDARD DESIGN CRITERIA

- A. Standard Size:
 - 1. Base Bid Dugouts: (2) 8' deep X 30' wide and (2) 8' deep x 40' wide, includes 8'x10' storage area.
 - 2. Base Bid Storage Building: (1) 12' wide X 20' deep
 - 3. Alternate No. 4 Storage Building: (2) 10' deep X 10' wide
- B. Design Loads:
 - 1. Seismic load performance category 'C', Exposure Group III
 - 2. Standard Live Roof Load: 60PSF
 - 3. Standard Floor Load: 250 PSF
 - 4. Standard Wind Load: 130 MPH
- C. Roof: Roof panel shall slope from front to back with a minimum of 6" fall. The roof shall extend a minimum of 12 inches beyond both side walls and back wall panel and have a turndown design which extends ½" below the top edge of the wall panels to prevent water migration into the building along top of wall panels. Roof shall have a Broom finish design, non-stained, owner to stain. Roof panel thickness shall have a minimum thickness of 4", steel reinforced and post-tensioned with a broom finish.
- D. Roof, floor, and wall panels shall each be produced as single component monolithic panels. Wall panels shall be set on top of floor panel.
- E. Precast concrete floor shall have ½" step-down around the entire perimeter to prevent water migration into the building along the bottom of the wall panels. Floor shall have a 5" minimum thickness, and be post-tensioned and steel reinforced.

2.3 MATERIALS

- A. Concrete: Steel-reinforced, 5000 PSI minimum 28-day compressive strength, air-entrained (ASTM C260).
- B. Reinforcing Steel: ASTM A615, grade 60 unless otherwise specified.
Welded Wire Fabric: ASTM 185 Grade 65
- C. Post-tensioning Strand: 41K Polystand CP50, 0.50, 270 KSI, 7-wire strand, enclosed within a greased plastic sheath, (ASTM A416). Roof and floor shall each be post-tensioned by a single, continuous tendon. Tendon shall form a substantially rectangular configuration having gently curving corners wherein the positioning of the cable member results in a pattern of one or more loops and a bisecting of the loop(s). The cable member shall start from one corner of the concrete building panel, forming a gentle perimeter loop(s) returning to a point where the cable member entered the concrete building panel. The tendon will then turn 90 degrees and follow the cable member(s) to a point midway along the "Y" axis of the concrete building panel and then turn 90 degrees along the "X" axis of the concrete building panel. This will bisect the concrete building panel and cross the opposite parallel portion of the cable member and exit from an adjacent side of the concrete building panel.
 - 1. If post-tensioning is not used in the roof panel, the following guidelines must be followed to ensure a watertight roof design.

- a. The entire precast concrete roof panel surface must be cleaned and primed with a material that prepares the concrete surface for proper adherence to the coating material.
 - b. The entire precast concrete roof panel surface shall be sealed with a 0.045 EPDM continuous membrane cemented to the concrete with a compound designed for this purpose.
- D. Caulking: All joints between panels shall be caulked on the exterior and interior surface of the joints. Caulking shall be DOW CORNING 790 silicone sealant or equal. Exterior caulk reveal to be 3/8" x 3/4" deep so that sides of joint are parallel for proper caulk adhesion. Back of the joint to be taped with bond breaking tape to ensure adhesion of caulk to parallel sides of joint and not the back.
- E. Panel Connections: All panels shall be securely fastened together with 3/8" thick steel brackets. Steel is to be of structural quality, hot-rolled carbon complying with ASTM A36 and hot dipped galvanized after fabrication. All fasteners to be 1/2" diameter bolts complying with ASTM A325 for carbon steel bolts. Cast-in anchors used for panel connections to be Dayton-Superior F-63 coil inserts, or equal. All inserts for corner connections must be secured directly to form before casting panels. No floating-in of connection inserts shall be allowed. Wall panels shall be connected to cast-in-place floor slab using expansion anchors providing adequate embedment by manufacturer.
- F. Vents: AS REQUIRED - Screened aluminum vents to be cast in rear wall. Vents shall be SUNVENT INDUSTRIES Model FL-164 or equal. AS REQUESTED, provide drainage slots in the back wall for water to drain from building.

2.4 ACCESSORIES

- A. Doors and Frames: Shall comply with Steel Door Institute "Recommended Specifications for Standard Steel Doors and Frames" (SDI-100) and as herein specified. All door and frame galvanizing shall be in accordance with ASTM A924 and A653, A60 minimum coating thickness.
1. The buildings shall be equipped with double 3'-0" x 6'-8" x 1-3/4" thick insulated, 18 gauge, metal doors with 16-gauge frames (to meet wall thickness). Doors to have flush top cap. 12 gauge flat astragals shall be applied to the active leaf to protect against the elements or forced opening. Doors and frames shall be factory bonderized and painted with one coat of rust inhibitive primer and one finish coat of enamel paint; color to be BOLT BROWN unless specified otherwise.
 2. Doors and frames shall meet SDI standard Level 2, 1 3/4" heavy duty.
Approved manufacturers: Republic, Steelcraft, Ceco, Black Mountain, Pioneer, Curries, Mesker, MPI, Door components or equal
Approved distributor: Integrated Entry Systems
- B. Door Hardware:
1. Pull Handle: Shall meet requirements of ANSI A156.2. Shall be thru bolt attached and constructed of a minimum 3/4" diameter stainless pull handle sized 8" center to center with a stainless backer plate, minimum 0.053" on both sides. Approved manufacturers: Design Hardware, Don-Jo, or equal
- C. Hinges: Shall comply with ANSI A156.1 and be of the ball bearing, non-removable pin type (3 per door minimum). Hinges shall be 4 1/2" x 4 1/2" US26D (652) brushed chrome finish. Manufacturer shall provide a lifetime limited warranty. Approved manufacturers: Design Hardware, or equal
- D. Deadbolt: Commercial Grade Deadbolt conforming to ANSI 156.5 furnished with a 2 1/4" face plate and a 1" projecting deadbolt with hardened steel pins. Dead bolts shall be UL and ADA approved. Finish shall be US26D (626) brushed chrome finish. Manufacturer shall provide a lifetime limited warranty. Approved manufacturers: Design Hardware, Dorma, or equal
- E. Surface Bolt: 8" Surface bolt UL listed. Finish US26D (626) brushed chrome finish. (2 per inactive leaf). Approved manufacturers: Don-Jo, Design Hardware, or equal

- F. Threshold: Bumper Seal type threshold with a maximum 1" rise to prevent water intrusion. Thresholds shall be approved for UL 10B suitable for use with fire doors rated up to three hours. Approved manufacturers: National Guard Products or equal
- G. Overhead Door Holder: Heavy duty surface mounted hold open device with hold open/stop angle of 85 to 110 degrees. Construction shall be stainless steel. Finish US32D (630) satin stainless steel finish. Approved manufacturers: ABH, Rockwood, or equal
- H. Drip Cap: Aluminum drip cap with minimum projection of 2 ½" shall be furnished. Approved Manufacturers: Design Hardware, National Guard Products, or equal
- I. Door Stop: ANSI 156.16 approved wall mounted door stop with keeper constructed of a corrosion resistant cast brass material. Finish US26D (626) brushed chrome finish. Approved manufacturers: Don-Jo, Rockwood, or equal
- J. Support Posts: For dugout units, provide a minimum of (4) 4" x 4" steel roof support posts, factory primed and painted.

2.5 FINISHES

- A. Interior of Building: Smooth form finish on all interior panel surfaces unless exterior finish is produced using a form liner, then smooth hand-troweled finish.
- B. Exterior of Building (Standard): Architectural precast concrete modular unit with split face style finish: Finish must be imprinted in top face of panel while in form using an open grid impression tool. Finished brick size shall be 7 5/8" x 15 5/8" with vertical steel float or light broom finish. Joints between each brick must be 3/8" wide x 3/8" deep. Back of joint shall be concave to simulate a hand-tooled joint. Each brick face shall be coated with the following water-based acrylic, water repellent penetrating concrete stain: 1) Canyon Tone stain by United Coatings, 2) Sherwin Williams (H&C concrete stain) or equal. Stain shall be applied per manufacturer's recommendation. Joints shall be kept substantially free of stain to maintain a gray concrete color.
 - 1. Stain color shall be selected from manufacturer's standard color options.
- C. Exterior of Roof: Flat, sloped style finish: Surfaces shall be coated with the following water-based acrylic, water repellent penetrating concrete stain: 1) Canyon Tone stain by United Coatings, 2) Sherwin Williams (H&C concrete stain) or equal. Stain shall be applied per manufacturer's recommendation.
 - 1. Stain color shall be selected from manufacturer's standard color options.

2.5 ELECTRICAL

- 1. See electrical drawings for all service panels, lighting, receptacles and wiring.
- 2. All components shall be surface mounted unless noted otherwise.

PART 3 – EXECUTION

3.1 SITE PREPARATION

- A. EASI-SET® building shall be field assembled on precast floor system and shall bear fully on a crushed stone base that is at least two feet larger than the length and width of building.
- B. Stone shall be a minimum of 4" thick and down to firm subgrade. The vertical soil capacity under stone shall be compacted to have minimum bearing of 1,500 pounds per square foot. Stone shall be 3/8" or smaller and must be screeded level within ¼" in both directions. Stone shall be placed within a perimeter form with flat and level top edge for screeding. Forming material shall remain around stone until after the building is set.
- C. The crushed stone base shall be kept within the confines of the soil or perimeter form. Do not allow the base to become unconfined so that it may wash, erode, or otherwise be undermined.
- D. Provide positive drainage for the fill, pad or slab as required.

3.2 INSPECTION

- A. Prefabricated building contractor must examine the surrounding installation areas and the conditions under which the work is to be performed, and notify the general contractor, in writing, of any conditions detrimental to proper and timely completion of the work. Do not proceed with dugout installation until unsatisfactory conditions have been corrected in a manner acceptable to the prefabricated dugout contractor.

3.3 SITE ACCESS

- A. Contractor must provide a level, unobstructed area large enough for a crane and a tractor-trailer to park adjacent to the pad. Crane must be able to place outriggers within 5'-0" of edge of pad; truck and crane must be able to get side by side under their own power. No overhead lines may be within 75' radius of center of pad. Firm roadbed with turns that allow 65' lowbed tractor-trailer must be provided directly to site. No building shall be placed closer than 2'-0" to an existing structure unless specifically permitted.

3.4 INSTALLATION

- A. Comply with the prefabricated dugout manufacturer's instructions and recommendations for proper installation procedure.
- B. Coordinate with work of stone base trade contractor to confirm correct location and size of building pad for each dugout prior to arrival of each unit on site.
- C. Set dugout units plumb, level, and square to prevent warp or rack.

3.3 CLEAN UP AND DISPOSAL

- A. The contractor shall remove from site all equipment, materials, and debris resulting from construction work, including this section. Restore area to a condition acceptable by the Landscape Architect. All work shall be complete and ready for use at the time of the final acceptance.

END OF SECTION

SECTION 13 3515 – BLEACHERS – ANGLE FRAME NON-ELEVATED

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section is part of the entire set of Contract Documents and shall be coordinated with the applicable provisions of the other parts.

1.2 WARRANTY

- A. The above shall carry, after proper erection, the following warranties:
1 Years - Failure of structural strength in any component.
5 Years - Anodized finish of seat plank.

1.3 DESIGN

- A. New bleachers consisting of (1) unit, 10 rows high x 15 in overall length, with the accessories and features defined below. Net seating capacity of 100/ UNIT (based on 18" per seat).

1.4 BLEACHER DESIGN / FABRICATION CRITERIA

- A. Applicable Codes. Michigan Building Codes 2000 Edition.
(*Except for Double Foot and Aisle Requirement.)
- B. Design Loads:
 - 1. Live Loads:
Uniform Loading - Structure = 100 PSF
Uniform Loading - Seat and Foot Planks = 120 PLF
 - 2. Sway Loads:
Perpendicular to Seats = 10 Pounds PFL
Parallel to Seats = 24 Pounds PLF
 - 3. Wind Loads:
Basic Design Wind Speed = 100 MPH (Exposure "C")
Horizontal 30 PSF (Minimum) of Vertical Projection
Vertical 30 PSF (Minimum) of Horizontal Projection
(*Note: All Bleachers must be anchored to meet wind loads specified above.)
- C. Recommended Items to Meet Building Officials and Code Administrators (BOCA) 1993 Edition, not included with the Bleacher as specified:
 - 1. Double Foot Plank: Shall consist of (2) such planks for seat rows 2 and up as described above.

1.5. ENGINEERING

- A. Engineering certifications and calculations by a Registered Professional Engineer shall be provided.

1.6 PRODUCT LIABILITY INSURANCE

- A. Each Bidder shall provide a certificate of product liability insurance, issued by the manufacturer for the life of the product, for a minimum amount of \$1,000,000 and acceptable to the Owner. Certificate does not need to be submitted with bid, but must be submitted prior to the award on Contract by Owner.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Bleachers shall be from one of the following manufacturers:

	MANUFACTURER	PHONE
1.	Dant Clayton	800-626-2177
2.	E&D Specialty Stands	800-525-8515
3.	GT Grandstands	813-305-1415
4.	National Recreation Systems	219-482-6023
5.	Southern Bleacher Company	800-433-912

- B. Bids from manufacturers other than companies listed will not be considered unless written approval is obtained a minimum of 10 days prior to date of bid receipt.

2.2 NON-ELEVATED ANGLE FRAME BLEACHERS

- A. Framework: Prefabricated aluminum angle spaced at 6'-0" intervals joined by means of aluminum

angle cross bracing.

- B. Shop Connections: Welded to meet AWS Standards and local code requirements.
- C. Joint Sleeve Assembly: Internal splices, where required shall be two per joint, and shall penetrate the joint a minimum of 8" in each direction and be riveted at one end only to allow for contraction and expansion.
- D. Rise and Depth Dimensions: 8" vertical rise and 26" tread depth, Seat height is 17" above its respective tread.
- E. Seats: Nominal 2"x10" anodized aluminum with anodized end caps.
- F. Treads: Nominal two (2) 2"x10" mill finish aluminum with anodized end caps on rows 2 and up.
- G. Risers: Nominal two (2) 1" x 6" mill finish aluminum with mill finish end caps on top row. Nominal 1" x 6" mill finish aluminum with mill finish end caps on rows 4 & up.

2.3 MATERIALS AND FINISHES

- A. Framework:
 - 1. Aluminum: Structural fabrication with aluminum alloy 6061-T6 mill finish. Each frame shall be unit-welded, using metal inert gas method, under guidelines by the American Welding Society. After fabrication all steel is hot dipped galvanized to ASTM A-123 specifications. All crossbracing and horizontal bracing shall be aluminum alloy 6061-T6 mill finish.
- B. Extruded Aluminum:
 - 1. Seat planks: Aluminum alloy 6063-T6, clear anodized 204R1, AA-M10C22A31, Class II with a wall thickness nominally .078" for impact and deformation resistance.
 - 2. Tread and Riser Planks: Aluminum alloy 6063-T6, mill finish with a wall thickness nominally 0.078" for impact and deformation resistance.
- C. Accessories:
 - 1. Channel End Caps: Aluminum alloy 6063-T6, clear anodized 204R1, AA M10C22A31, Class II.
 - 2. Hardware: Bolts and Nuts shall be hot dipped galvanized.
 - 3. Hold Down Clip Assembly: Aluminum alloy 6063-T6 mill finish.
 - 4. Joint Sleeve Assembly: Aluminum alloy 6061-T6, mill finish

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install bleacher unit in accordance with manufacturer's installation procedures.
- B. Clean up and restore the site upon completion removal of all shavings, dirt, debris, construction materials i.e. nuts, bolts etc.

END OF SECTION

SECTION 20 0500 - MECHANICAL GENERAL REQUIREMENTS

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes mechanical general administrative and procedural requirements. The following requirements are included in this Section to supplement the requirements specified in Division 01 Specification Sections.

1.03 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
1. AABC - Associated Air Balance Council; www.aabc.com.
 2. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org.
 3. ABMA - American Bearing Manufacturers Association; www.americanbearings.org.
 4. ABMA - American Boiler Manufacturers Association; www.abma.com.
 5. AGA - American Gas Association; www.aga.org.
 6. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
 7. AMCA - Air Movement and Control Association International, Inc.; www.amca.org.
 8. ANSI - American National Standards Institute; www.ansi.org.

9. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
 10. ASME - ASME International; (American Society of Mechanical Engineers); www.asme.org.
 11. ASSE - American Society of Sanitary Engineering; www.asse-plumbing.org.
 12. ASTM - ASTM International; www.astm.org.
 13. AWS - American Welding Society; www.aws.org.
 14. AWWA - American Water Works Association; www.awwa.org.
 15. CDA - Copper Development Association; www.copper.org.
 16. CGA - Compressed Gas Association; www.cganet.com.
 17. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.
 18. CSA - CSA International; (Formerly: IAS - International Approval Services); www.csa-international.org.
 19. CSI - Construction Specifications Institute (The); www.csiresources.org.
 20. CTI - Cooling Technology Institute; (Formerly: Cooling Tower Institute); www.cti.org.
 21. FM Approvals - FM Approvals LLC; www.fmglobal.com.
 22. HI - Hydraulic Institute; www.pumps.org.
 23. ICC - International Code Council; www.iccsafe.org.
 24. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
 25. IGSHPA - International Ground Source Heat Pump Association; www.igshpa.okstate.edu.
 26. Intertek - Intertek Group; (Formerly: ETL SEMCO; Intertek Testing Service NA); www.intertek.com.
 27. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry Inc.; www.mss-hq.org
 28. NADCA - National Air Duct Cleaners Association; www.nadca.com.
 29. NAIMA - North American Insulation Manufacturers Association; www.naima.org.
 30. NEBB - National Environmental Balancing Bureau; www.nebb.org.
 31. NECA - National Electrical Contractors Association; www.necanet.org.
 32. NEMA - National Electrical Manufacturers Association; www.nema.org.
 33. NETA - InterNational Electrical Testing Association; www.netaworld.org.
 34. NFPA - National Fire Protection Association; www.nfpa.org.
 35. NSF - NSF International; www.nsf.org.
 36. NSPE - National Society of Professional Engineers; www.nspe.org.
 37. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.
 38. STI - Steel Tank Institute; www.steeltank.com.
 39. TEMA - Tubular Exchanger Manufacturers Association, Inc.; www.tema.org.
 40. UL - Underwriters Laboratories Inc.; www.ul.com.
 41. USGBC - U.S. Green Building Council; www.usgbc.org.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

- 1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.04 **PERFORMANCE REQUIREMENTS**

- A. Systems Components Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

1.05 **QUALITY ASSURANCE**

- A. Scope of Work: Furnish all labor, material, equipment, technical supervision, and incidental services required to complete, test and leave ready for operation the mechanical systems as specified and as indicated on Drawings.

- 1. Contract Documents are complimentary, and what is required by one shall be as binding as if required by all. In the event of inconsistencies or disagreements within the Construction Documents bids shall be based on the most expensive combination of quality and quantity of the work indicated.

- B. Ordinances and Codes: Perform all Work in accordance with applicable Federal, State and local ordinances and regulations, the Rules and Regulations of ASHRAE, NFPA, SMACNA and UL, unless otherwise indicated.

- 1. Notify the Architect/Engineer in writing before submitting a proposal should any changes in Drawings or Specifications be required to conform to the above codes, rules or regulations.

- 2. If the Contractor performs any work knowing it to be contrary to such laws, ordinances, rules and regulations, and without notice to A/E, the Contractor shall bear all costs arising from corrective measures.

- C. Source Limitations: Obtain equipment and other components of the same or similar systems through one source from a single manufacturer.

- D. Tests and Inspections: Perform all tests required by state, city, county and/or other agencies having jurisdiction. Provide all materials, equipment, etc., and labor required for tests.

- E. Performance Requirements: Perform all work in a first class and workmanlike manner, in accordance with the latest accepted standards and practices for the trades involved.

- F. Sequence and Schedule: Perform work to avoid interference with the work of other trades. Remove and relocate work which in the opinion of the Owner's Representatives causes interference.

- G. Labeling Requirement for Packaged Equipment: Electrical panels on packaged mechanical equipment shall bear UL label or label of other Nationally Recognized Testing Laboratory (NRTL) (Intertek, CSA, etc.).

1.06 **CODES, PERMITS AND FEES**

- A. Unless otherwise indicated, all required permits, licenses, inspections, approvals and fees for Mechanical Work shall be secured and paid for by the Contractor. All Work shall conform to all applicable codes, rules and regulations.

- B. Rules of local utility companies shall be complied with. Check with each utility company supplying service to the installation and determine all devices including, but not limited to, all valves, meter boxes, and meters which will be required and include the cost of all such items in proposal.

- C. All work shall be executed in accordance with the rules and regulations set forth in local and state codes. Prepare any detailed drawings or diagrams which may be required by the governing

authorities. Where the drawings and/or specifications indicate materials or construction in excess of code requirements, the drawings and/or specifications shall govern.

- D. Refer to Division 22 Section "Domestic Water Piping" for purchase and installation of potable water meters.

1.07 **DRAWINGS**

- A. The drawings show the location and general arrangement of equipment, piping and related items. They shall be followed as closely as elements of the construction will permit.
- B. Examine the drawings of other trades and verify the conditions governing the work on the job site. Arrange work accordingly. Provide fittings, valves, and accessories as required to meet actual conditions.
- C. Deviations from the drawings, with the exception of minor changes in routing and other such incidental changes that do not affect the functioning or serviceability of the systems, shall not be made without the written approval of the Architect/Engineer.
- D. The Architectural and Structural Drawings take precedence in all matters pertaining to the building structure, Mechanical Drawings in all matters pertaining to Mechanical Trades and Electrical Drawings in all matters pertaining to Electrical Trades. Where there are conflicts or differences between the drawings for the various trades, report such conflicts or differences to the Architect/Engineer for resolution.
- E. Drawings are not intended to be scaled for rough-in or to serve as shop drawings. Take all field measurements required to complete the Work.

1.08 **MATERIAL AND EQUIPMENT MANUFACTURERS**

- A. Equipment: All items of equipment shall be furnished complete with all accessories normally supplied with the catalog items listed and all other accessories necessary for a complete and satisfactory operating system. All equipment and materials shall be new and shall be standard products of manufacturers regularly engaged in the production of plumbing, heating, ventilating and air conditioning equipment and shall be the manufacturer's latest design.
- B. If an approved manufacturer is other than the manufacturer used as the basis for design, the equipment or product provided shall be equal in size, quality, durability, appearance, capacity, and efficiency through all ranges of operation, shall conform with arrangements and space limitations of the equipment shown on the plans and/or specified, shall be compatible with the other components of the system and shall comply with the requirements for Items Requiring Prior Approval specified in this section of the Specifications. All costs to make these items of equipment comply with these requirements including, but not limited to, piping, sheet metal, electrical work, and building alterations shall be included in the original Bid.
- C. All package unit equipment and skid mounted mechanical components that are factory assembled shall meet, in detail, the products named and specified within each section of the Mechanical and Electrical Specifications.
- D. Changes Involving Electrical Work: The design of the mechanical systems is based on the equipment scheduled on the Drawings. Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified with no additional cost to project. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.
 - 1. Where equipment changes are made that involve additional Electrical Work (larger size motor, additional wiring of equipment, etc.) the Mechanical Trades involved shall compensate the Electrical Trades for the cost of the additional Work required.

1.09 INSPECTION OF SITE

- A. Visit the site, examine and verify the conditions under which the Work must be conducted before submitting Proposal. The submitting of a Proposal implies that the Contractor has visited the site and understands the conditions under which the Work must be conducted. No additional charges will be allowed because of failure to make this examination or to include all materials and labor to complete the Work.
- B. No contract sum adjustments or contract time extensions will be made for Contractor claims arising from conditions which were or could have been observable, ascertainable or reasonably foreseeable from a site visit or inquiry into local conditions affecting the execution of the work.

1.10 ITEMS REQUIRING PRIOR APPROVAL

- A. Bids shall be based upon manufactured equipment specified. All items that the Contractor proposes to use in the Work that are not specifically named in the Contract Documents must be submitted for review prior to bids. Such items must be submitted in compliance with Division 01 specifications. Requests for prior approval must be accompanied by complete catalog information, including but not limited to, model, size, accessories, complete electrical information and performance data in the form given in the equipment schedule on the drawings at stated design conditions. Where items are referred to by symbolic designations on the drawings, all requests for prior approval shall bear the same designations.
 - 1. Equipment to be considered for prior approval shall be equal in quality, durability, appearance, capacity and efficiency through all ranges of operation, shall fulfill the requirements of equipment arrangement and space limitations of the equipment shown on the plans and/or specified and shall be compatible with the other components of the system.
 - 2. All costs incurred to make equipment comply with other requirements, including providing maintenance, clearance, piping, sheet metal, electrical, replacement of other components, and building alterations shall be included in the original bid.
- B. Voluntary alternates may be submitted for consideration, with listed addition or deduction to the bid, but will not affect the awarding of the contract.

1.11 ACTION SUBMITTALS

- A. Submit for review in compliance with Division 01.
- B. Equipment and material submittals required are indicated in the Mechanical; Fire Suppression; Plumbing; and Heating, Ventilating and Air Conditioning Sections. Refer to Division 01 for submittal quantities.
- C. Submittals shall be in groupings of similar or related items. Plumbing fixture submittals shall be in one package including all fixtures intended to be used for this project. Incomplete submittal groupings will be returned "Rejected". Submit product data with identification mark number or symbol numbers as specified or scheduled on the Mechanical Drawings.
- D. Submittals shall be project specific. Standard detail drawings and schedule not clearly indicating which data is associated with this Project will be returned "Rejected".
- E. If deviations (not substitutions) from Contract Documents are deemed necessary by the Contractor, details of such deviations, including changes in related portions of the project and the reasons therefore, shall be included with the submittal for approval.

1.12 INFORMATIONAL SUBMITTALS

- A. Shop Drawings:
 - 1. Prepare shop drawings to scale for the Architect/Engineer for review.
 - 2. Shop drawings shall be reviewed by the Mechanical Contractor for completeness and accuracy prior to submitting to the Architect/Engineer for review. The shop drawings shall be dated and signed by the Mechanical Contractor prior to submission.

3. No equipment shall be shipped from stock or fabricated until shop drawings for them have been reviewed by the Architect/Engineer. Review is only for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Any action indicated is subject to the requirement of the plans and specifications.
 - a. By the review of shop drawings, the Architect/Engineer does not assume responsibility for actual dimensions or for the fit of completed work in position, nor does such review relieve Mechanical Trades of full responsibility for the proper and correct execution of the work required.
 - b. Contractor is responsible for:
 - 1) Dimensions, which shall be confirmed and correlated at the job site.
 - 2) Fabrication processes and techniques of construction.
 - 3) Quantities.
 - 4) Coordination of Contractor's work with all other trades.
 - 5) Satisfactory performance of Contractor's work.
 - 6) Temporary aspects of the construction process.

B. Coordination Drawings:

1. Submit project specified coordination drawings for review in compliance with Division 01 Specification Sections.

1.13 **CLOSEOUT SUBMITTALS**

A. Operation and Maintenance Instructional Manuals:

1. Submit project specific Operation and Maintenance Instructional Manuals for review in compliance with Division 01 Specification Sections.
2. Provide complete operation and maintenance instructional manuals covering all mechanical equipment herein specified, together with parts lists. Maintenance and operating instructional manuals shall be job specific to this project. Generic manuals are not acceptable. One copy of all manuals shall be furnished for Owner. Maintenance and operating instructional manuals shall be provided when construction is approximately 75 percent complete.
3. Format: Submit operation and maintenance manuals in the following format:
 - a. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.
 - 1) Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
 - 2) Enable inserted reviewer comments on draft submittals.
4. The operating and maintenance instructions shall include a brief, general description for all mechanical systems including, but not limited to:
 - a. Routine maintenance procedures.
 - b. Lubrication chart listing all types of lubricants to be used for each piece of equipment and the recommended frequency of lubrication.
 - c. Trouble-shooting procedures.
 - d. Contractor's telephone numbers for warranty repair service.
 - e. Submittals.

- f. Recommended spare parts list.
 - g. Names and telephone numbers of major material suppliers and subcontractors.
 - h. System schematic drawings.
- B. Record Drawings:
- 1. Submit record drawings in compliance with Division 01.
 - 2. Contractor shall submit to the Architect/Engineer, record drawings on electronic media or vellum which have been neatly marked to represent as-built conditions for all new mechanical work.
 - 3. The Contractor shall keep accurate note of all deviations from the construction documents and discrepancies in the underground concealed conditions and other items of construction on field drawings as they occur. The marked-up field documents shall be available for review by the Architect, Engineer and Owner at their request.
- C. Warranties:
- 1. Warranty: Comply with the requirements in Division 01 Specification Sections. Contractor shall warranty that the mechanical installation is free from defects and agrees to replace or repair, to the Owner's satisfaction, any part of this mechanical installation which becomes defective within a period of one year (unless specified otherwise in other Mechanical; Fire Suppression; Plumbing; or Heating, Ventilating and Air Conditioning Sections) from the date of substantial completion following final acceptance, provided that such failure is due to defects in the equipment, material, workmanship or failure to follow the contract documents.
 - 2. File with the Owner any and all warranties from the equipment manufacturers including the operating conditions and performance capacities they are based on.

1.14 **INSTRUCTION OF OWNER PERSONNEL**

- A. Before final inspection, instruct Owner's designated personnel in operation, adjustment, and maintenance of mechanical equipment and systems at agreed upon times. A minimum of 2 hours of formal instruction to Owner's personnel shall be provided for each building. Additional hours are specified in individual specification sections.
- B. For equipment requiring seasonal operation, perform instructions for other seasons within six months.
- C. Use operation and maintenance manuals as basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.
- D. In addition to individual equipment training provide overview of each mechanical system. Utilize the as-built documents for this overview.
- E. Prepare and insert additional data in operation and maintenance manual when need for such data becomes apparent during instruction.

1.15 **WARRANTY**

- A. Warranty: Comply with the requirements in Division 01 Specification Sections. Contractor shall warranty that the mechanical installation is free from defects and agrees to replace or repair, to the Owner's satisfaction, any part of this mechanical installation which becomes defective within a period of one year (unless specified otherwise in other Mechanical; Fire Suppression; Plumbing; or Heating, Ventilating and Air Conditioning Sections) from the date of substantial completion following final acceptance, provided that such failure is due to defects in the equipment, material, workmanship or failure to follow the contract documents.
- B. File with the Owner any and all warranties from the equipment manufacturers including the operating conditions and performance capacities they are based on.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.01 MECHANICAL DEMOLITION WORK

- A. Include draining of piping systems where required for demolition, modification of, or connection to existing systems.
- B. In general, demolition work is indicated on the Drawings. However, the Contractor shall visit the job site to determine the full extent and character of this Work.
- C. Unless specifically noted to the contrary, removed materials shall not be reused in the work. Salvaged materials that are to be reused shall be stored safe against damage and turned over to the appropriate trade for reuse.
 - 1. Salvaged materials of value that are not to be reused shall remain the property of the Owner unless such ownership is waived.
 - 2. Remove items from the systems and turn over to the Owner in their condition prior to removal. The Owner will move and store these materials.
 - 3. Items on which the Owner waives ownership shall become the property of the Contractor, who shall remove and legally dispose of same, away from the premises.
- D. Work that has been cut or partially removed shall be protected against damage until covered by permanent construction.
- E. Clean and flush the interior and exterior of existing relocated equipment and its related piping, valves, and accessories that are to be reused of mud, debris, pipe dope, oils, welding slag, loose mill scale, rust, and other extraneous material so that the existing equipment and accessories can be repainted and repaired as required for the proper operation and performance of the relocated equipment.
- F. Where existing equipment is to be removed, cap piping under floor, behind face of wall, above ceiling, or at mains.
- G. Cap ductwork and cap piping immediately adjacent to demolition as soon as demolition commences in order to allow existing systems to remain in operation.
 - 1. Cap or plug piping with same or compatible piping material.
 - 2. Cap or plug ducts with same or compatible ductwork material.

3.02 TEMPORARY SERVICES

- A. Provide temporary service as described in Division 01.

3.03 WORK INVOLVING OTHER TRADES

- A. Certain items of equipment or materials specified in the Mechanical Division may have to be installed by other trades due to code requirements or union jurisdictional requirements. In such instances, the Contractor shall complete the work through an approved, qualified subcontractor and shall include the full cost for same in proposal.

3.04 ACCEPTANCE PROCEDURE

- A. Upon successful completion of start-up and recalibration, but prior to building acceptance, substantial completion and commencement of warranties, the Architect/Engineer shall be requested in writing to observe the satisfactory operation of all mechanical control systems.
- B. The Contractor shall demonstrate operation of equipment and control systems, including each individual component, to the Owner and Architect/Engineer.
- C. After correcting all items appearing on the punch list, make a second written request to the Owner and Architect/Engineer for observation and approval.

- D. After all items on the punch list are corrected and formal approval of the mechanical systems is provided by the Architect/Engineer, the Contractor shall indicate to the Owner in writing the commencement of the warranty period.
- E. Operation of the following systems shall be demonstrated:
 - 1. Heating Systems.
 - 2. Domestic Hot Water Heaters.
 - 3. Domestic Hot Water Mixing Stations.
 - 4. Temperature Controls.
 - 5. Exhaust Systems.
- F. For systems requiring seasonal operation, demonstrate system performance within six months when weather conditions are suitable.

END OF SECTION

TMP Architecture, Inc.
Peter Basso Associates, Inc.

TMP22103D & 22104E
PBA2023.0155.01 & 2023.0156.01

SECTION 20 0510 - BASIC MECHANICAL MATERIALS AND METHODS

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section "Mechanical General Requirements."
2. Division 22 Section "Domestic Water Piping" for flushing and cleaning of potable water piping.
3. Division 23 Section "Piping Systems Flushing and Chemical Cleaning" for flushing and cleaning of HVAC piping.

1.02 **SUMMARY**

- A. This section includes mechanical materials and installation methods common to mechanical piping systems, sheet metal systems and equipment. This section supplements all other Division 20, 21, 22, and 23 Mechanical Sections, and Division 01 Specification Sections.

1.03 **DEFINITIONS**

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
1. ABS: Acrylonitrile-butadiene-styrene plastic.
 2. CPVC: Chlorinated polyvinyl chloride plastic.
 3. PE: Polyethylene plastic.
 4. PVC: Polyvinyl chloride plastic.
 5. RTRF: Reinforced thermosetting resin (fiberglass) fittings.
 6. RTRP: Reinforced thermosetting resin (fiberglass) pipe.
- G. The following are industry abbreviations for rubber materials:
1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 2. NBR: Acrylonitrile-butadiene rubber.

1.04 **ACTION SUBMITTALS**

- A. Product Data: For the following:
1. Transition fittings.
 2. Dielectric fittings.
 3. Mechanical sleeve seals.
 4. Escutcheons.

1.05 **INFORMATIONAL SUBMITTALS**

- A. Brazing Certificates: As required by ASME Boiler and Pressure Vessel Code, Section IX, or AWS B2.2.

1.06 **QUALITY ASSURANCE**

- A. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.
- B. Comply with NSF 14, "Plastics Piping System Components and Related Materials," for plastic, potable domestic water piping and components. Include marking "NSF-pw" on piping.
- C. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," for potable domestic water piping and components.
- D. Comply with NSF 372, "Drinking Water System Components – Lead Content" for potable domestic water piping and components.
- E. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- F. Duct Joint and Seam Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D9.1, "Sheet Metal Welding Code."
- G. Structural Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code--Steel."
 - 2. AWS D1.2, "Structural Welding Code--Aluminum."
 - 3. AWS D1.3, "Structural Welding Code--Sheet Steel."
 - 4. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
 - 5. AWS D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- H. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications," or AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."
- I. Soldering: Qualify processes and operators according to AWS B2.3/2.3M, "Specification for Soldering Procedure and Performance Qualification."
- J. Installer Qualifications:
 - 1. Installers of Grooved Components: Installers shall be certified by the grooved component manufacturer as having been trained and qualified to join piping with grooved couplings, fittings, and specialties.
 - 2. Installers of Pressure-Sealed Joints: Installers shall be certified by the pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.
 - 3. Fiberglass Pipe and Fitting Installers: Installers of RTRF and RTRP shall be certified by the manufacturer of pipes and fittings as having been trained and qualified to join fiberglass piping with manufacturer-recommended adhesive.

1.07 **DELIVERY, STORAGE, AND HANDLING**

- A. Storage and Protection: Provide adequate weather protected storage space for all mechanical equipment and materials deliveries to the job site. Storage locations will be designated by the Owner's Representative. Equipment stored in unprotected areas must be provided with temporary protection.
 - 1. Protect equipment and materials from theft, injury or damage.

2. Protect equipment outlets, pipe and duct openings with temporary plugs or caps.
3. Materials with enamel or glaze surface shall be protected from damage by covering and/or coating as recommended in bulletin "Handling and Care of Enameled Cast Iron Plumbing Fixtures", issued by the Plumbing Fixtures Manufacturer Association, and as approved.
4. Electrical equipment furnished by Mechanical Trades and installed by the Electrical Trades: Turn over to Electrical Trades in good condition, receive written confirmation of same.
5. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
6. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.08 **COORDINATION**

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations. Coordinate with other trades to ensure accurate locations and sizes of mechanical spaces, chases, slots, shafts, recesses and openings.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Install Work to avoid interference with work of other trades including, but not limited to, Architectural and Electrical Trades. Remove and relocate any work that causes an interference at Contractor's expense.
- D. Coordinate requirements for and provide access panels and doors for mechanical items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."
- E. The mechanical trades shall be responsible for all damage to other work caused by their work or through the neglect of their workers.
 1. All patching and repair of any such damaged work shall be performed by the trades which installed the work. The cost shall be paid by the Mechanical Trades.

PART 2 PRODUCTS

2.01 **MANUFACTURERS**

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

2.02 **PIPE, TUBE, AND FITTINGS**

- A. Refer to individual Division 21, 22, and 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.03 **JOINING MATERIALS**

- A. Refer to individual Division 21, 22, and 23 piping Sections for special joining materials not listed below.
- B. Unions: Pipe Size 2 Inches and Smaller:
 1. Ferrous pipe: Malleable iron ground joint type unions.
 2. Unions in galvanized piping system shall be galvanized.
 3. Copper tube and pipe: Bronze unions with soldered joints.

- C. Flanges: Pipe Sizes 2-1/2 Inch and Larger:
 - 1. Ferrous pipe: Standard weight, forged steel weld neck flanges.
 - 2. Copper tube and pipe: Slip-on bronze flanges.
- D. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- E. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated. Square head bolts and nuts are not acceptable.
- F. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- G. Solder Filler Metals: ASTM B 32, lead-free, antimony-free, silver-bearing alloys. Include water-flushable flux according to ASTM B 813.
- H. Brazing Filler Metals: Alloys meeting AWS A5.8.
 - 1. Use Type BcuP Series, silver-bearing, copper-phosphorus alloys for joining copper or bronze socket fittings with copper pipe. Flux is prohibited unless used with bronze fittings.
 - 2. Use Type Bag Series, cadmium-free silver alloys for joining copper with steel, stainless steel, or other ferrous alloys.
- I. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- J. Welding Materials: Comply with Section II, Part C, of ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.
- K. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F 493.
- L. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
- M. Solvent Cements for Joining ABS Piping: ASTM D 2235.
- N. Solvent Cements for Joining PVC to ABS Piping Transition: ASTM D 3138.
- O. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.04 **PIPE THREAD COMPOUNDS**

- A. General: Pipe thread compounds for the fluid service compatible with piping materials provided.
- B. Potable Water Service and Similar Applications: Compounds acceptable to U.S. Department of Agriculture (USDA) or Food and Drug Administration (FDA). Compounds containing lead are prohibited.
- C. Galvanized Steel: Inorganic zinc-rich coatings or corrosion inhibited proprietary compounds to coat raw carbon steel surfaces, in lieu of subsequent painting. Compounds containing lead are prohibited.
 - 1. Manufacturers:
 - a. Carboline "Carbo-Zinc 12."

- b. Tnemec.
- c. Koppers.
- D. Steam and Steam Condensate: Graphite and oil or proprietary corrosion inhibited compounds suitable for system temperatures.
 - 1. Manufacturers:
 - a. Cameron; A Schlumberger Company; Key "Graphite Paste."
 - b. Other approved.
- E. Natural Gas System: Use either of the following:
 - 1. Tetrafluoroethylene (Teflon) tape 2 to 3 mils thick for threaded joints.
 - a. Manufacturers:
 - 1) Cadillac Plastic.
 - 2) Permacel.
 - 3) Other approved.
 - 2. Lead-free pipe thread compounds suitable for service.
 - a. Manufacturers:
 - 1) HCC Holdings, Inc.; Hercules Pro Dope.
 - 2) Mill-Rose Company (The); Clean-Fit Products; Blue Monster Thread Sealant.
 - 3) Oatey; Great Blue Pipe Joint Compound.
 - 4) RectorSeal LLC: A CSW Industrials Company; No. 5, No.5 Special, and No. 5 Sub-Zero Pipe Thread Sealants.

2.05 **TRANSITION FITTINGS**

- A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
 - 1. Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Dresser Industries, Inc.; DMD Div.
 - c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
 - d. JCM Industries.
 - e. Smith-Blair, Inc.
 - f. Viking Johnson.
 - 2. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
 - 3. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
 - 4. Aboveground Pressure Piping: Pipe fitting.
- B. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
 - 1. Manufacturers:
 - a. IPEX Inc. (formerly Eslon Thermoplastics).
- C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

1. Manufacturers:
 - a. Thompson Plastics, Inc.
- D. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
 1. Manufacturers:
 - a. NIBCO INC.
 - b. NIBCO, Inc.; Chemtrol Div.
- E. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.
 1. Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Fernco, Inc.
 - c. Mission Rubber Company.
 - d. Plastic Oddities, Inc.
 - e. Can-Tex Industries Division of Harsco Corp. "CT-Adaptors".
 - f. Joint Inc., "Caulder".

2.06 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Brass Unions, Brass Nipples, Brass Couplings: For systems up to 286 deg F.
- D. Dielectric-Flange Kits: Include full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 1. Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Capitol Manufacturing Co.
 - d. GF Piping Systems; George Fischer Central Plastics.
 - e. Epcos Sales, Inc.
 - f. Pipeline Seal and Insulator, Inc.
 - g. Watts Water Technologies, Inc.; Watts Regulator Co.
 - h. Zurn Industries, Inc.; Wilkins Div.
 2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.
- E. Dielectric Nipple/Waterway Fittings: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, male NPT threaded, or grooved ends; and 300-psig minimum working pressure at 230 deg F.
 1. Manufacturers:
 - a. ASC Engineered Solutions; Gruvlok Manufacturing; DI-LOK Nipples.

- b. Elster Group; Perfection Corp.; ClearFlow.
- c. Precision Plumbing Products, Inc.; ClearFlow.
- d. Sioux Chief Manufacturing Co., Inc.
- e. Tyco Fire & Building Products; Grinnell Mechanical Products; Figure 407 ClearFlow.
- f. Victaulic Co. of America; Style 47 ClearFlow.

2.07 MODULAR MECHANICAL SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve or pipe and core drilled hole.
 - 1. Manufacturers:
 - a. Advance Products & Systems, Inc.; Innerlynx.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.; Thunderline Link Seal.
 - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: Stainless steel. Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: Stainless steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.08 SLEEVES

- A. Steel Pipe: ASTM A53, Type E, Grade B, Schedule 40, and 0.375 inch wall black.
- B. Steel Pipe: ASTM A53, Type E, Grade B, Schedule 40, and 0.375 inch wall galvanized, plain ends.
- C. Water Stop: Cast or ductile iron; fabricated steel; PVC; or rotationally molded HDPE pipe; with plain ends and integral water stop, unless otherwise indicated.
 - 1. Manufacturers:
 - a. Advance Products & Systems, Inc.; Infinity and Gal-Vo-Plast Sleeves.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.

2.09 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping or Piping in High Humidity Areas: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type with spring clips.

- d. Bare Piping in Finished Spaces: One-piece, stamped-steel type.
- e. Bare Piping in Unfinished Service Spaces or Equipment Rooms: Split-plate, stamped-steel type with concealed hinge and set screw.

2.10 GROUT

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

2.11 EPOXY BONDING COMPOUND

- A. Two-component system suitable for bonding wet or dry concrete to each other and to other materials.
- B. Manufacturers:
 - 1. Euco 452 #450; Euclid Chemical Co.
 - 2. Epobond; L & M Construction Chemicals.
 - 3. Sikadur 87; Sika Corp.

2.12 LEAK DETECTOR SOLUTION

- A. Commercial leak detector solution for pipe system testing.
- B. Manufacturers:
 - 1. American Gas and Chemicals Inc.; Leak Tec.
 - 2. Cole-Parmer Inst. Co.; Leak Detector.
 - 3. Guy Speaker Co. Inc.; Squirt 'n Bubbles.

2.13 PIPING CONCEALMENT SYSTEM

- A. Manufacturers:
 - 1. ARSCO Manufacturing Company.
 - 2. JG Innovations Inc.
- B. Description: Modular system of support brackets and covers made to protect piping.
- C. Brackets: Glass-reinforced nylon.
- D. Covers: Galvanized steel sections of length, shape, and size required for size and routing of piping.

2.14 PIPE PENETRATION ASSEMBLIES

- A. Contractor may choose from one of the following:
- B. Pipe Roof Penetration Enclosures
 - 1. Manufacturers:
 - a. Pate Company (The); pca Series.
 - b. Portal Plus, Inc.
 - c. Thybar Corporation; Thycurb.
 - 2. Prefabricated roof curb with:
 - a. Minimum 18 gage welded galvanized steel construction.

- b. Integral base plate.
 - c. Factory installed insect and decay resistant wood nailer.
 - d. EPDM compression molded rubber cap for single or multiple pipes as required. Quantity of molder rubber caps shall be sufficient for no more than one pipe or conduit per cap.
 - e. Stainless steel draw-band clamps.
- C. Pipe Roof Penetration Hood Assembly
- 1. Manufacturers:
 - a. Pate Company (The); pca Series.
 - 2. Heavy gage aluminum construction.
 - 3. Removable top cover.
 - 4. Fully insulated aluminum mounting base to isolate hood from galvanized curb.
 - 5. Includes prefabricated roof curb with:
 - a. Minimum 18 gage welded galvanized steel construction.
 - b. Integral base plate.
 - c. Factory installed insect and decay resistant wood nailer.

PART 3 EXECUTION

3.01 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Refer to piping application schedules on the Drawings.
- B. Install piping according to the following requirements and Division 21, 22, and 23 Sections specifying piping systems, and in accordance with manufacturer's instructions.
- C. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. The Drawings shall be followed as closely as elements of construction will permit.
- D. During the progress of construction, protect open ends of pipe, fittings, and valves to prevent the admission of foreign matter. Place plugs or flanges in the ends of all installed work whenever work stops. Plugs shall be commercially manufactured products.
- E. Prior to and during laying of pipe, maintain excavations dry and clear of water and extraneous materials. Provide minimum 4 inches of clearance in all directions for pipe passing under or through building grade beams.
- F. Weld-o-lets and thread-o-lets can be used for annular flow measuring devices, temperature control components, and thermal wells in steel pipe. Pipe taps shall be drilled and deburred. Torch cutting is not acceptable.
- G. Brazolets can be used for annular flow measuring devices, temperature control components, and thermal wells in copper tube. Pipe taps shall be drilled and deburred. Torch cutting is not acceptable.
- H. Clean and lubricate elastomer joints prior to assembly.
- I. Clean damaged galvanized surfaces and touch-up with a zinc rich coating.
- J. Install piping to conserve building space and not interfere with use of space.
- K. Group piping whenever practical at common elevations.

- L. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
 - 1. Install piping to allow for expansion and contraction at locations where piping crosses building or structure expansion joints.
- M. Slope piping and arrange systems to drain at low points.
- N. Slope horizontal piping containing non-condensable gases 1 inch per 100 feet, upward in the direction of the flow.
- O. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- P. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- Q. In concealed locations where piping, other than black steel, cast-iron, or galvanized steel, is installed through holes or notches in studs, joists, rafters or similar members less than 1-1/2 inches from the nearest edge of the member, the pipe shall be protected by shield plates. Protective shield plates shall be a minimum of 1/16 inch thick steel, shall cover the area of the pipe where the member is notched or bored, and shall extend a minimum of 2 inches above sole plates and below top plates.
- R. Do not penetrate building structural members unless specifically indicated on drawings.
- S. Install piping above accessible ceilings to allow sufficient space for ceiling panel and light fixture removal.
- T. Install valves with stems upright or horizontal, not inverted.
- U. Provide clearance for installation of insulation and access to valves and fittings.
- V. Install piping to permit valve and equipment servicing. Do not install piping below valves and/or terminal equipment. Do not install piping above electrical equipment.
- W. Install piping at indicated slopes. Provide drain valves with hose end connections and caps at all piping low points, where piping is trapped and at all equipment.
- X. Install piping free of sags and bends.
- Y. Install fittings for changes in direction and branch connections.
- Z. Unless otherwise indicated or specified, install branch connections to mains using tee fittings in main pipe:
 - 1. Branch connected to bottom of main pipe for HVAC systems. Side connection is acceptable. Connection above centerline of main is unacceptable. For up-feed risers, connect branch to top of main pipe.
 - 2. Branch connected to top of main for steam and condensate, plumbing systems, compressible gasses, and vacuum.
- AA. Install piping to allow application of insulation.
- BB. Select system components with pressure rating equal to or greater than system operating pressure.
- CC. After completion, fill, clean, and treat systems. Refer to Division 23 Sections "Hydronic Piping," "Piping Systems Flushing and Chemical Cleaning," and "HVAC Water Treatment."
- DD. Install escutcheons for penetrations of walls below ceiling, and ceilings.
- EE. Sleeves are not required for core-drilled holes in poured concrete walls.

- FF. Permanent sleeves are not required for holes formed by removable PE sleeves in poured concrete walls.
- GG. Install sleeves for pipes passing through footings and foundation walls, masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
1. Cut sleeves to length for mounting flush with both surfaces of walls.
 - a. Exception: Extend sleeves installed in floors 2 inches above finished floor level.
 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Schedule 40 Black Steel Sleeves: For pipes smaller than NPS 12 penetrating interior walls.
 - b. 0.375 Inch Wall Black Steel Sleeves: For pipes NPS 12 and larger penetrating interior walls.
 - c. Schedule 40 Galvanized Steel Sleeves: For pipes smaller than NPS 12 penetrating floors, and roof slabs.
 - d. 0.375 Inch Wall Galvanized Steel Sleeves: For pipes NPS 12 and larger penetrating floors and roof slabs.
 - e. For pipes penetrating floors with membrane water proofing provide cast iron sleeve with clamping flanges. Secure/seal membrane to sleeves with clamping flanges.
 4. Seal sleeves in concrete floors roof slabs and masonry walls with grout.
 5. Seal sleeves in plaster/gypsum-board partitions with plaster or dry wall compound and caulk with non-hardening silicone sealant to provide airtight installation.
 6. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- HH. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and modular mechanical seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing modular mechanical seals.
1. Install Schedule 40 galvanized steel pipe for sleeves smaller than 12 inches in diameter.
 2. Install 0.375 galvanized steel pipe for sleeves 12 inches and larger in diameter.
 3. Modular Mechanical Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble modular mechanical seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- II. New, Poured Concrete, Underground, Exterior-Wall and Slab on Grade Pipe Penetrations: Install water stop sleeves prior to pour. Seal pipe penetrations using modular mechanical seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing modular mechanical seals.
1. Modular Mechanical Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble modular mechanical seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- JJ. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

1. Seal openings around pipes in sleeves through walls, floors and ceilings, and where floors, fire rated walls and smoke barriers are penetrated. Firestop materials shall be UL listed and shall have a fire rating equal to or greater than the penetrated barrier.
2. Refer to Division 07 Specification Sections for materials and UL Classified firestop systems.

KK. Pipe Roof Penetration Enclosures:

1. Coordinate delivery of roof penetration enclosures to jobsite.
2. Locate and set curbs on roof.
3. Framing, flashing, and attachment to roof structure are specified under Division 07.
4. Attach cap to curbs, cut pipe boots to fit pipe, and clamp boots to pipe or conduit.

LL. Verify final equipment locations for roughing-in.

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

3.02 **PIPING JOINT CONSTRUCTION**

- A. Join pipe and fittings according to the following requirements and Division 21, 22, and 23 Sections specifying piping systems.
- B. Cut piping square.
- C. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- D. Remove scale, slag, dirt, oil, and debris from inside and outside of pipe and fittings before assembly.
- E. Clean damaged galvanized surfaces and touch-up with a zinc rich coating.
- F. Use standard long sweep pipe fittings for changes in direction. No mitered joints or field fabricated pipe bends will be permitted. Short radius elbows may be used where specified or specifically authorized by the Architect.
- G. Make tee connections with screwed tee fittings, soldered fittings or specified welded connections. Make welded branch connections with either welding tees or forged branch outlet fittings in accordance with ASTM A234, ANSI B16.9 and ANSI B16.11. For forged branch outlets, furnish forged fittings flared for improved flow where attached to the run, reinforced against external strains and to full pipe-bursting strength requirements. "Fishmouth" connections are not acceptable.
- H. Use eccentric reducers for drainage and venting of pipelines; bushings are not permitted.
- I. Provide pipe openings using fittings for all systems control devices, thermometers, gauges, etc. Drilling and tapping of pipe wall for connections is prohibited.
- J. Provide temperature sensing device thermal wells and similar piping specialty connections.
- K. Provide instrument connections except thermal wells with specified isolating valves at point of connection to system.
- L. Locate instrument connections in accordance with manufacturer's instructions for accurate read-out of function sensed. Locate instrument connections for easy reading and service of devices.
- M. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."
- N. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.

- O. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- P. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
 - 1. Weld-o-lets and thread-o-lets can be used for annular flow measuring devices, temperature control components, and thermal wells. Pipe taps shall be drilled and deburred. Torch cutting is not acceptable.
- Q. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on gaskets and bolt threads.
 - 1. Assemble flanged joints with fresh-stock gasket and hex head nuts, bolts or studs. Make clearance between flange faces such that the connections can be gasketed and bolted tight without strain on the piping system. Align flange faces parallel and bores concentric; center gaskets on the flange faces without projection into the bore.
 - 2. Lubricate bolts before assembly to insure uniform bolt stressing. Draw up and tighten bolts in staggered sequence to prevent unequal gasket compression and deformation of the flanges. Do not mate a flange with a raised face to a companion flange with a flat face; machine the raised face down to a smooth matching surface and use a full-face gasket. After the piping system has been tested and is in service at its maximum temperature, check bolting torque to provide required gasket stress.
- R. Grooved Joints: Assemble joints with grooved-end-pipe or grooved-end-tube coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. Galvanized piping shall be cut grooved to prevent damage to galvanizing on internal pipe surfaces. The grooved coupling manufacturer's factory trained representative shall provide on-site training for contractor's field personnel in the use of grooving tools, application of groove, and installation of grooved joint products. The manufacturer's representative shall periodically visit the jobsite and review installation. Contractor shall remove and replace any joints deemed improperly installed.
- S. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.
- T. Pressure-Sealed Joints: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.
- U. Dissimilar-Metal Piping Joints: Construct joints using dielectric fittings compatible with both piping materials. Refer to Application Schedules on the Drawings.
- V. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
 - 3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 5. PVC Nonpressure Piping: Join according to ASTM D 2855.
 6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.
- W. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- X. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
- Y. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
1. Plain-End Pipe and Fittings: Use butt fusion.
 2. Plain-End Pipe and Socket Fittings: Use socket fusion.
- Z. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.
- AA. Remake joints which fail pressure tests with new materials including pipe, fittings, gaskets and/or a filler.
- 3.03 ACCESS DOORS**
- A. Provide access doors for installation by architectural trades. Provide access doors in the walls, as required to make all valves, controls, coils, motors, air vents, filters, electrical boxes and other equipment installed by the Contractor accessible. Minimum size 12 inches x 12 inches. Provide access doors in the ceiling, for accessibility as mentioned above, 24 inches x 24 inches minimum size. Areas with accessible ceilings (ceilings where lay-in panels are not fastened in place and can be individually removed without removal of adjacent tiles) will not require access doors. Refer to Division 08 Section "Access Doors and Frames" for manufacturers and model numbers and additional information.
 - B. When access doors are in fire resistant walls or ceilings, they shall bear the Underwriters' Laboratories, Inc., Label, with time design rating equal to or greater than the wall or ceiling unless they were a part of the tested assembly.
- 3.04 EQUIPMENT CONNECTIONS**
- A. Make connections to equipment, fixtures, and other items included in the work in accordance with the submittals and rough-in measurements furnished by the manufacturers of the particular equipment furnished.
 1. Any and all additional connections not shown on the drawings but shown on the equipment manufacturer's submittal or required for the successful operation of the equipment shall be installed as part of this Contract at no additional charge to the Owner.
 - B. All piping connections to pumps, coils, and other equipment shall be installed without strain at the pipe connection of this equipment. When directed, remove the bolts in flanged connections or disconnect piping to demonstrate that piping has been so connected.
- 3.05 PIPING CONNECTIONS**
- A. Make connections according to the following, unless otherwise indicated:
 1. Install unions, in piping NPS 2 and smaller, where indicated on Drawings, at final connection to each piece of equipment and at all control valves.
 2. Install flanges, in piping NPS 2-1/2 and larger, where indicated on Drawings, at final connection to each piece of equipment and at all control valves.

3.06 INSTALLATION OF PIPE CONCEALMENT SYSTEM

- A. Install cover system, brackets, and cover components for piping according to manufacturer's "Installation Manual."

3.07 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated. Housekeeping pad locations and sizes shall be coordinated by mechanical contractor prior to the placement of concrete slabs.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.
- E. For suspended equipment, furnish and install all inserts, rods, structural steel frames, brackets and platforms required. Obtain approval of Architect for same including loads, locations and methods of attachment.
- F. Equipment Rigging Over Roof Areas: Protect building structure against damage during equipment rigging. Make provisions to distribute load of equipment to main roof structure, and to prevent damage to roof decking, roofing, or purlins.
- G. The Contract Documents indicate items to be purchased and installed. The items are noted by a manufacturer's name, catalog number and/or brief description. The catalog number may not designate all the accessory parts for a particular application. Arrange with the manufacturer for the purchase of all items required for a complete installation.

3.08 PAINTING

- A. Painting of mechanical systems, equipment, and components is specified in Division 09.
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.09 CONCRETE BASES

- A. Concrete housekeeping pads for floor mounted mechanical equipment shall be provided by Architectural Trades.
- B. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions.
 - 1. Construct concrete bases as shown on Drawings or specified, but not less than 4 inches larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 - 7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section.

3.10 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- C. Where pipe and/or equipment support members must be welded to structural building framing, Contractor shall seek prior approval from Architect and structural engineer. Scrape, brush clean, and apply one coat of zinc rich primer after welding.
- D. Field Welding: Comply with AWS D1.1.

3.11 EPOXY BONDING TO EXISTING MATERIALS

- A. Use epoxy bonding compound to set sleeves or pipes in existing concrete to bond new concrete and/or grout to existing materials or to bond dissimilar materials.
- B. The compound, when applied in accordance with the manufacturer's instructions, shall be capable of initial curing within 48 hours at temperatures as low as 40 deg F and shall be capable of bonding any combination of the following properly prepared materials: Wet or dry, cured or uncured concrete or mortar; vitrified clay; cast iron and carbon steel.

3.12 JACKING OF PIPE

- A. Do not jack pipe in place except upon prior approval of proposed materials and complete details of methods.

3.13 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor mechanical materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.14 GROUTING

- A. Mix and install grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

3.15 CUTTING, CORING AND PATCHING

- A. Refer to Division 01 Specification Sections for requirements for cutting, coring, patching and refinishing work necessary for the installation of mechanical work.
- B. All cutting, coring, patching and repair work shall be performed by the Contractor through approved, qualified subcontractors. Contractor shall include full cost of same in bid.

3.16 EXCAVATION AND BACKFILLING

- A. Refer to Division 31 Specification Sections.

- B. Provide all excavation, trenching, tunneling and backfilling required for the mechanical work.
- C. Provide all pumping and/or well pointing required for the mechanical work.
- D. Provide foundations if required to support underground piping.
- E. Backfill all excavations with well-tamped granular material. Backfill all excavations under wall footings with lean mix concrete up to underside of footings and extend concrete within excavation a minimum of four (4) feet each side of footing. Granular backfill shall be placed in layers not more than 8 inches in thickness, 95 percent compaction throughout with approved compaction equipment. Tamp, roll as required. Excavated material shall not be used.

3.17 **FLASHING**

- A. Provide all flashing required for mechanical work. Refer to Division 07 Specification Sections.

3.18 **LUBRICATION**

- A. Provide all lubrication for the operation of the equipment until acceptance by the Owner. Contractor is responsible for all damage to bearings up to the date of acceptance of the equipment. Protect all bearings and shafts during installation. Thoroughly grease steel shafts to prevent corrosion. Provide covers as required for proper protection of all motors and other equipment during construction.

3.19 **FILTERS**

- A. Provide and maintain filters in air handling systems throughout the construction period and prior to final acceptance of the building. Do not run air handling equipment, without all prefilters and final filters as specified.
- B. Immediately prior to final building acceptance by the Owner, Contractor shall:
 - 1. Replace all disposable type air filters with new units.

3.20 **CLEANING**

- A. Each Mechanical Trade shall be responsible for removing all debris daily as required to maintain the work area in a neat, orderly condition.
- B. After equipment, steam, condensate and HVAC water piping systems have been completed and tested, each entire system shall be cleaned and flushed. Refer to Division 23 Section "Piping Systems Flushing and Chemical Cleaning" for requirements. Provide temporary bypass piping and fittings, temporary valves and strainers, temporary water make-up piping with approved means of backflow prevention, and temporary pumps as needed to perform specified flushing and cleaning requirements.
- C. Prior to connection of new HVAC piping to existing HVAC piping systems, all new piping shall be subject to initial flushing, cleaning and final flushing. Refer to Division 23 Section "Piping Systems Flushing and Chemical Cleaning" for requirements. Provide temporary bypass piping and fittings, temporary valves and strainers, temporary water make-up piping with approved means of backflow prevention, and temporary pumps as needed to perform specified flushing and cleaning requirements.
- D. Flushing, cleaning, and disinfection of domestic water piping is specified in Division 22 Section "Domestic Water Piping."
- E. Exterior surfaces of all piping, ductwork and equipment shall be wiped down to remove excess dirt and debris prior to concealment by Architectural Trades work.
- F. Upon completion of work in each respective area, clean and protect work. Just prior to final acceptance, perform additional cleaning as necessary to provide clean equipment and areas to the Owner.

END OF SECTION

SECTION 20 0513 - MOTORS

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Mechanical Vibration Controls" for mounting motors and vibration isolation devices.
 - 3. Division 21, 22, and 23 Sections for application of motors and reference to specific motor requirements for motor-driven equipment.
 - 4. Division 26 Section "Enclosed Switches and Circuit Breakers".
 - 5. Division 26 Section "Enclosed Controllers".
 - 6. Division 26 Section "Fuses".

1.02 SUMMARY

- A. This Section includes basic requirements for factory-installed motors.

1.03 DEFINITIONS

- A. ABMA: American Bearing Manufacturers Association. (Formerly AFBMA: Anti-Friction Bearing Manufacturers Association.)
- B. Factory-Installed Motor: A motor installed by motorized-equipment manufacturer as a component of equipment.
- C. Field-Installed Motor: A motor installed at Project site and not factory installed as an integral component of motorized equipment.

- D. **Packaged Self Contained Equipment:** Equipment which includes component mechanical and electrical equipment mounted on common bases, skids or frames or in common enclosures with internal control and power wiring factory installed and ready to accept a single electrical service connection. Provide the equipment complete with enclosed controllers, main disconnect switches, control transformers, control devices, wiring and accessories as required.

1.04 **QUALITY ASSURANCE**

- A. **Testing Agency Qualifications:** A Nationally Recognized Testing Laboratory (NRTL), acceptable to authorities having jurisdiction, with the experience and capability to conduct the testing indicated.
- B. **Electrical Components, Devices, and Accessories:** Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

1.05 **DELIVERY, STORAGE, AND HANDLING**

- A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

1.06 **COORDINATION**

- A. Coordinate features of motors, installed units, and accessory devices. Provide motors that are:
 - 1. Compatible with the following:
 - a. Magnetic controllers.
 - b. Multispeed controllers.
 - c. Reduced-voltage controllers.
 - d. Solid-state controllers.
 - e. Variable frequency controllers.
 - 2. Designed and labeled for use with variable frequency controllers, and suitable for use throughout speed range without overheating.
 - 3. Matched to torque and horsepower requirements of the load.
 - 4. Matched to ratings and characteristics of supply circuit and required control sequence.
- B. Coordinate electrical scope of work to be provided by Division 20, 21, 22, and 23 with this Section, related Division 20, 21, 22, and 23 Specifications, Division 26 Specifications and the Drawings.
- C. Electrical work provided under Division 20, 21, 22, and 23: Furnish UL Listed components in accordance with this section, Division 26, and applicable NEMA and NEC (ANSI C 1) requirements. Provide wiring, external to electrical enclosures, in conduit.
- D. Furnished, installed and wired under Division 20, 21, 22, and 23 unless otherwise indicated:
 - 1. Disconnected components in packaged self-contained equipment that are so constructed that components of wiring must be disconnected for shipment and reconnected after installation.
- E. Furnished and installed under Division 20, 21, 22, and 23 and wired under Division 26 unless otherwise indicated:
 - 1. Motors required for mechanical equipment
 - 2. **Packaged Self-Contained Equipment:**
 - a. Provide equipment ready to accept a single electrical service connection.

- b. For equipment with remote mounted control panels, provide mounting of the control panel and external wiring from the control panel to the package self-contained equipment.
3. Variable frequency controllers.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following:
 1. Dayton.
 2. Toshiba Intl.
 3. Baldor Electric/Reliance.
 4. Rockwell Automation/Allen-Bradley.
 5. Nidec Motor Corporation; U.S. Electrical Motors.
 6. Regal Beloit/GE Commercial Motors.
 7. Regal Beloit/Leeson.
 8. Regal Beloit/Marathon.
 9. Siemens.

2.02 MOTOR REQUIREMENTS

- A. Motor requirements apply to factory-installed motors except as follows:
 1. Different ratings, performance, or characteristics for a motor are specified in another Section.
 2. Manufacturer for a factory-installed motor requires ratings, performance, or characteristics, other than those specified in this Section, to meet performance specified.
 3. Submersible motors integral to pumps and excluded from NEMA and EISA standards.
- B. Electrical Power Supply Characteristics: Coordinate electrical system requirements with Division 26.
- C. Electrical Power System Characteristics: As scheduled on the Drawings.
- D. Electrical Connection: Conduit connection boxes, threaded for conduit. For fractional horsepower motors where connection is made directly, provide screwed conduit connection in end frame.

2.03 MOTOR CHARACTERISTICS

- A. Motors 1/2 HP and Larger: Three phase, unless otherwise indicated.
- B. Motors Smaller Than 1/2 HP: Single phase, unless otherwise indicated.
- C. Frequency Rating: 60 Hz.
- D. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.
- E. Service Factor: 1.15 for open drip proof motors; 1.0 for totally enclosed motors.
- F. Duty: Continuous duty at ambient temperature of 105 deg F and at altitude of 3300 feet above sea level.
- G. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
- H. Brake Horsepower Input: Shall not exceed 90 percent of the rated motor horsepower.

- I. Enclosure: Open drip proof (ODP) for motors installed indoors and out of the airstream. Totally-enclosed fan-cooled (TEFC) for motors installed outdoors or within the airstream.

2.04 **POLYPHASE MOTORS**

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Fire pump motors, C-face motors, JP and JM frame motors, and motors over 200 horsepower shall be energy efficient motors. Efficiency of the motor shall be determined based on the NEMA MG1. The minimum efficiencies, nominal efficiencies and shall meet or exceed Table 12-11.

HP	1800 RPM OPEN DRIP-PROOF MOTORS 4 POLE		1800 RPM ENCLOSED MOTORS 4 POLE	
	NOMINAL	MINIMUM	NOMINAL	MINIMUM
	EFF	EFF	EFF	EFF
1	82.5	81.5	82.5	81.5
1.5	84	82.5	84	82.5
2	84	82.5	84	82.5
3	86.5	85.5	87.5	86.5
5	87.5	86.5	87.5	86.5
7.5	88.5	87.5	89.5	88.5
10	89.5	88.5	89.5	88.5
15	91	90.2	91	90.2
20	91	90.2	91	90.2
25	91.7	91	92.4	91.7
30	92.4	91.7	92.4	91.7
40	93	92.4	93	92.4
50	93	92.4	93	93
60	93.6	93	93.6	93
75	94.1	93.6	94.1	93.6
100	94.1	93.6	94.5	94.1
125	94.5	94.1	94.5	94.1
150	95	94.5	95	94.5
200	95	94.5	95	94.5

HP	1200 RPM OPEN DRIP-PROOF MOTORS 6 POLE		3600 RPM OPEN DRIPPROOF MOTORS 2 POLE	
	NOMINAL	MINIMUM	NOMINAL	MINIMUM
	EFF	EFF	EFF	EFF
1	80	78.5	--	--
1.5	84	82.5	82.5	81.5
2	85.5	84	84	82.5
3	86.5	85.5	84	82.5
5	87.5	86.5	85.5	84
7.5	88.5	87.5	85.5	86.5
10	90.2	89.5	88.5	87.5
15	90.2	89.5	89.5	88.5
20	91	90.2	90.2	89.5
25	91.7	91	91	90.2
30	92.4	91.7	91	90.2
40	93	92.4	91.7	91
50	93	93	92.4	91.7
60	93.6	93	93	92.4
75	93.6	93	93	92.4
100	94.1	93.6	93	92.4

HP	1800 RPM OPEN DRIP-PROOF MOTORS 4 POLE		1800 RPM ENCLOSED MOTORS 4 POLE	
	NOMINAL	MINIMUM	NOMINAL	MINIMUM
	<u>EFF</u>	<u>EFF</u>	<u>EFF</u>	<u>EFF</u>
125	94.1	93.6	93.6	93
150	94.5	94.1	93.6	93
200	94.5	94.1	94.5	94.1

- C. Efficiency: Motors 1 horsepower to 200 horsepower shall be premium efficient motors meeting requirements of NEMA Premium Efficiency Motor Program. Efficiency of the motor shall be determined based on the NEMA MG1. The nominal efficiencies shall meet or exceed Table 12-12.

Nominal Efficiencies For "NEMA Premium™" Induction Motors
Rated 600 Volts or Less (Random Wound)

HP	Open Drip-Proof			Totally Enclosed Fan-Cooled		
	<u>6-pole</u>	<u>4-pole</u>	<u>2-pole</u>	<u>6-pole</u>	<u>4-pole</u>	<u>2-pole</u>
1	82.5	85.5	77.0	82.5	85.5	77.0
1.5	86.5	86.5	84.0	87.5	86.5	84.0
2	87.5	86.5	85.5	88.5	86.5	85.5
3	88.5	89.5	85.5	89.5	89.5	86.5
5	89.5	89.5	86.5	89.5	89.5	88.5
7.5	90.2	91.0	88.5	91.0	91.7	89.5
10	91.7	91.7	89.5	91.0	91.7	90.2
15	91.7	93.0	90.2	91.7	92.4	91.0
20	92.4	93.0	91.0	91.7	93.0	91.0
25	93.0	93.6	91.7	93.0	93.6	91.7
30	93.6	94.1	91.7	93.0	93.6	91.7
40	94.1	94.1	92.4	94.1	94.1	92.4
50	94.1	94.5	93.0	94.1	94.5	93.0
60	94.5	95.0	93.6	94.5	95.0	93.6
75	94.5	95.0	93.6	94.5	95.4	93.6
100	95.0	95.4	93.6	95.0	95.4	94.1
125	95.0	95.4	94.1	95.0	95.4	95.0
150	95.4	95.8	94.1	95.8	95.8	95.0
200	95.4	95.8	95.0	95.8	96.2	95.4

Nominal Efficiencies For "NEMA Premium™" Induction Motors
Rated Medium Volts for 5kV or Less (Form Wound)

HP	Open Drip-Proof			Totally Enclosed Fan-Cooled		
	<u>6-pole</u>	<u>4-pole</u>	<u>2-pole</u>	<u>6-pole</u>	<u>4-pole</u>	<u>2-pole</u>
250	95.0	95.0	94.5	95.0	95.0	95.0
300	95.0	95.0	94.5	95.0	95.0	95.0
350	95.0	95.0	94.5	95.0	95.0	95.0
400	95.0	95.0	94.5	95.0	95.0	95.0
450	95.0	95.0	94.5	95.0	95.0	95.0
500	95.0	95.0	94.5	95.0	95.0	95.0

- D. Stator: Copper windings, unless otherwise indicated.
- E. Rotor: Squirrel cage, unless otherwise indicated.
- F. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA 9, L-10 life of 120,000 hours. Calculate bearing load with NEMA minimum V- belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
- G. Temperature Rise: Match insulation rating, unless otherwise indicated.

- H. Insulation: Class F, unless otherwise indicated.
- I. Code Letter Designation:
 - 1. Motors 10 HP and Larger: NEMA starting Code (KVA Code) F or G.
 - 2. Motors Smaller Than 10 HP: Manufacturer's standard starting characteristic.
 - 3. Fire Pump Motors: NEMA starting Code (KVA Code) B.
- J. Enclosure: Cast iron for motors 7.5 hp and larger; rolled steel for motors smaller than 7.5 hp.
 - 1. Finish: Gray enamel.
- K. Sound Level: Not to exceed NEMA MG-1 12.54.

2.05 **POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS**

- A. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - 2. Premium-Efficient Motors: Class B temperature rise; Class F insulation.
- B. Shaft Grounding: Provide a means to protect motor from common mode currents.
 - 1. Required for:
 - a. Motors used with variable frequency controllers.
 - b. Motors 100 HP and larger.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Electro Static Technology, Inc.; Aegis SGR Conductive Microfiber.
- C. Source Quality Control: Perform the following tests on each motor according to NEMA MG 1:
 - 1. Measure winding resistance.
 - 2. Read no-load current and speed at rated voltage and frequency.
 - 3. Measure locked rotor current at rated frequency.
 - 4. Perform high-potential test.

2.06 **ELECTRONICALLY COMMUTATED MOTOR (ECM)**

- A. Furnish for equipment where specified or scheduled with ECM.
 - 1. Synchronous, constant torque, ECM with permanent magnet rotor. Rotor magnets to be time-stable, nontoxic ceramic magnets (Sr-Fe).
 - 2. Driven by a frequency converter with an integrated power factor correction filter. Conventional induction motors will not be acceptable.
 - 3. Each motor with an integrated variable-frequency drive, tested as one unit by manufacturer.
 - 4. Motor speed adjustable over full range from 0 rpm to maximum scheduled speed.
 - 5. Variable motor speed to be controlled by a 0- to 10 V-dc or 4- to 20-mA input.
 - 6. Integrated motor protection verified by UL to protect equipment against over-/undervoltage, overtemperature of motor, electronics, or both, overcurrent, locked rotor, and dry run (no-load condition).

2.07 SINGLE-PHASE MOTORS

- A. Type: One of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
 - 2. Split-phase start, capacitor run.
 - 3. Capacitor start, capacitor run.
- B. Shaded-Pole Motors: For motors 1/20 hp and smaller only.
- C. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.
- D. Bearings: Ball type for belt-connected motors and other motors with high radial forces on motor shaft; sealed, prelubricated-sleeve type for other single-phase motors.

2.08 ENCLOSED CONTROLLERS

- A. Provide enclosed controllers in accordance with requirements specified in Division 26 Section "Enclosed Controllers".

2.09 ENCLOSED SWITCHES AND CIRCUIT BREAKERS

- A. Provide enclosed switches and circuit breakers in accordance with requirements specified in Division 26 Section "Enclosed Switches and Circuit Breakers".

2.10 FUSES

- A. Provide fuses in accordance with requirements specified in Division 26 Section "Fuses".

PART 3 EXECUTION

3.01 FIELD QUALITY CONTROL

- A. All three phase motors 1/2 HP and above shall be tested by the Testing Agency.
- B. Prepare for acceptance tests as follows:
 - 1. Check motor nameplates for horsepower, speed, phase and voltage.
 - 2. Check coupling alignment and shaft end play.
 - 3. Run each motor with its controller. Demonstrate correct rotation, alignment, and speed at motor design load.
 - 4. Test interlocks and control features for proper operation.
 - 5. Verify that current in each phase is within nameplate rating.
- C. Testing: Engage a qualified testing agency to perform the following field quality-control testing:
 - 1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.15.1. Certify compliance with test parameters.
 - 2. Jog motor as required to verify proper phase and shaft rotation. Immediately after start-up, check bearing temperature and smooth operation. Take current reading at full load using a clamp-on ammeter. If ammeter reading is over the rated full load current, determine reason for discrepancy and take necessary corrective actions. Record all readings, motor nameplate data and overload heater data.
 - 3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.02 ADJUSTING

- A. Align motors, bases, shafts, pulleys and belts. Tension belts according to manufacturer's written instructions.

3.03 **CLEANING**

- A. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. Clean motors, on completion of installation, according to manufacturer's written instructions.

END OF SECTION

SECTION 20 0519 - METERS AND GAGES

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 22 Section "Domestic Water Piping" for domestic water service meters inside the building.

1.02 DEFINITIONS

- A. CR: Chlorosulfonated polyethylene synthetic rubber.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.
- C. FPR: Fiberglass reinforced plastic.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated; include performance curves.

1.04 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: Schedule for the following indicating manufacturer's number, scale range, and location for each:
 - 1. Thermometers.
 - 2. Gages.
 - 3. Flowmeters.
 - 4. Thermal-energy meters.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For the following to include in operation and maintenance manuals:
 - 1. Flowmeters.
 - 2. Thermal-energy meters.

1.06 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.

- B. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," and NSF 372 Drinking Water System Components – Lead Content for potable domestic water piping and components.

PART 2 PRODUCTS

2.01 MANUFACTURERS

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

2.02 METAL-CASE, LIQUID-IN-GLASS THERMOMETERS

- A. Manufacturers:
 - 1. AMETEK, Inc.; U.S. Gauge Div.
 - 2. Miljoco Corporation.
 - 3. REOTEMP Instrument Corporation.
 - 4. Trerice, H. O. Co.
 - 5. Weiss Instruments, Inc.
 - 6. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
- B. Case: Die-cast aluminum or Chrome-plated brass, 9 inches long.
- C. Tube: Red, blue, or green reading, organic liquid filled, with magnifying lens.
- D. Tube Background: Satin-faced, nonreflective aluminum with permanent scale markings.
- E. Window: Glass or plastic.
- F. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.
- G. Stem: Copper-plated steel, aluminum, or brass for thermowell installation and of length to suit installation.
- H. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.03 THERMOWELLS

- A. Manufacturers: Same as manufacturer of thermometer being used.
- B. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer. Brass for compatible services less than 353 degrees F; ANSI 18-8 stainless steel for all others to suit service. Furnish extension neck to accommodate insulation where applicable.

2.04 PRESSURE GAGES

- A. Manufacturers:
 - 1. AMETEK, Inc.; U.S. Gauge Div.
 - 2. Cambridge.
 - 3. Dwyer Instruments, Inc.
 - 4. Marsh Bellofram.
 - 5. Miljoco Corporation.
 - 6. Trerice, H. O. Co.
 - 7. Weiss Instruments, Inc.
 - 8. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
- B. Direct-Mounting, Dial-Type Pressure Gages: Indicating-dial type complying with ASME B40.100.
 - 1. Case: Stainless steel, aluminum, or FRP, 6-inch diameter.
 - 2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
 - 3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
 - 4. Movement: Mechanical, with link to pressure element and connection to pointer.
 - 5. Dial: Satin-faced, nonreflective aluminum with permanent scale markings.
 - 6. Pointer: Red or other dark-color metal.
 - 7. Window: Glass or plastic.
 - 8. Ring: Stainless steel or chrome plated metal.
- C. Accuracy: Grade A, plus or minus 1 percent of middle half scale. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.

2. Water: 0-100 PSIG (1 psi divisions to 50 psi; 5 psi divisions above 50 psi), liquid filled.
 3. Range for Fluids under Pressure: 1-1/2 times expected working pressure. If not a standard scale, select next largest scale.
- D. Pressure-Gage Fittings:
1. Valves: NPS 1/4 brass ball type.
 2. Syphons: NPS 1/4 coil of brass tubing with threaded ends.
 3. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.
- 2.05 **TEST PLUGS**
- A. Manufacturers:
1. Peterson Equipment Co., Inc.
 2. Miljoco Corporation.
- B. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping.
- C. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F for cold services, and 500 psig at 275 deg F for hot services.
- D. Core Inserts: One or two self-sealing rubber valves.
1. Insert material for air, water, oil, or gas service at 20 to 200 deg F shall be Neoprene.
 2. Insert material for air or water service at minus 30 to plus 275 deg F shall be Nordel.
- E. Test Kit: Furnish test kit(s) containing one pressure gage and adaptor, thermometer(s), and carrying case. Pressure gage, adapter probes, and thermometer sensing elements shall be of diameter to fit test plugs and of length to project into piping.
1. Pressure Gage: Small bourdon-tube insertion type with 2- to 3-inch- diameter dial and probe. Dial range shall be 0 to 200 psig.
 2. Low-Range Thermometer: Small bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial ranges shall be 25 to 125 deg F.
 3. High-Range Thermometer: Small bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial ranges shall be 0 to 220 deg F.
 4. Carrying case shall have formed instrument padding.
- 2.06 **MAGNETIC INDUCTIVE FLOWMETER**
- A. Manufacturers:
1. Badger Meter, Inc.; Magnetoflow with Primo Amplifier.
 2. Emerson Process Management; Rosemount Division.
- B. Description: Magnetic inductive flowmeter and amplifier for measuring the flow of conductive liquids, with flanged ends, suitable for in-line installation.
- C. Accuracy: 0.25 percent of rate at 1 to 39 fps.
- D. Pressure Limits: 150 psi.
- E. Ambient Temperature Limits: Minus 4 deg F to 140 deg F.
- F. Liner Material:
1. Meter Sizes NPS 1/4 to NPS 3/8: PFA.
 2. Meter Sizes NPS 1/2 to NPS 24: PTFE.
 3. Meter Sizes NPS 1 to NPS 54: Soft and hard rubber.
 4. Meter Sizes NPS 14 to NPS 36: Halar.
 5. NSF Listed Meters Sizes NPS 4 and Larger: Hard Rubber.
- G. Measured Fluid Temperature Limits:
1. Remote Amplifier:
 - a. PFA, PTFE, and Halar Liners: 311 deg F.
 - b. Rubber Liner: 178 deg F.
 2. Meter Mounted Amplifier:
 - a. PFA, PTFE, and Halar Liners: 212 deg F.
 - b. Rubber Liner: 178 deg F.
- H. Flowmeter:
1. Meter Housing Material: Carbon steel, welded.
 2. Flanges: Carbon steel, ANSI B16.5 Class 150 raised face.
 3. Pipe Spool Material: Type 316 stainless steel.

- 4. Electrode Material: Type 316 stainless steel.
 - I. Meter Enclosure Classification: NEMA 4.
 - J. Junction Box Enclosure: Die-cast aluminum with powder coat finish. NEMA 4.
 - K. Amplifier: Microprocessor based with back-lit LCD display in cast aluminum, powder coated NEMA 4X enclosure suitable for either remote wall mounting or mounting on meter, and with:
 - 1. Digital and analog outputs.
 - 2. Bidirectional flow sensing/totalization.
 - 3. Automatic zero-point stability.
 - 4. Empty pipe detection.
 - 5. RS232 serial communication.
 - 6. 115 VAC, 60 Hz power supply.
- 2.07 **MAGNETIC INDUCTIVE FLOWMETER (INSERTION TYPE)**
- A. Manufacturers:
 - 1. KOBOLD Instruments Inc.; Model PME-12R40.
 - 2. KROHNE Inc.
 - B. Description: Magnetic inductive flowmeter for measuring the flow of conductive liquids in pipes and suitable for installation in pipes size NPS 1-1/2 to NPS 12.
 - C. Input Power: 24 VDC, 2.5 watts.
 - D. Current Output: 4-20mA, active bi-directional measurement, output always positive.
 - E. Temperature Ratings:
 - 1. Ambient Temperature: 140 deg F maximum.
 - 2. Measured Fluid Temperature: 0 to 212 deg F.
 - F. Pressure Rating: 230 psig at 75 deg F.
 - G. Transmitter Span: 1-5 meters/second (adjustable).
 - H. Accuracy: Plus or minus 2 percent of velocity at the measuring electrode.
 - I. Repeatability: Plus or minus 2 percent of measured value.
 - J. Noise Immunity: CE per EN 50081-1-2 and EN 50082-1-2.
 - K. Electrical Protection (Enclosure) Type: NEMA 4X/IP 65.
 - L. Wetted Parts:
 - 1. Sensor Tip: PVDF with Viton O-ring.
 - 2. Electrodes: Type 316 L stainless steel.
 - 3. Flow Transmitter: Provided with Type 316L stainless steel weld sleeve.
 - 4. Sealing Ring: Buna-N.
 - M. Case: Aluminum, epoxy powder coated.

PART 3 EXECUTION

3.01 THERMOMETER APPLICATIONS

- A. Provide the following temperature ranges for thermometers:
 - 1. Domestic Hot Water: 30 to 180 deg F, with 2-degree scale divisions.
 - 2. Domestic Cold Water: 30 to 130 deg F, with 2-degree scale divisions.

3.02 GAGE APPLICATIONS

- A. Install dry-case-type pressure gages on inlet and outlet of each pressure-reducing valve.
- B. Install liquid-filled-case-type pressure gages at suction and discharge of each pump.

3.03 INSTALLATIONS

- A. Install direct-mounting thermometers and adjust vertical and tilted positions.
- B. Install thermowells with socket extending to center of pipe and in vertical position in piping tees where thermometers are indicated.
- C. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.
- D. Install ball valve and snubber fitting in piping for each pressure gage for fluids (except steam).
- E. Install test plugs in tees in piping.
- F. Install flow indicators, in accessible positions for easy viewing, in piping systems.
- G. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters as prescribed by manufacturer's written instructions.
- H. Install flowmeter elements in accessible positions in piping systems.

- I. Install differential-pressure-type flowmeter elements with at least minimum straight lengths of pipe upstream and downstream from element as prescribed by manufacturer's written instructions.
 - J. Install wafer-orifice flowmeter elements between pipe flanges.
 - K. Install permanent indicators on walls or brackets in accessible and readable positions.
 - L. Install connection fittings for attachment to portable indicators in accessible locations.
 - M. Mount meters on wall if accessible; if not, provide brackets to support meters.
- 3.04 **CONNECTIONS**
- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance for meters, gages, machines, and equipment.
 - B. Connect flowmeter-system elements to meters.
 - C. Connect flowmeter transmitters to meters.
 - D. Connect thermal-energy-meter transmitters to meters.
 - E. Ground equipment according to Division 26 Section "Grounding and Bonding."
 - F. Connect wiring according to Division 26 Section "Conductors and Cables."
- 3.05 **ADJUSTING**
- A. Calibrate meters according to manufacturer's written instructions, after installation.
 - B. Adjust faces of meters and gages to proper angle for best visibility.
- END OF SECTION**

SECTION 20 0529 - HANGERS AND SUPPORTS

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
 - 2. Division 20 Section "Mechanical General Requirements."
 - 3. Division 20 Section "Basic Mechanical Materials and Methods."
 - 4. Division 20 Section "Mechanical Vibration Controls" for vibration isolation devices.
 - 5. Division 23 Section(s) "Metal Ducts" for duct hangers and support.

1.02 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry Inc.
- B. MFMA: Metal Framing Manufacturers Association.

1.03 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.04 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel pipe hangers and supports.
 - 2. Thermal-hanger shield inserts.

1.05 INFORMATIONAL SUBMITTALS

- A. Shop Drawings Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers. Include Product Data for components.
 2. Metal framing systems. Include Product Data for components.
 3. Pipe stands. Include Product Data for components.
 4. Equipment supports.
- 1.06 **QUALITY ASSURANCE**
- A. MSS Standards: Pipe hangers, supports, and accessories shall comply with the following:
1. MSS SP-58, Pipe Hangers and Supports – Materials, Design and Manufacture, Selection, Application, and Installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

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

2.02 HANGER ROD MATERIAL

- A. Threaded, hot rolled, steel rod conforming to ASTM A 36 or A575.
1. Rod continuously threaded.
 2. Use of rod couplings is prohibited.

2.03 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article, and schedules and details on the Drawings for where to use specific hanger and support types.
1. Hangers and Supports for Fire Protection Piping: UL listed or FMG approved.
- B. Manufacturers:
1. Anvil; ASC Engineered Solutions.
 2. B-Line by Eaton.
 3. Carpenter & Paterson, Inc.
 4. Hilti USA.
 5. nVent Electric plc; CADDY.
 6. PHD Manufacturing, Inc.
- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.04 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.05 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Manufacturers:
1. Anvil; Anvil-Strut; ASC Engineered Solutions.
 2. B-Line by Eaton.
 3. nVent Electrical plc; ERISTRUT Div.
 4. Power-Strut; a part of Atkore International.
 5. Unistrut; a part of Atkore International.
 6. Hilti USA.
- C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
- D. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- E. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.06 METAL INSULATION SHIELDS

- A. Manufacturers:
1. Anvil; ASC Engineered Solutions.
 2. B-Line by Eaton.
 3. Carpenter & Paterson, Inc.

4. nVent Electric plc; CADDY.
 5. PHD Manufacturing, Inc.
 - B. Description: MSS SP-58, Type 40, protective shields. Shields shall span an arc of 180 degrees.
 - C. Shield Dimensions for Pipe: Not less than the following:
 1. NPS 1/4 to NPS 2: 12 inches long and 0.048 inch thick.
- 2.07 **PIPE COVERING PROTECTION SADDLES**
- A. Manufacturers:
 1. Anvil; ASC Engineered Solutions.
 2. B-Line by Eaton.
 3. Carpenter & Paterson, Inc.
 4. nVent Electric plc; CADDY.
 5. PHD Manufacturing, Inc.
 - B. Description: MSS SP-58, Type 39A and Type 39B, for suspension of insulated hot pipe where heat losses are to be kept to a minimum.
 1. Saddles shall match insulation thickness.
 2. Saddle length: 12 inches.
 3. Furnish with center rib for pipe sized NPS 12 and larger.
- 2.08 **PLASTIC INSULATION SHIELDS**
- A. Manufacturers:
 1. Anvil; ASC Engineered Solutions.
 2. Armacell LLC; Insuguard.
 3. B-Line by Eaton; Snap'N Shield.
 4. Hydra-Zorb Company; Bronco.
 - B. Description: Polypropylene copolymer protective shields with modular elements designed to snap directly onto strut channel, clevis hangers, or structural members. Shields shall span an arc of 180 degrees.
 1. Operating Temperature Range: Minus 40 deg F to plus 178 deg F.
 - C. Certifications:
 1. UL Classified for USA: UL-723 (ASTM E 84).
 2. UL listed for Canada: ULC-S102.2.
 3. Meets UL94 HB flammability standards.
 - D. Shield Dimensions for Pipe: Not less than the following:
 1. NPS 1/4 to NPS 4: 12 inches long.
- 2.09 **THERMAL-HANGER SHIELDS**
- A. Manufacturers:
 1. American Mechanical Insulation Sales Inc. (AMIS).
 2. B-Line by Eaton.
 3. nVent Electric plc; CADDY.
 4. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
 5. Rilco Manufacturing Company, Inc.
 6. Value Engineered Products, Inc.
 - B. Description: Manufactured assembly consisting of insulation insert encased in 360 degree sheet metal shield.
 1. Minimum Compressive Strength of Insert Material:
 - a. 100-psig- for sizes smaller than NPS 6.
 - b. 600-psig- for sizes NPS 6 and larger.
 - C. Insulation-Insert Material for Cold Piping: Full 360 degree, water-repellent treated, ASTM C 533, Type I calcium silicate with vapor barrier.
 - D. Insulation-Insert Material for Hot Piping: Full 360 degree, water-repellent treated, ASTM C 533, Type I calcium silicate.
 - E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.
 - F. Include carbon steel ASTM A36 load distribution plates as required by load, pipe movement, hanger style, and hanger spacing.
 - G. Thermal-Hanger Shields for Flexible Foamed Elastomeric Insulated Piping:

1. Manufacturer:
 - a. B-Line by Eaton/Armacell; Armafix IPH.
 - b. Aeroflex USA, Inc.; Aerofix-U.
 - c. ZSi-Foster, Inc.; Cush-A-Therm.
 2. Insulation-Insert Material for Copper Piping with Flexible Foamed Elastomeric Insulation: Use the following:
 - a. Flexible foamed elastomeric, ASTM 534, Type I-Tubular Grade 1 with PUR/PIP support inserts.
- H. Thermal-Hanger Shields for Small Diameter Piping:
1. Manufacturer:
 - a. Hydra-Zorb Company; Klo-Shure Insulation Couplings.
 2. Insulation-Insert Material for Small Diameter Piping with Flexible Foamed Elastomeric or Glass Fiber Insulation: Use the following:
 - a. Rigid Hyrel thermoplastic insulation coupling designed for use with pipe or tube NPS 4 and smaller, and insulation from 3/8 inch to 1-1/2 inch thick.
- 2.10 **FASTENER SYSTEMS**
- A. Post-Installed Anchors:
1. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - a. Manufacturers:
 - 1) B-Line by Eaton.
 - 2) DeWalt Engineered by Powers.
 - 3) Hilti, Inc.
 - 4) ITW Ramset/Red Head.
 - 5) MKT Fastening, LLC.
 2. Internally Threaded Screw Anchors: Internally threaded, self-tapping screw anchor designed for performance in cracked and uncracked concrete. Suitable base materials include normal-weight concrete, sand-lightweight concrete and concrete over steel deck.
 - a. UL Listed or FMG approved for fire sprinkler piping.
 - b. Available Sizes: For 1/4- inch, 3/8- inch, and 1/2- inch diameter rod sizes
 - c. Manufacturers:
 - 1) B-Line by Eaton; Rapid Rod Hangers.
 - 2) DeWalt Engineered by Powers; Snake+.
 3. Chemical Fasteners: Insert-type-stud bonding system anchor for use with hardened portland cement concrete, and tension and shear capacities appropriate for application. Exception: Do not use chemical fasteners to support hanger systems for fire protection piping.
 - a. Manufacturers:
 - 1) DeWalt Engineered by Powers.
 - 2) Hilti, Inc.
 - 3) ITW Ramset/Red Head.
 - 4) MKT Fastening, LLC.
 - b. Bonding Material: ASTM C 881, Type IV, Grade 3, 2-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
 - c. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud, unless otherwise indicated.
 - d. Washer and Nut: Zinc-coated steel.
- 2.11 **ROOF MOUNTED PIPING SUPPORTS**
- A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Low, Fixed-Height, Single-Base Stand: Assembly of base and horizontal member, and pipe support, for roof installation without membrane penetration.
1. Manufacturers:

- a. B-Line by Eaton; Dura-Blok.
 - b. Eco Support Products.
 - c. MIFAB, Inc.; C-Port.
 - d. MIRO Industries; Conduit and Condensate Supports, and Rooftop Sleeper Support.
 - e. nVent Electric plc; CADDY.
 - f. Portable Pipe Hangers.
2. Base: Plastic, stainless steel, or recycled rubber.
 3. Horizontal Member: Cadmium-plated-steel or galvanized-steel strut designed for use with standard strut clamps and accessories.
- C. Low, Adjustable-Height, Single-Base Stand: Assembly of base, horizontal member, and adjustable vertical members, and pipe support, for roof installation without membrane penetration.
- 2.12 **ROOF MOUNTED EQUIPMENT SUPPORTS**
- A. Equipment Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted equipment.
- B. Non-Penetrating Equipment Supports: Assembly of two or more bases and horizontal members, for roof installation without membrane penetration.
1. Manufacturers:
 - a. B-Line by Eaton; Dura-Blok.
 - b. Eco Support Products.
 - c. MIFAB, Inc.; C-Port.
 - d. MIRO Industries; HD and LD Mechanical Unit Supports.
 - e. nVent Electric plc; CADDY.
 - f. Portable Pipe Hangers.
 2. Base: Plastic, stainless steel, or recycled rubber.
 3. Horizontal Member: Cadmium-plated-steel, galvanized-steel, or stainless steel strut, and planking; designed for use with standard strut clamps, all-thread rod, and accessories.
- C. Roof Rail-Type Equipment Stands: Welded 18 gage galvanized steel shell, base plate and counter flashing. Factory installed chemically treated wood nailer. Fully mitered end sections. Internal bulkhead reinforcement.
1. Roof Rail Type Supports: Coordinate installation and type with Architectural Trades. Top shall be level and extend a minimum of 10 inches above top of roof insulation.
 - a. Manufacturers:
 - 1) Pate.
 - 2) Thybar; TEMS Series.
 - 3) Roof Products and Systems.
 - 4) Greenheck.
 - 5) Creative Metals.
- 2.13 **EQUIPMENT SUPPORTS**
- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.
- 2.14 **MISCELLANEOUS MATERIALS**
- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
1. Properties: Nonstaining, noncorrosive, and nongaseous.
 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 EXECUTION

3.01 HANGER AND SUPPORT APPLICATIONS

- A. Refer to application schedules on the Drawings.
- B. For insulated pipe, oversize hanger elements to accommodate insulation thickness.
- C. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- D. Comply with MSS SP-58 for pipe hanger selections and applications that are not specified in piping system Sections.

- E. Use hangers and supports with galvanized, metallic coatings for outdoor applications or where exposed to outdoor conditions.
- F. Use hangers and supports with plastic coating, or galvanized metallic coatings for applications in corrosive atmospheres.
- G. Use metal framing, with plastic coating, or galvanized metallic coatings for metal framing in corrosive atmospheres.
- H. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- I. Use padded hangers for piping that is subject to scratching.
- J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. MSS Type 8 or spring type to meet system requirements.
- K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 - 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 - 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 - 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 - 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- L. Concrete Structure Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Anchor Devices, Concrete and Masonry: in accordance with Group I, Group II, Type 2, Class 2, Style 1 and Style 2, Group III and Group VIII or FS FF-S-325A. Furnish cast-in floor type equipment anchor devices with adjustable positions. Furnish built in anchor devices for masonry, unless otherwise approved by the Architect. Powder actuated anchoring devices shall not be used to support any mechanical systems components.
 - 2. Inserts, Concrete: TYPE 18 or 19. When applied to loads equivalent to piping in sizes NPS 2 and larger, and where otherwise required by imposed loads, a one foot length of 1/2 inch reinforcing rod shall be inserted and wired through wing slots. Proprietary type continuous inserts may be proposed and shall be submitted for approval.
 - 3. Use mechanical-expansion anchors where required in concrete construction.
 - 4. Use chemical fasteners where required in concrete construction.
- M. Steel Frame Structure Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Beam Clamps:
 - a. Center Loading: TYPE 21, 28, 29 and 30, unless otherwise indicated. Type 27 shall be allowed to support single pipes NPS 6 size or smaller only.
 - b. "C" Clamps: Type 19, 20 or 23, for supporting single pipes NPS 2-1/2 size or smaller only. Use of "C" clamps, or beam clamps of "C" pattern, or any modification thereof, is prohibited for supporting multiple pipes or pipes larger than NPS 2-1/2.
- N. Hanger-Rod Attachments for Wood Construction: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. All Steel Ceiling Plates: UL listed and suitable for attachment to wood beams. For pipe sizes NPS 1/2 to NPS 2. Install in accordance with manufacturer's instructions to maintain listing.
 - 2. Threaded Side Beam Brackets: UL listed and FMG approved, suitable for attachment to wood beams. For pipe sizes NPS 2 to NPS 4. Install in accordance with manufacturer's instructions to maintain listing.
- O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Use spring supports and sway braces TYPES 48, 49, 50, 51, 52, 53, 54, 55 or 56. For specific points:
 - a. Provide spring supports at point of support where vertical movement will occur.

- b. For light loads and vertical movement less than 1/4 inch, TYPES 48 or 49 spring cushion supports.
 - c. For vertical movements in excess of 1/4 inch but less than 1/2 inch, TYPES 51, 52 or 53 variable spring supports shall be used, loaded to not more than 75 percent of published load rating.
 - d. For vertical movements of 1/2 inch and more, TYPES 54, 55 and 56 constant support spring hangers.
 - e. Sway braces; TYPE 50.
 - f. Variable spring hangers in accordance with referenced MSS Standards with "medium" allowable load change.
- P. Comply with MSS SP-58 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- Q. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

3.02 **HANGER AND SUPPORT INSTALLATION**

- A. Steel Pipe Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structural frame.
- B. Provide necessary piping and equipment supporting elements including: building structure attachments, supplementary steel, hanger rods, stanchions and fixtures, vertical pipe attachments, horizontal pipe attachments, anchors, guides, spring supports in accordance with the referenced codes, standards, and requirements specified. Support piping and equipment from building structure, not from roof deck, floor slab, other pipe, duct or equipment.
- C. At connections between piping systems, hangers and equipment of dissimilar metals, insulate, using dielectric insulating material, nonferrous piping against direct contact with the building steel by insulating the contact point of the hanger and pipe or the hanger and building steel. Test each point of dielectric insulation with an ohm meter to ensure proper isolation of dissimilar materials. Test shall be observed by the Owner's Representative and/or Architect.
- D. Use copper plated or plastic coated supporting element in contact with copper tubing or glass piping.
- E. File and paint cut ends and shop or field prime paint supporting element components.
- F. Secure Type 40 shields to support elements in a manner that prevents movement and damage to insulation and jacket materials.
- G. Hang piping parallel with the lines of the building, unless otherwise indicated. Route piping in an orderly manner and maintain gradient. Space piping and components so a threaded pipe fitting may be removed between adjacent pipes and so there will be not less than 1/2 inch of clear space between finished surfaces and piping. Arrange hangers on adjacent parallel service lines in line with each other.
- H. Flange loads on connected equipment shall not exceed 75 percent of maximum allowed by equipment manufacturer. Flange loads in liquid containing systems shall be checked in the presence of the Architect when piping is full of liquid. No flange load is allowed on pumps, vibration isolated equipment or flexible connectors.
- I. Spring supports, within specified limitations: Constant support type, where necessary to avoid transfer of load from support to support or onto connected equipment; otherwise, variable support type located at points subject to vertical movement.
- J. Where necessary, brace piping and supports against reaction, sway and vibration.
- K. Do not hang piping from joist pans, floor decks, roof decks, equipment, ductwork, or other piping.
- L. Install turnbuckles, swing eyes and clevises to accommodate temperature changes, pipe accessibility, and adjustment for load pitch. Rod couplings are not acceptable.
- M. Install hangers and supports for piping at intervals specified, at locations not more than 3 feet from the ends of each runout, not more than 3 feet from connections to equipment, and not over 25 percent of specified interval from each change in direction of piping and for concentrated loads such as valves, etc.
- N. Base the load rating for pipe support elements on loads imposed by insulated weight of pipe filled with water. The span deflection shall not exceed slope gradient of pipe.

- O. If structural steel, roofs, or tunnels will allow support spacing greater than that shown above, Contractor shall submit proposed support system along with structural calculations documenting the allowance of such spacing, in accordance with ANSI, B31.1, and MSS Guidelines.
- P. Support vertical risers independently of connected horizontal piping whenever practical, with supports at the base and at intervals to accommodate system range of load with thermal conditions. Support vertical risers at each floor penetration for piping in shafts or chases. Guide for lateral stability. Fit horizontal piping connected to moving risers with two spring supports connected adjacent to riser, spaced according to required hanger spacing.
- Q. For risers at temperatures of 100 deg F or less place riser clamps under fittings. Support carbon steel pipe at each operating level or floor and at not more than 15-foot intervals for pipe 2 inches and smaller, and at not more than 20 foot intervals for pipe 2-1/2 inches and larger.
- R. After the piping systems have been installed, tested and placed in satisfactory operation, firmly tighten hanger rod nut and jam nut and upset threads to prevent movement of fasteners.
- S. Attach pipe anchors and pipe alignment guides to the building structure where indicated. If not indicated, the method used is optional to the Contractor, subject to approval by the Architect. In the case of structural steel, make attachment by clamping in accordance with the American Institute of Steel Construction Specification for the Design, Fabrication and Erection of Structural Steel for Building.
- T. Attach supporting elements connected to structural steel columns to preclude vertical slippage and cascading failure.
- U. Attach pipe hangers and other supporting elements to roof purlins and trusses at panel points.
- V. Where eccentric loading beam clamps are approved and where other work is supported by similar eccentric loading support element from the same structural member, locate eccentric loading support elements to minimize structural member torsion load.
- W. Limit the location of supporting elements for piping and equipment, when supported from roof, to panel points of the bar joists.
- X. Building structure shall not be reinforced except as approved by the Architect in writing.
- Y. Use approved cast-in-place inserts or built-in anchors for attachment to concrete structure. Size inserts and anchors for the total applied load with a safety factor in accordance with applicable codes but in no case less than 5. Coordinate installation of all imbedded items in accordance with manufacturer's instructions. Position anchorage and imbedded items as indicated and/or where required and support against displacement during placing of concrete. Cutting or repositioning of concrete beam or girder or reinforcing steel to accommodate inserts will not be allowed. Provide removable closures in imbedded device openings to prevent entry of concrete.
- Z. Support piping and equipment from concrete building frame, not from roof or floor slabs unless otherwise indicated.
- AA. Use cast-in-place inserts in concrete beams and girders. Drilled anchors/wedge type inserts shall be used on vertical surfaces only. Coordinate with structural engineer.
- BB. Attach piping supports to the side of concrete beams and concrete joist. Provide supplementary support steel as required. Cast-in-place or drilled anchors will not be permitted in the bottom of concrete beams and concrete joist.
- CC. Attach piping supports to the side of concrete beams or concrete joist. Where intermediate hangers are required to meet the hanger spacing schedule, the Contractor may propose attachment of intermediate pipe supports to the bottom of the concrete slab pending submittal of a satisfactory pull out test. The Contractor shall submit pull out test criteria, pull out test results, proposed hanger detail and hanger point loads to the Architect for written approval.
- DD. Trapeze Pipe Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- EE. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

- FF. Fastener System Installation:
 - 1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
 - GG. Roof-Mounting Pipe and Equipment Stand Installation:
 - 1. Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 - 2. Curb or Rail Mounting Type Stands: Assemble components or fabricate stand and mount on permanent, stationary roof curb or rail. Refer to Division 07 Section "Roof Accessories" for curb and rail installation.
 - 3. Maintain support manufacturer's recommended spacing.
 - HH. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
 - II. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
 - JJ. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
 - KK. Install lateral bracing with pipe hangers and supports to prevent swaying.
 - LL. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
 - MM. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
 - NN. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.
 - OO. Refer to individual piping sections for hanger spacing and hanger rod sizes.
- 3.03 **EQUIPMENT SUPPORTS**
- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
 - B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
 - C. Provide lateral bracing, to prevent swaying, for equipment supports.
- 3.04 **METAL FABRICATIONS**
- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers.
 - B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
 - C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.
- 3.05 **ADJUSTING**
- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
 - B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.
- 3.06 **PAINTING**
- A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
 - B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.

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- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 20 0547 - MECHANICAL VIBRATION CONTROLS

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."

1.02 ACTION SUBMITTALS

- A. Product Data: Include load deflection curves for each vibration isolation device.

1.03 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: Signed and sealed by a qualified professional engineer. Include the following:
 - 1. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.
 - 2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, and spring deflection changes. Include certification that riser system has been examined for excessive stress and that none will exist.
 - 3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.

1.04 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. Installation of these items is specified in Division 07 Section "Roof Accessories."

PART 2 PRODUCTS

2.01 VIBRATION ISOLATION EQUIPMENT BASES

- A. **Type A:** Direct Isolator Attachment
 - 1. Unit to be isolated is so constructed that vibration isolators of the type specified may be directly attached, provided that the edge deflection of the isolated unit base over unsupported span between mountings does not exceed specified or manufacturer's limits. If units to be isolated will not meet required deflection provisions, Type B bases shall be provided.
- B. **Type B:** Factory-fabricated, welded, structural-steel bases or rails.

1. Structural Steel Bases:
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type WF or a comparable product by one of the following:
 - 1) Amber/Booth; a VMC Group Company.
 - 2) Kinetics Noise Control, Inc.
 - 3) Korfund Dynamics; a VMC Group Company.
 - 4) Vibration Eliminator Co., Inc.
 - 5) Vibration Isolation Co., Inc. (Pump Bases Only)
 - 6) Vibration Mountings & Controls; a VMC Group Company.
 - 7) Vibro-Acoustics.
 - b. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails. Include supports for suction and discharge elbows for pumps.
 - c. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
 - d. Support Brackets: Factory-welded steel angles on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
 2. Structural-Steel Rails:
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type ICS or a comparable product by one of the following:
 - 1) Amber/Booth; a VMC Group Company.
 - 2) Kinetics Noise Control, Inc.
 - 3) Korfund Dynamics; a VMC Group Company.
 - 4) Vibration Eliminator Co., Inc.
 - 5) Vibration Isolation Co., Inc. (Pump Bases Only)
 - 6) Vibration Mountings & Controls; a VMC Group Company.
 - 7) Vibro-Acoustics.
 - b. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails. Include supports for suction and discharge elbows for pumps.
 - c. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
 - d. Support Brackets: Factory-welded steel angles on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
- C. **Type C** Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for field-applied, cast-in-place concrete.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type BMK/KSL or a comparable product by one of the following:
 - a. Amber/Booth; a VMC Group Company.
 - b. Kinetics Noise Control, Inc.
 - c. Korfund Dynamics; a VMC Group Company.
 - d. Vibration Eliminator Co., Inc.
 - e. Vibration Isolation Co., Inc. (Pump Bases Only)
 - f. Vibration Mountings & Controls; a VMC Group Company.
 - g. Vibro-Acoustics.
 2. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails. Include supports for suction and discharge elbows for pumps.
 3. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
 4. Support Brackets: Factory-welded steel angles on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
 5. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

- D. **Type D** Curb Mounted Aluminum Bases:
1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type CMAB or a comparable product by one of the following:
 - a. Kinetics Noise Control, Inc.
 - b. ThyCurb/Thybar.
 - c. Vibro-Acoustics.
 - d. Vib-Iso.
 2. Description: Factory-assembled, fully enclosed, insulated, air- and watertight curb rail designed to resiliently support equipment.
 3. Upper Frame: Corrosion resistant extruded aluminum. Upper frame shall overlap lower frame for water runoff. Mitered ends heliarc welded to prevent water leakage through corners.
 4. Lower Frame: Corrosion resistant extruded aluminum. Lower framed shall overlap roof curb for water runoff. Mitered ends heliarc welded to prevent water leakage through corners.
 5. Safety Stops: Neoprene, mounted in corners of lower frame for extreme wind conditions and mild seismic disturbances under normal conditions.
 6. Isolators: Cadmium plated free-standing springs with positive spring retainer and flexible ties.
 7. Splicing Kit: Required for bases shipped in multiple pieces.
 8. Weatherseal: Flexible frictionless EPDM.
 9. Static Deflection: Nominal 1 inch.
- E. **Type E** Rooftop Spring Curb:
1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type RSC or a comparable product by one of the following:
 - a. Kinetics Noise Control, Inc.
 - b. ThyCurb/Thybar.
 - c. Vibro-Acoustics.
 2. Description: Factory-assembled, fully enclosed, insulated, air- and watertight curb rail designed to resiliently support equipment; and to withstand wind forces as required by local codes.
 3. Lower Support Assembly: Sheet-metal "Z" section containing adjustable and removable steel springs that support upper floating frame. Upper frame shall provide continuous support for equipment and shall be captive to resiliently resist wind forces. Lower support assembly shall have a means for attaching to building structure and a wood nailer for attaching roof materials, and shall be insulated with a minimum of 2 inches of rigid, glass-fiber insulation on inside of assembly.
 4. Spring Isolators: Adjustable, restrained spring isolators shall be mounted on 1/4-inch-thick, elastomeric vibration isolation pads and shall have access ports, for level adjustment, with removable waterproof covers at all isolator locations. Isolators shall be located so they are accessible for adjustment at any time during the life of the installation without interfering with the integrity of the roof.
 - a. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with restraint.
 - 1) Housing: Steel with resilient vertical-limit stops and adjustable equipment mounting and leveling bolt.
 - 2) Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 3) Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 4) Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
 - 5) Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - b. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers (maximum 3 layers separated by steel shims) to achieve 90 percent efficiency, molded with a nonslip pattern and galvanized steel

baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.

- 1) Material: Bridge-bearing neoprene, complying with AASHTO M 251.
- 2) Durometer Rating: 40.
5. Snubber Bushings: All-directional, elastomeric snubber bushings at least 1/4 inch thick.
6. Water Seal: Galvanized sheet metal with EPDM seals at corners, attached to upper support frame, extending down past wood nailer of lower support assembly, and counterflashed over roof materials.
7. Sound Isolation: Within perimeter of roof curb rails and as detailed on the Drawings:
 - a. Two layers of 2-inch thick board insulation, minimum 3-lb/cu. ft. density, glass fibers bonded with a thermosetting resin. Comply with ASTM C 612 Type IA or Type IB.
 - b. Two layers of 5/8-inch thick water-resistant gypsum core wall panel surfaced with paper on front, back, and long edges. Comply with ASTM C 1396.
 - c. One layer of 6-inch thick fiberglass blanket insulation.
8. Static Deflection: Nominal 1 inch, 2 inches, or 3 inches.

2.02 VIBRATION ISOLATORS

- A. **Type 1a** Elastomeric Isolator Pads: Oil- and water-resistant elastomer, arranged in single or multiple layers (maximum 3 layers separated by steel shims) to achieve 90 percent efficiency, molded with a nonslip pattern and galvanized steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type W, Super W, WSW, and WSWSW or comparable products by one of the following:
 - a. Amber/Booth; a VMC Group Company.
 - b. Kinetics Noise Control, Inc.
 - c. Korfund Dynamics; a VMC Group Company.
 - d. Vibration Eliminator Co., Inc.
 - e. Vibration Mountings & Controls; a VMC Group Company.
 - f. Vibro-Acoustics.
 2. Material: Standard neoprene for indoor applications.
 3. Material: Bridge-bearing neoprene, complying with AASHTO M 251 for outdoor applications.
- B. **Type 1b** Elastomeric Isolator Pads: Oil- and water-resistant elastomer, single layer, molded with a nonslip pattern and galvanized steel baseplates of sufficient stiffness for uniform loading over pad area, and 1/4 inch steel load bearing plate. Factory cut to sizes that match requirements of supported equipment.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type Super WMSW and MBSW or a comparable product by one of the following:
 - a. Amber/Booth; a VMC Group Company.
 - b. Kinetics Noise Control, Inc.
 - c. Korfund Dynamics; a VMC Group Company.
 - d. Vibration Eliminator Co., Inc.
 - e. Vibration Mountings & Controls; a VMC Group Company.
 - f. Vibro-Acoustics.
 2. Material: Standard neoprene for indoor applications.
 3. Material: Bridge-bearing neoprene, complying with AASHTO M 251 for outdoor applications.
- C. **Type 2** Elastomeric Mounts: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type ND or a comparable product by one of the following:
 - a. Amber/Booth; a VMC Group Company.
 - b. Kinetics Noise Control, Inc.

- c. Korfund Dynamics; a VMC Group Company.
 - d. Vibration Eliminator Co., Inc.
 - e. Vibration Mountings & Controls; a VMC Group Company.
 - f. Vibro-Acoustics.
 2. Durometer Rating: Selected for maximum possible static deflection with the loading of each piece of equipment.
 3. Materials: Cast-ductile-iron housing containing two separate and opposing, molded, bridge-bearing neoprene elements that prevent central threaded sleeve and attachment bolt from contacting the casting during normal operation.
 4. Neoprene: Bridge-bearing neoprene as defined by AASHTO.
- D. **Type 3** Spring Isolators: Freestanding, open-spring isolators.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type SLF or a comparable product by one of the following:
 - a. Amber/Booth; a VMC Group Company.
 - b. Kinetics Noise Control, Inc.
 - c. Korfund Dynamics; a VMC Group Company.
 - d. Vibration Eliminator Co., Inc.
 - e. Vibration Mountings & Controls; a VMC Group Company.
 - f. Vibro-Acoustics.
 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 100 psig.
 6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.
- E. **Type 4** Restrained Spring Isolators: Restrained single and multiple spring mounts.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Types SLR and SLRS or comparable products by one of the following:
 - a. Amber/Booth; a VMC Group Company.
 - b. Kinetics Noise Control, Inc.
 - c. Korfund Dynamics; a VMC Group Company.
 - d. Vibration Eliminator Co., Inc.
 - e. Vibration Mountings & Controls; a VMC Group Company.
 - f. Vibro-Acoustics.
 2. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4-inch- thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
 3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
- F. **Type 5** Thrust Restraints
 1. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression or tension as required, and with a load stop. Include rod and angle-iron brackets with back-up plates for attaching to equipment and ductwork.
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type WBI for fan inlet connections, and Type WBD for fan outlet connections, or comparable products by one of the following:
 - 1) Amber/Booth; a VMC Group Company.
 - 2) Kinetics Noise Control, Inc.

- 3) Korfund Dynamics; a VMC Group Company.
 - 4) Vibration Eliminator Co., Inc.
 - 5) Vibration Mountings & Controls; a VMC Group Company.
 - 6) Vibro-Acoustics.
- b. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
 - c. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - d. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - e. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
 - f. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - g. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 - h. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.03 VIBRATION ISOLATION HANGERS

A. **Type 8a** Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type 30N or a comparable product by one of the following:
 - a. Amber/Booth; a VMC Group Company.
 - b. Kinetics Noise Control, Inc.
 - c. Korfund Dynamics; a VMC Group Company.
 - d. Vibration Eliminator Co., Inc.
 - e. Vibration Mountings & Controls; a VMC Group Company.
 - f. Vibro-Acoustics.
2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
7. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.

B. **Type 8b** Spring Hangers with Vertical-Limit Stop: Precompressed combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type PC30N or a comparable product by one of the following:
 - a. Amber/Booth; a VMC Group Company.
 - b. Kinetics Noise Control, Inc.
 - c. Korfund Dynamics; a VMC Group Company.
 - d. Vibration Eliminator Co., Inc.
 - e. Vibration Mountings & Controls; a VMC Group Company.
 - f. Vibro-Acoustics.
2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.

6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
7. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
8. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.

2.04 **FACTORY FINISHES**

- A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
 1. Powder coating on springs and housings.
 2. All hardware shall be electrogalvanized. Hot-dip galvanize metal components for exterior use.
 3. Baked enamel for metal components on isolators for interior use.
 4. Color-code or otherwise mark vibration isolation devices to indicate capacity range.

PART 3 EXECUTION

3.01 **EXAMINATION**

- A. Examine areas and equipment to receive vibration isolation devices for compliance with requirements, installation tolerances, and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 **INSTALLATION**

- A. Install roof curbs, equipment supports, and roof penetrations as specified in Division 07 Section "Roof Accessories."
- B. Install thrust limits at centerline of thrust, symmetrical on either side of equipment.

3.03 **APPLICATION**

- A. Refer to Vibration Isolator Application Schedule on the drawings for isolator application and minimum deflection.

3.04 **CONNECTIONS**

- A. Vibration isolate piping connected to vibration isolated equipment using Type 8a or 8b spring hangers, and with distance to be isolated as scheduled on the Drawings. Maximum spacing between isolators same as maximum distance between pipe hangers and supports.
- B. Vibration isolate ductwork connected to air handling units, return air fans, and vibration isolated equipment using Type 8a or 8b spring hangers, and in accordance with isolation distances scheduled on the Drawings.

3.05 **EQUIPMENT BASES**

- A. Fill concrete inertia bases, after installing base frame, with 3000-psi concrete; trowel to a smooth finish.
 1. Cast-in-place concrete materials and placement requirements are specified in Division 03.
- B. Concrete Bases: Anchor equipment to concrete base according to supported equipment manufacturer's written instructions.
 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
 2. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base and anchor into structural concrete floor.
 3. Place and secure anchorage devices. Use Setting Drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
 5. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 6. Cast-in-place concrete materials and placement requirements are specified in Division 03.

3.06 **FIELD QUALITY CONTROL**

- A. Testing: Perform the following field quality-control testing:
 1. Isolator deflection.
 2. Snubber minimum clearances.

3.07 **ADJUSTING**

- A. Adjust isolators after piping systems have been filled and equipment is at operating weight.

- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
 - C. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop.
 - D. Adjust active height of spring isolators.
 - E. Adjust snubbers according to manufacturer's written recommendations.
- 3.08 **CLEANING**
- A. After completing equipment installation, inspect vibration isolation devices. Remove paint splatters and other spots, dirt, and debris.

END OF SECTION

SECTION 20 0553 - MECHANICAL IDENTIFICATION

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PART 1 GENERAL

- 1.01 **RELATED DOCUMENTS**
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
B. Related Sections include the following:
1. Division 20 Section "Mechanical General Requirements."
- 1.02 **ACTION SUBMITTALS**
A. Product Data: For each type of product indicated.
- 1.03 **INFORMATIONAL SUBMITTALS**
A. Samples: For color, letter style, and graphic representation required for each identification material and device.
B. Valve numbering scheme.
- 1.04 **CLOSEOUT SUBMITTALS**
A. Valve Schedules: For each piping system. Furnish extra copies (in addition to mounted copies) to include in Maintenance Manuals.
- 1.05 **QUALITY ASSURANCE**
A. ASME Compliance: Comply with ASME (ANSI) A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.
- 1.06 **COORDINATION**
A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
B. Coordinate installation of identifying devices with location of access panels and doors.
C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified:
1. Seton.
 2. Brady.
 3. EMED.
 4. Craftmark.
 5. Brimar Industries, Inc.
 6. Marking Services Inc. (MSI).
 7. Kolbi Pipe Marker Co.

2.02 EQUIPMENT IDENTIFICATION DEVICES

- A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.
1. Data:
 - a. Manufacturer, product name, model number, and serial number.
 - b. Capacity, operating and power characteristics, and essential data.
 - c. Labels of tested compliances.
 2. Location: Accessible and visible.
 3. Fasteners: As required to mount on equipment.
- B. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.
1. Terminology: Match schedules as closely as possible.
 2. Data:
 - a. Name and plan number.
 - b. Equipment service.
 - c. Design capacity.
 - d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.
 3. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.
- C. Equipment Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.
1. Data: Instructions for operation of equipment and for safety procedures.
 2. Engraving: Manufacturer's standard letter style, of sizes and with terms to match equipment identification.
 3. Thickness: Minimum 1/16 inch, unless otherwise indicated.
 4. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

2.03 PIPING IDENTIFICATION DEVICES

- A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.
1. Colors: Comply with ASME (ANSI) A13.1, unless otherwise indicated.
 2. Type and Size of Letters: Comply with ANSI A13.1, unless otherwise indicated.
 3. Legends: Spelled out in full or commonly used and accepted abbreviations.
 4. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers extending 360 degrees around pipe at each location.
 5. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
 6. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.
- B. Pretensioned Pipe Markers: Precoiled semirigid plastic formed to cover full circumference of pipe and to attach to pipe without adhesive.

- C. Shaped Pipe Markers: Preformed semirigid plastic formed to partially cover circumference of pipe and to attach to pipe with mechanical fasteners that do not penetrate insulation vapor barrier.
 - D. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.
 - E. Plastic Tape: Continuously printed, vinyl tape at least 3 mils thick with pressure-sensitive, permanent-type, self-adhesive back.
 - 1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches: 3/4 inch minimum.
 - 2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.
 - F. Underground Pipe Markers: Bright colored continuously printed plastic ribbon tape of not less than 6 inches wide by 4mil thick, manufactured for direct burial service.
 - G. Detectable Underground Pipe Markers: Continuously printed plastic ribbon tape with detectable aluminum core and with colors meeting APWA requirements, not less than 6 inches wide by 4 mil thick, manufactured for direct burial service.
- 2.04 **DUCT IDENTIFICATION DEVICES**
- A. Duct Markers: Engraved, color-coded laminated plastic. Include direction and quantity of airflow, air handling unit or fan number, and duct service (such as supply, return, and exhaust). Include contact-type, permanent adhesive.
 - B. Duct Markers: Vinyl, 2-inch minimum character height, with permanent pressure sensitive adhesive. Include direction and quantity of airflow, air handling unit or fan number, and duct service (such as supply, return, and exhaust).
- 2.05 **VALVE TAGS**
- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers, with numbering scheme approved by Architect/Engineer. Provide 5/32-inch hole for fastener.
 - 1. Material: 0.032-inch- thick brass.
 - 2. Valve-Tag Fasteners: Brass wire-link chain or beaded chain.
- 2.06 **VALVE SCHEDULES**
- A. Valve Schedules: For each piping system, on standard-size bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Valve-Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include mounting screws.
 - 2. Frame: Finished hardwood or extruded aluminum.
 - 3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.
- 2.07 **WARNING TAGS**
- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags; of plasticized card stock with matte finish suitable for writing.
 - 1. Size: 3 by 5-1/4 inches minimum.
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.
 - 4. Color: Yellow background with black lettering.

PART 3 EXECUTION

3.01 APPLICATIONS, GENERAL

- A. Products specified are for applications referenced in other Division 20, 21, 22, and 23 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.02 EQUIPMENT IDENTIFICATION

- A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:

1. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
 2. Pumps, compressors, chillers, condensers, and similar motor-driven units.
 3. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
 4. Fans, blowers, primary balancing dampers, and mixing boxes.
 5. Packaged HVAC central-station and zone-type units.
- B. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.
1. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
 3. Locate markers where accessible and visible. Include markers for the following general categories of equipment:
 - a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
 - b. Fire department hose valves and hose stations.
 - c. Meters, gages, thermometers, and similar units.
 - d. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
 - e. Pumps, compressors, chillers, condensers, and similar motor-driven units.
 - f. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
 - g. Fans, blowers, primary balancing dampers, and mixing boxes.
 - h. Packaged HVAC central-station and zone-type units.
 - i. Tanks and pressure vessels.
 - j. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.
- C. Install equipment signs with screws or permanent adhesive on or near each major item of mechanical equipment. Locate signs where accessible and visible.
1. Identify mechanical equipment with equipment markers in the following color codes:
 - a. Green: For cooling equipment and components.
 - b. Yellow: For heating equipment and components.
 - c. Orange: For combination cooling and heating equipment and components.
 - d. Brown: For energy-reclamation equipment and components.
 2. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 3. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
 4. Include signs for the following general categories of equipment:
 - a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
 - b. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
 - c. Pumps, compressors, chillers, condensers, and similar motor-driven units.
 - d. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
 - e. Fans, blowers, primary balancing dampers, and mixing boxes.
 - f. Packaged HVAC central-station and zone-type units.
 - g. Tanks and pressure vessels.
 - h. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.
- D. Install access panel markers with screws on equipment access panels.

- E. Area Served: Equipment serving different areas of a building other than where the equipment is installed shall be permanently marked in a manner that, in addition to identifying the equipment as specified in this Section, also identifies the area it serves.

3.03 **PIPING IDENTIFICATION**

- A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.
 - 1. Pipes with OD, Including Insulation, Less Than 6 Inches: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, minimum 3/4 inch wide, lapped at least 1-1/2 inches at both ends of pipe marker, and covering full circumference of pipe.
 - 2. Pipes with OD, Including Insulation, 6 Inches and Larger: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, minimum 1-1/2 inches wide, lapped at least 3 inches at both ends of pipe marker, and covering full circumference of pipe.
- B. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior non-concealed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and non-accessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced markers.
- C. Underground Pipe Markers: Install 6 to 8 inches below finished grade, directly above buried pipe.

3.04 **DUCT IDENTIFICATION**

- A. Install engraved duct markers with permanent adhesive on air ducts in the following color codes:
 - 1. Refer to Schedule.
 - 2. ASME (ANSI) A13.1 Colors and Designs: For hazardous material exhaust.
 - 3. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- B. Identify ductwork with vinyl markers and flow direction arrows.
- C. Locate markers at air handling units, each side of floor and wall penetrations, near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.05 **VALVE-TAG INSTALLATION**

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; plumbing fixture supply stops; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following:
 - 1. Valve-Tag Size and Shape:
 - a. Cold Water: Minimum 1-1/2 inches, round or square.
 - b. Hot Water: Minimum 1-1/2 inches, round or square.
 - c. Fire Protection: Minimum 1-1/2 inches, round or square.
 - d. Gas: Minimum 1-1/2 inches, round or square.
 - e. Steam: Minimum 1-1/2 inches, round or square.

3.06 **VALVE-SCHEDULE INSTALLATION**

- A. Mount valve schedule on wall in accessible location in each major equipment room.

3.07 **HAZARDOUS MATERIAL IDENTIFICATION DEVICES**

- A. Mount to wall or door of room containing hazard. Indicate classification of refrigerant or other hazard.

3.08 **WARNING-TAG INSTALLATION**

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

3.09 **ADJUSTING**

- A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.10 **CLEANING**

- A. Clean faces of mechanical identification devices and glass frames of valve schedules.

3.11 **SCHEDULES**

- A. Paint colors are listed here for reference only. Painting is specified under Division 9.

PIPE LABELING AND COLOR CODING

<u>Pipe System Label</u>	<u>Drawing Abbrev.</u>	<u>Labels</u>	<u>Piping</u>
Sanitary Sewer	SAN	White on Green	Dark Brown
Sanitary Vent	V	White on Green	Dark Brown
Rain Conductor	RC	White on Green	Dark Brown
Acid Waste	AW	Black on Yellow	Black
Acid Vent	AV	Black on Yellow	Black
Domestic Cold Water	CW	White on Green	Light Green
High Pressure Domestic Cold Water	HPCW	White on Green	Light Green
Non-Potable Cold Water	NPCW	Black on Yellow	
Domestic Hot Water	HW	Black on Yellow	Dark Green
High Pressure Domestic Hot Water	HPHW	Black on Yellow	Dark Green
High Pressure Domestic Hot Water Return	HPHWR	Black on Yellow	Dark Green
Domestic Hot Water Return	HWR	Black on Yellow	Dark Green
Soft Cold Water	SCW	White on Green	Light Green
Soft Hot Water	SHW	White on Green	Dark Green
Soft Hot Water Return	SHWR	White on Green	Dark Green
Natural Gas	G	Black on Yellow	Yellow
Fuel Oil Supply	FOS	Black on Yellow	Yellow
Fuel Oil Return	FOR	Black on Yellow	Yellow
Compressed Air (90psig)	A(90psig)	Black on Yellow	Dark Blue
Compressed Air (25psig)	A	White on Green	Dark Blue
Laboratory Vacuum	LVAC	Black on Yellow	Unpainted
Carbon Dioxide	CO ₂	Black on Yellow	Unpainted
High Purity Water	DI	White on Green	White
Hot Water Htg. Supply	HWHS	Black on Yellow	Dark Blue
Hot Water Htg. Return	HWHR	Black on Yellow	Dark Blue
Terminal Unit Heating Sup.	THS	Black on Yellow	Dark Blue
Terminal Unit Heating Ret.	THR	Black on Yellow	Dark Blue
Animal Heating Supply	AHS	Black on Yellow	Dark Blue
Animal Heating Return	AHR	Black on Yellow	Dark Blue
Energy Recovery Loop Sup.	ERLS	Black on Yellow	Dark Blue
Energy Recovery Loop Ret.	ERLR	Black on Yellow	Dark Blue
Chilled Water Supply	CHWS	White on Green	Light Blue
Chilled Water Return	CHWR	White on Green	Light Blue
Condenser Water Supply	CWS	White on Green	Light Green
Condenser Water Return	CWR	White on Green	Light Green
Process Cooling Water Sup.	PCWS	White on Green	Light Green
Process Cooling Water Ret.	PCWR	White on Green	Light Green
Refrigerant Liquid	RL	Black on Yellow	
Refrigerant Suction	RS	Black on Yellow	
Steam Condensate	LPC	Black on Yellow	Aluminum
Medium Pressure Steam Condensate	MPC	Black on Yellow	Aluminum
High Pressure Steam Condensate	HPC	Black on Yellow	Aluminum

<u>Pipe System Label</u>	<u>Drawing Abbrev.</u>	<u>Labels</u>	<u>Piping</u>
Pumped Steam Condensate	PC	Black on Yellow	Aluminum
Medium Pressure Steam (60 psig)	MPS	Black on Yellow	Aluminum
High Pressure Steam,	HPS	Black on Yellow	Aluminum
Low Pressure Steam (5 psig)	LPS	Black on Yellow	Aluminum
Fire Protection	FP	White on Red	Bright Red
Medical Gases			

Refer to Division 22 Section "Medical Gas Systems."

SHEET METAL WORK

<u>Service</u>	<u>Abbrev.</u>	<u>Labels</u>	<u>Ductwork</u>
Air Conditioning Supply	Supply Air	White on Green	White
Air Conditioning Return	Return Air	White on Green	White
Exhaust Systems	Exhaust Air	Black on Yellow	Green
Outside Air Intake	Outside Air	White on Green	White
Mixed Air	Mixed Air	White on Green	White

END OF SECTION

SECTION 20 0700 - MECHANICAL INSULATION

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 20 Section "Hanger and Supports" for thermal hanger shield inserts.
 - 4. Division 22 Section "Plumbing Fixtures: for protective shielding guards."

5. Division 23 Section "Metal Ducts" for duct liners.
- 1.02 **SUMMARY**
- A. This Section includes mechanical insulation for pipe, duct, and equipment.
- 1.03 **DEFINITIONS**
- A. ASJ: All-service jacket.
B. FSK: Foil, scrim, kraft paper.
C. PSK: Polypropylene, scrim, kraft paper.
D. PVC: Polyvinyl Chloride.
E. SSL: Self-sealing lap.
- 1.04 **INDOOR PIPING INSULATION SYSTEMS DESCRIPTION**
- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are scheduled on the Drawings, or identified for each piping system and pipe size range.
B. Sanitary Waste Piping Where Heat Tracing Is Installed, All Pipe Sizes: Glass-Fiber Pipe Insulation, Type I: 1-1/2 inches thick.
C. Hot Service Drains, All Pipe Sizes: Glass-Fiber or Mineral Wool, Preformed Pipe Insulation, Type I or II: 1 inch thick.
D. Hot Service Vents, All Pipe Sizes: Glass-Fiber or Mineral Wool, Preformed Pipe Insulation, Type I or II: 1 inch thick.
- 1.05 **INDOOR DUCT AND PLENUM INSULATION SYSTEMS DESCRIPTION**
- A. Acceptable indoor duct and plenum insulation materials and thicknesses are scheduled on the Drawings.
- 1.06 **ABOVEGROUND, OUTDOOR DUCT AND PLENUM INSULATION SYSTEMS DESCRIPTION**
- A. Acceptable outdoor duct and plenum insulation materials and thicknesses are scheduled on the Drawings.
- 1.07 **EQUIPMENT INSULATION SYSTEMS DESCRIPTION**
- A. Acceptable equipment insulation materials and thicknesses are scheduled on the Drawings.
- 1.08 **FIELD-APPLIED JACKETING SYSTEMS DESCRIPTION**
- A. Acceptable field-applied jacketing materials and thicknesses are scheduled on the Drawings, or identified for each piping system and pipe specialty.
- 1.09 **ACTION SUBMITTALS**
- A. Product Data: For each type of product indicated, identify thermal conductivity, thickness, and jackets (both factory and field applied, if any).
1. ESR Report: For fire-rated grease duct insulation.
- 1.10 **QUALITY ASSURANCE**
- A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.
B. Ductwork Maximum Temperature Limits: Based on ASTM C 411 test procedures.
- 1.11 **DELIVERY, STORAGE, AND HANDLING**
- A. Prior to installation, protect insulation from exposure to water and from physical damage. Prior to installation, store insulation in manufacturer's original packaging.
- 1.12 **COORDINATION**
- A. Coordinate size and location of supports, hangers, and pre-insulated pipe shields/supports specified in Division 20 Section "Hangers and Supports."
B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

- C. Coordinate installation and testing of heat tracing.
- 1.13 **SCHEDULING**
- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
 - B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 PRODUCTS

2.01 **INSULATION MATERIALS, GENERAL REQUIREMENTS**

- A. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- B. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- E. Adhesives used shall be fire resistant in their dry states and UL listed.

2.02 **PIPE INSULATION MATERIALS**

- A. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Aeroflex USA, Inc.; Aerocel Tube and Sheet.
 - b. Armacell LLC; AP Armaflex.
 - c. IK Insulation Group; K-Flex USA LLC; Insul-Tube and Insul-Sheet.
- B. Glass-Fiber, Preformed Pipe Insulation, Type I:
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Johns Manville; Micro-Lok.
 - b. Knauf Insulation; 1000 Pipe Insulation.
 - c. Manson Insulation Inc.; Alley-K.
 - d. Owens Corning; Fiberglas Pipe Insulation.
 - 2. Type I, 850 deg F Materials: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ or ASJ-SSL. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.

2.03 **DUCTWORK INSULATION MATERIALS**

- A. Blanket Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. CertainTeed Corp.; Duct Wrap.
 - b. Johns Manville; Microlite EQ.
 - c. Knauf Insulation; Duct Wrap.
 - d. Manson Insulation Inc.; Alley Wrap B.
 - e. Owens Corning; All-Service Duct Wrap.
- C. Board Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. CertainTeed Corp.; Commercial Board.
 - b. Fibrex Insulations Inc.; FBX.
 - c. Johns Manville; 800 Series Spin-Glass.
 - d. Knauf Insulation; Insulation Board.
 - e. Manson Insulation Inc.; AK Board.
 - f. Owens Corning; Fiberglas 700 Series.

2.04 **EQUIPMENT INSULATION MATERIALS**

- A. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Aeroflex USA, Inc.; Aerocel Tube and Sheet.
 - b. Armacell LLC; AP Armaflex.
 - c. IK Insulation Group; K-Flex USA LLC; Insul-Tube and Insul-Sheet.
- B. Board Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For equipment applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. CertainTeed Corp.; Commercial Board.
 - b. Fibrex Insulations Inc.; FBX.
 - c. Johns Manville; 800 Series Spin-Glas.
 - d. Knauf Insulation; Insulation Board.
 - e. Manson Insulation Inc.; AK Board.
 - f. Owens Corning; Fiberglas 700 Series.
- C. Large Diameter Pipe and Tank Insulation: Glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. CertainTeed Corp.; CrimpWrap.
 - b. Johns Manville; MicroFlex.
 - c. Knauf Insulation; Pipe and Tank Insulation.
 - d. Manson Insulation Inc.; AK Flex.
 - e. Owens Corning; Fiberglas Pipe and Tank Insulation.

2.05 **INSULATING CEMENTS**

- A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Insulco, Division of MFS, Inc.; SmoothKote.
 - b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
 - c. Rock Wool Manufacturing Company; Delta One Shot.

2.06 **ADHESIVES**

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to it and to surfaces to be insulated, unless otherwise indicated.
- B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Aeroflex USA, Inc.; Aero seal and Aero seal LVOC.
 - b. Armacell LCC; 520 Adhesive.
 - c. Foster Products Corporation, H. B. Fuller Company; 85-75.
- C. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Childers Products, H.B. Fuller Company; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. Johns Manville Industrial Insulation; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.
- D. PVC Jacket Adhesive: Compatible with PVC jacket.
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Dow Chemical Company (The); 739, Dow Silicone.

- b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
- c. P.I.C. Plastics, Inc.; Welding Adhesive.
- d. Red Devil, Inc.; Celulon Ultra Clear.
- e. Speedline Corporation; Speedline Vinyl Adhesive.

2.07 **MASTICS**

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Childers Products, H.B. Fuller Company; CP-35.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-90.
 - c. Johns Manville Industrial Insulation; CB-50.
 - d. Marathon Industries, Inc.; 590.
 - e. Mon-Eco Industries, Inc.; 55-40.
 - f. Vimasco Corporation; 749.
 - 2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
 - 5. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Childers Products, H.B. Fuller Company; CP-10.
 - b. Foster Products Corporation, H. B. Fuller Company; 35-00.
 - c. Johns Manville Industrial Insulation; CB-05/15.
 - d. Marathon Industries, Inc.; 550.
 - e. Mon-Eco Industries, Inc.; 55-50.
 - f. Vimasco Corporation; WC-1/WC-5.
 - 2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 200 deg F.
 - 4. Solids Content: 63 percent by volume and 73 percent by weight.
 - 5. Color: White.

2.08 **SEALANTS**

- A. FSK and Metal Jacket Flashing Sealants:
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Childers Products, H.B. Fuller Company; CP-76-8.
 - b. Foster Products Corporation, H. B. Fuller Company; 95-44.
 - c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Vimasco Corporation; 750.
 - 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 3. Fire- and water-resistant, flexible, elastomeric sealant.
 - 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 - 5. Color: Aluminum.
- B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Childers Products, H.B. Fuller Company; CP-76.
 - 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 3. Fire- and water-resistant, flexible, elastomeric sealant.
 - 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 - 5. Color: White.

2.09 **FACTORY-APPLIED JACKETS**

- A. Insulation systems indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
 4. PSK Jacket: Metalized polypropylene, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
- 2.10 **FIELD-APPLIED FABRIC-REINFORCING MESH**
- A. Woven Glass-Fiber Fabric for Pipe Insulation: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch for covering pipe and pipe fittings.
 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Vimasco Corporation; Elastafab 894.
 - b. Or approved equal.
 - B. Woven Glass-Fiber Fabric for Duct and Equipment Insulation: Approximately 6 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. inch for covering equipment.
 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Childers Products, H.B. Fuller Company; Chil-Glas No. 5.
 - b. Or approved equal.
 - C. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch, in a Leno weave, for duct, equipment, and pipe.
 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Foster Products Corporation, H. B. Fuller Company; Mast-A-Fab.
 - b. Vimasco Corporation; Elastafab 894.
- 2.11 **FIELD-APPLIED CLOTHS**
- A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and pre-sized a minimum of 8 oz./sq. yd.
 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.
 - b. Lewco Products.
 - c. Mid-Mountain.
 - d. TCI.
- 2.12 **FIELD-APPLIED JACKETS**
- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
 - B. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 - C. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
 - D. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as specified; roll stock ready for shop or field cutting and forming.
 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Airex Manufacturing, Inc.; E-Flex Guard.
 - b. Johns Manville; Zeston and Ceel-Co.
 - c. P.I.C. Plastics, Inc.; FG Series.
 - d. Proto PVC Corporation; LoSmoke.
 - e. Speedline Corporation; SmokeSafe.
 2. Adhesive: As recommended by jacket material manufacturer.
 3. Color: White.
 4. Factory-fabricated tank heads and tank side panels.
 - E. PVC Fitting Covers: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C, and including flexible glass fiber insulation inserts.
 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Airex Manufacturing, Inc.
 - b. Johns Manville; Zeston and Ceel-Co.
 - c. P.I.C. Plastics, Inc.; FG Series.

- d. Proto PVC Corporation; LoSmoke.
- e. Speedline Corporation; SmokeSafe.
- 2. Adhesive: As recommended by manufacturer.
- 3. Color: White.
- 4. Factory-fabricated fitting covers:
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, and mechanical joints.
- F. Metal Jacket:
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. PABCO-Childers Metals; Johns Manville Industrial Insulation; Metal Jacketing Systems.
 - b. RPR Products, Inc.; Insul-Mate.
 - 2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.
 - a. Sheet and roll stock ready for shop or field sizing or factory cut and rolled to size.
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper.
 - d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper or 2.5-mil- thick Polysurlyn.
 - e. Factory-Fabricated Fitting Covers:
 - 1) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 2) Provide factory fabricated PVC tee covers, flange and union covers, beveled collars and valve covers.
 - 3) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
 - 3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
 - a. Sheet and roll stock ready for shop or field sizing factory cut and rolled to size.
 - b. Material, finish, and thickness are indicated in field-applied jacket systems.
 - c. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper.
 - d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper or 2.5-mil- thick Polysurlyn.
 - e. Factory-Fabricated Fitting Covers:
 - 1) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 2) Provide factory fabricated PVC tee covers, flange and union covers, beveled collars and valve covers.
 - 3) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.13 INSULATION COVERS

- A. Flexible Style: Custom fabricated composite jackets for valves, flanges, and expansion joints consisting of 4 inches of high temperature fiberglass insulation compressed between Teflon impregnated fiberglass inner and outer facing stitched with fiberglass core Teflon thread and secured with Velcro fasteners and double D-ring cinching. Service temperature range of minus 40 deg F to 500 deg F.
 - 1. Fabricators:
 - a. Apex Energy & Environmental Products Inc.
 - b. 3i Supply Co.; K-TEX.
 - c. Valley Group of Companies.
- B. Rigid Style: Custom fabricated composite jackets for valves, flanges, and expansion joints consisting of rigid foam insulation with silicone impregnated fiberglass outer facing stitched with fiberglass thread and secured with Velcro fasteners and double D-ring cinching. Service temperature range of minus 40 deg F to 500 deg F.
 - 1. Fabricators:
 - a. Valley Group of Companies.

2.14 **REMOVABLE AND REUSABLE ACOUSTIC INSULATION COVERS**

- A. Flexible Style: Custom fabricated composite jackets consisting of:
1. Two inches of high temperature, high density, needled fiberglass mat insulation.
 2. High density mass loaded vinyl
 3. Teflon impregnated fiberglass inner and outer facing with double sewn and bonded seams.
 4. Extended Velcro flap on closing seams.
 5. Stainless steel lacing hardware with wire twist fastener.
 6. Include aluminum nameplate having embossed lettering with tag description.
- B. Manufacturer:
1. Shannon Enterprises of W.N.Y. Inc.; INSULTECH; LT450A-TT Series.

2.15 **TAPES**

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136 and UL listed.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Ideal Tape Co., Inc., an American Biltrite company; 728 Cold Seal ASJ or comparable products by one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division.
 - b. 3M Venture Tape.
 2. Width: 3 inches.
 3. Thickness: 9 mils.
 4. Adhesion: 70 ounces force/inch in width.
 5. Elongation: 3 percent.
 6. Tensile Strength: 45 lbf/inch in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with rubber or acrylic adhesive; complying with ASTM C 1136 and UL listed.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Ideal Tape Co., Inc., an American Biltrite company; 491 FSK or 791 Cold Seal Acrylic FSK, or comparable products by one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division.
 - b. 3M Venture Tape.
 2. Width: 3 inches.
 3. Thickness: 6 mils.
 4. Adhesion (Rubber Adhesive): 100 ounces force/inch in width.
 5. Adhesion (Acrylic Adhesive): 90 ounces force/inch in width.
 6. Elongation: 3 percent.
 7. Tensile Strength: 35 lbf/inch in width.
 8. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Ideal Tape Co., Inc., an American Biltrite company; 370 White PVC tape, or comparable products by one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division.
 - b. 3M Venture Tape.
 2. Width: 2 inches.
 3. Thickness: 5 mils.
 4. Adhesion: 20 ounces force/inch in width.
 5. Elongation: 500 percent.
 6. Tensile Strength: 15 lbf/inch in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive and UL listed.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Ideal Tape Co., Inc., an American Biltrite company; 488 AWF rubber adhesive or 788 Cold Seal acrylic adhesive, or comparable products by one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division.

- b. 3M Venture Tape.
2. Width: 3 inches.
3. Thickness: 3.0 to 4.0 mils.
4. Adhesion (Rubber Adhesive): 90 ounces force/inch in width.
5. Adhesion (Acrylic Adhesive): 50 ounces force/inch in width.
6. Elongation: 3 percent.
7. Tensile Strength: 14 to 20 lbf/inch in width.

2.16 **SECUREMENTS**

- A. Bands:
 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. PABCO-Childers Metals; Johns Manville Industrial Insulation; Pab-Bands and Fabstraps.
 - b. RPR Products, Inc.; Bands.
 2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing or closed seal.
 3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing or closed seal.
 4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.
- B. Insulation Pins and Hangers:
 1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
 - a. Products: Subject to compliance with requirements, provide one of the products specified.
 - 1) AGM Industries, Inc.; CWP-1.
 - 2) GEMCO; CD.
 - 3) Midwest Fasteners, Inc.; CD.
 - 4) Nelson Stud Welding; TPA, TPC, and TPS.
 2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 - a. Products: Subject to compliance with requirements, provide one of the products specified.
 - 1) AGM Industries, Inc.; CWP-1.
 - 2) GEMCO; Cupped Head Weld Pin.
 - 3) Midwest Fasteners, Inc.; Cupped Head.
 - 4) Nelson Stud Welding; CHP.
 3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, provide one of the products specified.
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
 - 2) GEMCO; Perforated Base.
 - 3) Midwest Fasteners, Inc.; Spindle.
 - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, provide one of the products specified.
 - 1) GEMCO; Nylon Hangers.
 - 2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
 - b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
 - c. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
 5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, provide one of the products specified.
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
 - 2) GEMCO; Press and Peel.
 - 3) Midwest Fasteners, Inc.; Self Stick.
 - b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive-backed base with a peel-off protective cover.
 6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - a. Products: Subject to compliance with requirements, provide one of the products specified.
 - 1) AGM Industries, Inc.; RC-150.
 - 2) GEMCO; R-150.
 - 3) Midwest Fasteners, Inc.; WA-150.
 - 4) Nelson Stud Welding; Speed Clips.
 - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
 7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - a. Manufacturers:
 - 1) GEMCO.
 - 2) Midwest Fasteners, Inc.
 - C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
 - D. Wire: 0.062-inch soft-annealed, stainless steel.
 1. Manufacturers:
 - a. ACS Industries, Inc.
 - b. C & F Wire.
 - c. PABCO-Childers Metals; Johns Manville Industrial Insulation.
 - d. RPR Products, Inc.
- 2.17 **CORNER ANGLES**
- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
 - B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.

- C. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or 316.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
 - 1. Verify that systems and equipment to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
 - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that applies to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.03 COMMON INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at the 4 o'clock or 8 o'clock position on horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive as recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. For services with surface temperatures below ambient, install a continuous unbroken vapor barrier. Seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install thermal hanger insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover thermal hanger inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.

3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at the 4 o'clock or 8 o'clock position on the pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness. Where compression of insulation is possible, fabricate/install insulation per manufacturer's recommendations.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above ambient services, do not install insulation to the following:
1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Manholes.
 5. Handholes.
 6. Cleanouts.
- 3.04 **PENETRATIONS**
- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Below-Grade Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations that Are Not Fire Rated: Install insulation through walls and partitions as detailed.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations:
1. Terminate ductwork insulation at angle closure of fire damper sleeves.
 2. Install pipe insulation continuously through penetrations of fire-rated walls and partitions.
 - a. Firestopping is specified in Division 07 Section "Through-Penetration Firestop Systems."
- F. Insulation Installation at Floor Penetrations:

1. Duct: Install insulation through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at angle closure of fire damper sleeves.
2. Pipe: Install insulation continuously through floor penetrations.
 - a. Seal penetrations through fire-rated assemblies according to Division 07 Section "Through-Penetration Firestop Systems."

3.05 **GENERAL PIPE INSULATION INSTALLATION**

- A. Requirements in this Article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible Elastomeric, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
 1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least two times the insulation thickness over adjacent pipe

- insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.
- E. Install removable and reusable insulation covers in accordance with fabricator's instructions, and at the following locations:
1. At steam valves.
 2. At valves, flanges, and expansion joints. Expansion joints shall have jacket installed in a manner to allow for replacing of joints without removing insulation cover.
- 3.06 **FLEXIBLE ELASTOMERIC PIPE INSULATION INSTALLATION**
- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
1. Install pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install mitered sections of pipe insulation.
 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed valve covers manufactured of same material as pipe insulation when available.
 2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 3. Install insulation to flanges as specified for flange insulation application.
 4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- 3.07 **GLASS-FIBER AND MINERAL WOOL PIPE INSULATION INSTALLATION**
- A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
 4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:

1. Install PVC fitting covers when available.
 2. When PVC fitting covers are not available, install preformed pipe insulation to outer diameter of pipe flange:
 - a. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 - b. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with fiberglass or mineral wool blanket insulation as specified for system.
 3. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install PVC fitting covers when available.
 2. When PVC fitting covers are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install PVC fitting covers when available.
 2. When PVC fitting covers are not available, install mitered sections of pipe insulation to valve body.
 3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 4. Install insulation to flanges as specified for flange insulation application.
- 3.08 **DUCT AND PLENUM INSULATION INSTALLATION**
- A. Blanket Insulation Installation on Ducts and Plenums: Secure with insulation pins.
1. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not over compress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 2. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.
 3. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.

4. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 5. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not over compress insulation during installation.
 - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.
 5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- C. Flexible Elastomeric Thermal Insulation Installation for Ducts and Plenums: Install insulation over entire surface of ducts and plenums.
1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
 2. Seal longitudinal seams and end joints.
 3. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with strips of same material used to insulate duct and following manufacturer's installation instructions.
- 3.09 **EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION**
- A. Secure insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
 2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
 3. Protect exposed corners with secured corner angles.
 4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
 - a. Do not weld anchor pins to ASME-labeled pressure vessels.
 - b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
 - c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
 - d. Do not over compress insulation during installation.
 - e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
 - f. Impale insulation over anchor pins and attach speed washers.
 - g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
 6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
 7. Stagger joints between insulation layers at least 3 inches.
 8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
 9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
 10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.
- B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.
1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
 2. Seal longitudinal seams and end joints.
- C. Insulation Installation on Pumps:
1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch centers, starting at corners. Install 3/8-inch- diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
 2. Fabricate boxes from galvanized steel, at least 0.040 inch thick.
 3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.
- 3.10 **FIELD-APPLIED JACKET INSTALLATION**
- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

- B. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
 - 1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
 - 2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
 - 3. Completely encapsulate insulation with coating, leaving no exposed insulation.
 - C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
 - 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
 - D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.
 - E. Where self-adhesive jackets are indicated, install according to manufacturer's instructions and details on the drawings. Overlap seams arranged to shed water.
 - F. Where sound barrier jackets are indicated, install in accordance with manufacturer's instructions.
- 3.11 **FIRE-RATED INSULATION SYSTEM INSTALLATION**
- A. Where fire-rated insulation system is indicated, install two layers in strict accordance with manufacturer's instructions, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
 - B. Insulate duct access panels and doors in strict accordance with insulation manufacturer's to achieve same fire rating as duct.
 - C. Maintain a copy of insulation manufacturer's installation instructions on site for Code Official.
 - D. Where fire-rated plenum wrap system is indicated, secure to system piping to maintain a continuous UL-listed fire rating.
 - E. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Division 07 Section "Through-Penetration Firestop Systems."
- 3.12 **FINISHES**
- A. Duct, Equipment, and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system specified in Division 09 painting Sections.
 - B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
 - C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
 - D. Do not field paint aluminum or stainless-steel jackets.

END OF SECTION

TMP Architecture, Inc.
Peter Basso Associates, Inc.

TMP22103D & 22104E
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SECTION 22 1116 - DOMESTIC WATER PIPING

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods" for materials and methods common to mechanical piping systems.
 - 3. Division 20 Section "Hangers and Supports."
 - 4. Division 20 Section "Meters and Gages" for thermometers, pressure gages, and fittings.
 - 5. Division 22 Section "General-Duty Valves for Plumbing."
 - 6. Division 22 Section "Domestic Water Piping Specialties" for water distribution piping specialties.

1.02 SUMMARY

- A. This Section includes domestic water piping and water meters inside the building.
- B. Water meters will be furnished and installed by utility company.

1.03 PERFORMANCE REQUIREMENTS

- A. Where not indicated on the Drawings, provide components and installation capable of producing domestic water piping systems with 125 psig, unless otherwise indicated.
 - 1. Exception: PEX plastic piping insert fittings specified are limited to 100 psig.

1.04 SYSTEMS DESCRIPTION

- A. Potable and non-potable domestic water piping system materials are scheduled on the Drawing.
- B. Under-Building-Slab, Water-Service Piping on Service Side of Water Meter: Refer to Division 22 Section "Facility Water Distribution."
- C. Refer to Application Schedules on the Drawings for valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Hot-Water-Piping, Balancing Duty: Calibrated balancing valves.

2. Drain Duty: Hose-end drain valves.
 3. Isolation Valves at Domestic Water Meters: Gate Valves, NPS 2 and Smaller: Class 150, bronze.
 4. Isolation Valves at Domestic Water Meters: Gate Valves, NPS 2-1/2 and Larger: Class 125, OS&Y, bronze-mounted cast iron.
- D. Transition and special fittings with pressure ratings at least equal to piping rating may be used unless otherwise indicated.
- 1.05 **ACTION SUBMITTALS**
- A. Product Data: For pipe, tube, fittings, and couplings and water meters.
- 1.06 **INFORMATIONAL SUBMITTALS**
- A. Coordination Drawings: For piping in equipment rooms and other congested areas, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
1. Domestic water piping.
- 1.07 **CLOSEOUT SUBMITTALS**
- A. Field quality-control test reports.
- B. Water Samples: Specified in Part 3 "Cleaning" Article.
- 1.08 **QUALITY ASSURANCE**
- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.
- C. Comply with NSF 14, "Plastics Piping System Components and Related Materials," for plastic, potable domestic water piping and components. Include marking "NSF-pw" on piping.
- D. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," and NSF 372 Drinking Water System Components – Lead Content for potable domestic water piping and components.
- E. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be as recommended by the manufacturer of the grooved components.
- 1.09 **PROJECT CONDITIONS**
- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
1. Notify Architect no fewer than two days in advance of proposed interruption of water service.
 2. Do not proceed with interruption of water service without Architect's written permission.
- 1.10 **COORDINATION**
- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- PART 2 PRODUCTS**
- 2.01 **MANUFACTURERS**
- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
- 2.02 **PIPING MATERIALS**
- A. Transition Couplings for Aboveground Pressure Piping: Coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
- 2.03 **COPPER TUBE AND FITTINGS**
- A. Soft Copper Tube: ASTM B 88, Type K, water tube, annealed temper.
1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
 2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Furnish Class 300 flanges if required to match piping.

3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- B. Hard Copper Tube: ASTM B 88, Type L, water tube, drawn temper.
 1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
 2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Furnish Class 300 flanges if required to match piping.
 3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- C. Grooved-Joint Systems:
 1. Manufacturers:
 - a. ASC Engineered Solutions; Gruvlok; Fig. 64 CTS SlideLOK.
 - b. Victaulic Company; Style 606 and Style 607.
 2. Grooved-End-Tube Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, gasket suitable for hot water, and bolts and nuts.
 3. Copper, Grooved-End Fittings: ASTM B 75 copper tube or ASTM B 584 bronze castings.
- D. Copper or Bronze Pressure-Seal Fittings:
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Viega North America; ProPress System.
 - b. NIBCO Inc.; Press System.
 - c. Mueller Industries, Inc.; Streamline PRS.
 - d. Elkhart Products Corporation; an Aalberts Industries Company; Xpress.
 - e. Apollo Valves; by Conbraco Industries; ApolloXpress.
 - f. ASC Engineered Solutions; Anvil Press.
 2. Housing: Copper.
 3. O-Rings and Pipe Stops: EPDM.
 4. Tools: Manufacturer's special tools.
 5. Maximum 200-psig working-pressure rating at 250 deg F.
- E. Copper, Mechanically Formed Tee Option: For forming T-branch on copper water tube. Mechanically formed tee fittings may be used up to half size of main.
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. T-DRILL Industries Inc.

2.04 VALVES

- A. General-duty plumbing valves; and drain valves are specified in Division 22 Section "Plumbing Valves."
- B. Balancing valves are specified in Division 22 Section "Domestic Water Piping Specialties."

2.05 WATER METERS

- A. Refer to Division 20 Section "Mechanical General Requirements."
- B. Displacement-Type Water Meters NPS 2 and Smaller: AWWA C700, nutating-disc totalization meter with bronze case and 150-psig minimum working-pressure rating; with registration in gallons or cubic feet as required by utility; and with threaded end connections.
 1. Manufacturers:
 - a. AALIAN; a Venture Measurement Product Line; Niagara.
 - b. Badger Meter, Inc.
 - c. Sensus Metering Systems Inc.

PART 3 EXECUTION

3.01 EXCAVATION

- A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earthwork."

3.02 PIPING SYSTEM INSTALLATION

- A. Basic piping installation requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."

- B. Install under-building-slab copper tubing according to Copper Development Association's "Copper Tube Handbook." Joints under slab are not allowed. Install PVC sleeve where piping penetrates slab.
 - C. Install sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 20 Section "Basic Mechanical Materials and Methods."
 - D. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Pressure gages are specified in Division 20 Section "Meters and Gages," and strainers are specified in Division 22 Section "Domestic Water Piping Specialties."
 - E. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping.
 - 1. Install hose-end drain valves at low points in water mains, risers, and branches.
 - 2. Install stop-and-waste drain valves where indicated.
 - F. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Calibrated balancing valves are specified in Division 22 Section "Domestic Water Piping Specialties."
 - G. Install domestic water piping level with 0.25 percent slope downward toward drain without pitch and plumb.
- 3.03 **JOINT CONSTRUCTION**
- A. Basic piping joint construction requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."
- 3.04 **WATER METER INSTALLATION**
- A. Water meters will be furnished and installed by utility company.
 - B. Rough-in domestic water piping for water meter installation and install water meters according to utility company's requirements.
 - C. Install water meters according to AWWA M6 and utility's requirements.
 - 1. Install displacement-type water meters with shutoff valve on water-meter inlet. Install valve on water-meter outlet and valved bypass around meter unless prohibited by authorities having jurisdiction.
 - 2. Install turbine-type water meters with shutoff valve on water-meter inlet. Install valve on water-meter outlet and valved bypass around meter unless prohibited by authorities having jurisdiction.
 - 3. Install compound-type water meters with shutoff valves on water-meter inlet and outlet and on valved bypass around meter. Support meters, valves, and piping on brick or concrete piers.
 - 4. Install remote registration system according to standards of utility and of authorities having jurisdiction.
- 3.05 **HANGER AND SUPPORT INSTALLATION**
- A. Pipe hanger and support devices are specified in Division 20 Section "Hangers and Supports." Install the following:
 - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs: According to the following:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer than 100 Feet: MSS Type 43, adjustable roller hangers.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
 - B. Install supports according to Division 20 Section "Hangers and Supports."
 - C. Support vertical piping and tubing at base and at each floor.
 - D. Rod diameter may be reduced 1 size for double-rod hangers, to a minimum of 3/8 inch.
 - E. Install supports for vertical steel piping every 15 feet.

- F. Install hangers for drawn-temper copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 3/4 and Smaller: 60-inches with 3/8-inch rod.
 - 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
 - 3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 - 4. NPS 2-1/2: 108 inches with 1/2-inch rod.
- G. Install supports for vertical copper tubing every 10 feet.
- H. Soft copper tube: Continuous support using v-shaped plastic pipe channel, maximum hanger spacing 8 feet with 3/8-inch rod.
- I. Alternate support for copper tubing NPS 3/4 and smaller: Continuous support using v-shaped plastic pipe channel, maximum hanger spacing 8 feet with 3/8-inch rod.

3.06 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect domestic water piping to distribution side of water meter with shutoff valve.
- C. Install piping adjacent to equipment and machines to allow service and maintenance.
- D. Connect domestic water piping to the following:
 - 1. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 22 Section "Plumbing Fixtures."
 - 2. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.
 - 3. Water Heaters: Cold-water supply and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.

3.07 FIELD QUALITY CONTROL

- A. Inspect domestic water piping as follows:
 - 1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - 2. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
 - 3. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
 - 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- B. Test domestic water piping as follows:
 - 1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 - 2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 4. Cap and subject piping to static water pressure of 150 psig. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - 5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
 - 6. Prepare reports for tests and required corrective action.

3.08 ADJUSTING

- A. Perform the following adjustments before operation:
 - 1. Close drain valves, hydrants, and hose bibbs.

2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.
5. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.09 **CLEANING AND DISINFECTION**

- A. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.
- B. Clean and disinfect potable domestic water piping as follows:
 1. Purge new piping and parts of existing domestic water piping that have been altered, extended, or repaired before using.
 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction or, if methods are not prescribed, procedures described in either AWWA C651 or AWWA C652 or as described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- C. Prepare and submit reports of purging and disinfecting activities.

END OF SECTION

SECTION 22 1119 - DOMESTIC WATER PIPING SPECIALTIES

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 20 Section "Meters and Gages" for thermometers, pressure gages, and flow meters in domestic water piping.
 - 4. Division 22 Section "Domestic Water Piping " for water meters.
 - 5. Division 22 Section "Drinking Fountains, Water Coolers and Cuspidors" for water filters for water coolers.

1.02 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.03 ACTION SUBMITTALS

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

1.04 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: Diagram power, signal, and control wiring.

1.05 CLOSEOUT SUBMITTALS

- A. Field quality-control test reports.
- B. Flow Reports and Settings: For calibrated balancing valves.
- C. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.06 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.
- B. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.
- C. NSF Compliance:

1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."
3. Comply with NSF 372, "Drinking Water System Components – Lead Content" for components with wetted surfaces in contact with potable water.

PART 2 PRODUCTS

2.01 VACUUM BREAKERS

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; Conbraco Industries, Inc.
 - b. FEBCO; a Division of Watts Water Technologies, Inc.
 - c. Watts Water Technologies, Inc.; Watts Regulator Co.
 - d. Zurn Plumbing Products Group; Wilkins Div.
 2. Standard: ASSE 1001.
 3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
 4. Body: Bronze.
 5. Inlet and Outlet Connections: Threaded.
 6. Finish: Chrome plated.
- B. Hose-Connection Vacuum Breakers:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; Conbraco Industries, Inc.
 - b. MIFAB, Inc.
 - c. Watts Water Technologies, Inc.; Watts Regulator Co.
 - d. Woodford Manufacturing Company.
 2. Standard: ASSE 1011.
 3. Body: Bronze or brass, nonremovable, with manual drain.
 4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
 5. Finish: Chrome or nickel plated.
- C. Pressure Vacuum Breakers:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; Conbraco Industries, Inc.
 - b. FEBCO; a Division of Watts Water Technologies, Inc.
 - c. Watts Water Technologies, Inc.; Ames Fire & Waterworks.
 - d. Watts Water Technologies, Inc.; Watts Regulator Co.
 - e. Zurn Plumbing Products Group; Wilkins Div.
 2. Standard: ASSE 1020.
 3. Operation: Continuous-pressure applications.
 4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
 5. Size and Capacity: As indicated on the drawings.
 6. Accessories:
 - a. Valves: Ball type, on inlet and outlet.

2.02 BACKFLOW PREVENTERS

- A. Reduced-Pressure-Principle Backflow Preventers:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; Conbraco Industries, Inc.
 - b. FEBCO; a Division of Watts Water Technologies, Inc.
 - c. Watts Water Technologies, Inc.; Ames Fire & Waterworks.
 - d. Watts Water Technologies, Inc.; Watts Regulator Co.
 - e. Zurn Plumbing Products Group; Wilkins Div.
 2. Standard: ASSE 1013.

3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
5. Size and Capacities: As scheduled on the drawings.
6. Body: Bronze for NPS 2 and smaller; cast-iron or ductile-iron, with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
7. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
8. Configuration: Designed for horizontal, straight through flow. Accessories:
 - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
 - b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
 - c. Y-Pattern strainer and soft-seated check valve.

2.03 **WATER PRESSURE-REDUCING VALVES**

A. Water Regulators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bell & Gossett; Xylem Inc.
 - b. Taco, Inc.
 - c. Watts Water Technologies, Inc.; Watts Regulator Co.
2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 150 psig.
4. Size and Capacities: As scheduled on the drawings.
5. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
6. Valves for Booster Heater Water Supply: Include integral bypass.
7. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

B. Water Control Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; by Conbraco Industries.
 - b. CLA-VAL Automatic Control Valves.
 - c. Flomatic Corporation.
 - d. OCV Control Valves.
 - e. Watts Water Technologies, Inc.; Watts Regulator Co.
 - f. Zurn Plumbing Products Group; Wilkins Div.
2. Description: Pilot-operation, diaphragm-type, single-seated main water control valve.
3. Pressure Rating: Initial working pressure of 150 psig minimum with AWWA C550 or FDA-approved, interior epoxy coating. Include small pilot-control valve, restrictor device, specialty fittings, and sensor piping.
4. Main Valve Body: Cast- or ductile-iron body with AWWA C550 or FDA-approved, interior epoxy coating; or stainless-steel body.
 - a. Pattern: Angle or Globe-valve design.
 - b. Trim: Stainless steel.
5. Size and Capacities: As scheduled on the drawings.
6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.

2.04 **TEMPERATURE-ACTUATED WATER MIXING VALVES**

A. Water-Temperature Limiting Devices:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Controls; Morris Group International; ST70.
 - b. Apollo Valves; Conbraco Industries, Inc.; Model MVD (34D Series).
 - c. Bradley Corporation.
 - d. Lawler Manufacturing Company, Inc.
 - e. Leonard Valve Company; Series 170-LF and 270-LF.
 - f. Watts Water Technologies, Inc.; Powers Division; Hydroguard Series LFe480, LFG480, and LFLM495.

- g. Watts Water Technologies, Inc.; Watts Regulator Co.
 - h. Zurn Plumbing Products Group; Wilkins Div.
 - 2. Standard: ASSE 1070.
 - 3. Pressure Rating: 125 psig.
 - 4. Type: Thermostatically controlled water mixing valve.
 - 5. Material: Bronze body with corrosion-resistant interior components.
 - 6. Connections: 1/2-inch union or 3/8-inch compression; with integral check valves.
 - 7. Accessories: Adjustable temperature-control knob.
 - 8. Outlet Temperature Range: Adjustable from 85 deg F to 120 deg F. Set at 105 deg F.
 - 9. Minimum Flow Rate: 0.5 gpm.
 - 10. Valve Finish: Chrome plated.
 - B. Primary, Thermostatic, Water Mixing Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Controls; Morris Group International; MV17.
 - b. Apollo Valves; Conbraco Industries, Inc.
 - c. Armstrong International, Inc. (RADA).
 - d. Bradley Corporation.
 - e. Lawler Manufacturing Company, Inc.
 - f. Leonard Valve Company.
 - g. Symmons Industries, Inc.
 - h. Watts Water Technologies, Inc.; Powers Division.
 - i. Watts Water Technologies, Inc.; Watts Regulator Co.
 - j. Zurn Plumbing Products Group; Wilkins Div.
 - 2. Standard: ASSE 1017.
 - 3. Type: Cabinet-type, thermostatically controlled water mixing valve.
 - 4. Material: Bronze body with corrosion-resistant interior components.
 - 5. Connections: Threaded union inlets and outlet.
 - 6. Accessories: Manual temperature control, check stops and strainers on hot- and cold-water supplies, and adjustable, temperature-control handle.
 - 7. Valve Pressure Rating: 125 psig minimum, unless otherwise indicated.
 - 8. Size, Settings, and Capacities: As scheduled on the drawings.
 - 9. Valve Finish: Chrome plated.
 - 10. Cabinet: Factory-fabricated, stainless steel, for surface mounting and with hinged, stainless-steel door.
 - C. Automatic Temperature Control Mixing Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Controls; Morris Group International; ST7069.
 - b. Apollo Valves; Conbraco Industries, Inc.; 34 HL Series.
 - c. Lawler Manufacturing Company, Inc.
 - 2. Standard: ASSE 1069.
 - 3. Type: Cabinet-type, thermostatically controlled water mixing valve.
 - 4. Material: Bronze body with corrosion-resistant interior components.
 - 5. Connections: Threaded inlets and outlet.
 - 6. Accessories: Manual temperature control, check stops and strainers on hot- and cold-water supplies, and adjustable, temperature-control.
 - 7. Valve Pressure Rating: 125 psig minimum, unless otherwise indicated.
 - 8. Tempered-Water Setting: Maximum 120 deg F.
 - 9. Size and Capacities: As scheduled on the drawings.
 - 10. Valve Finish: Chrome plated.
 - 11. Cabinet: Factory-fabricated, stainless steel, for surface mounting and with hinged, stainless-steel door.

2.05 **STRAINERS FOR DOMESTIC WATER PIPING**

- A. Y-Pattern Strainers:

1. Manufacturers:
 - a. Apollo Valves; Conbraco Industries, Inc.
 - b. Keckley Company.
 - c. Metraflex Company.
 - d. Mueller Steam Specialty; a Watts Brand.
 - e. NIBCO, Inc.
 - f. Titan Flow Control, Inc.
 - g. Watts.
 - h. Yarway; Emerson Automation Solutions.
 2. CWP: 200 psig minimum, unless otherwise indicated.
 3. SWP: 125 psig minimum, unless otherwise indicated.
 4. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 and larger.
 5. End Connections: Threaded or soldered for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
 6. Screen: Stainless steel with round perforations, unless otherwise indicated.
 7. Perforation Size:
 - a. Strainers NPS 2 and Smaller: 0.033 inch.
 - b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.
 - c. Strainers NPS 5 and Larger: 0.045 inch.
 8. Drain: Pipe plug.
- 2.06 **TRAP-SEAL PRIMER VALVES**
- A. Supply-Type, Trap-Seal Primer Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. MIFAB, Inc.
 - b. PPP Inc.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Watts Water Technologies, Inc.
 2. Standard: ASSE 1018.
 3. Pressure Rating: 125 psig minimum.
 4. Body: Bronze.
 5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
 6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
 7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for piping joining materials, joint construction, and basic installation requirements.
- B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
 1. Locate backflow preventers in same room as connected equipment or system.
 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
 3. Do not install bypass piping around backflow preventers.
 4. Install strainer and soft-seated check valve upstream of backflow preventer. Exception: Fire protection backflow preventers.
- C. Install water regulators with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.

- D. Install water control valves with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.
 - E. Install balancing valves in locations where they can easily be adjusted.
 - F. Install temperature-actuated water mixing valves with strainers, and check stops or shutoff valves on inlets and with shutoff valve on outlet.
 - 1. Install thermometers and water regulators if specified.
 - 2. Install cabinet-type units recessed in or surface mounted on wall as specified.
 - G. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve, solenoid valve, and pump.
 - H. Install hose stations with check stops or shutoff valves on inlets and with thermometer on outlet.
 - 1. Install shutoff valve on outlet if specified.
 - 2. Install cabinet-type units recessed in or surface mounted on wall as specified. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Division 06 Section "Rough Carpentry."
 - I. Install water hammer arresters in water piping according to PDI-WH 201.
 - J. Install air vents at high points of water piping.
 - K. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
 - L. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.
 - M. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.
- 3.02 **DOMESTIC WATER CARTRIDGE-FILTER INSTALLATION**
- A. Install cartridge filters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
 - B. Attach wall brackets for off-floor, wall-mounting, cartridge filter to vertical surface. Attach housing(s), and base if any, to wall bracket.
 - C. Install housings for off-floor, in-line, cartridge filters in piping.
 - D. Install isolation valves on inlet and outlet piping of each water filter.
 - E. Install pressure gages on inlet and outlet piping of each water filter. Pressure gages are specified in Division 20 Section "Meters and Gages."
 - F. Install filter elements in cartridges after completion of flushing and cleaning.
- 3.03 **CONNECTIONS**
- A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping and specialties.
 - B. Ground equipment according to Division 26 Section "Grounding and Bonding."
 - C. Connect wiring according to Division 26 Section "Conductors and Cables."
- 3.04 **LABELING AND IDENTIFYING**
- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Pressure vacuum breakers.
 - 2. Reduced-pressure-principle backflow preventers.
 - 3. Primary, thermostatic, water mixing valves.
 - 4. Primary water tempering valves.
 - 5. Supply-type, trap-seal primer valves.
 - 6. Trap-seal primer systems.
 - B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 20 Section "Mechanical Identification."
- 3.05 **FIELD QUALITY CONTROL**
- A. Perform the following tests and prepare test reports:
 - 1. Test each backflow prevention device according to authorities having jurisdiction and the device's reference standard.

- B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.06 **ADJUSTING**

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves as follows:
 - 1. Set calibrated balancing valves at calculated presettings.
 - 2. Measure flow each station and adjust where necessary.
 - 3. Record settings and mark balancing devices.
- C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION

TMP Architecture, Inc.
Peter Basso Associates, Inc.

TMP22103D & 22104E
PBA2023.0155.01 & 2023.0156.01

SECTION 22 1316 - SANITARY WASTE AND VENT PIPING

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements".
 - 2. Division 20 Section "Basic Mechanical Materials and Methods".
 - 3. Division 22 Section "Drainage Piping Specialties".
 - 4. Division 22 Section "Sanitary Waste and Vent Piping" for piping outside building.

1.02 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.
- C. LLDPE: Linear, low-density polyethylene plastic.
- D. NBR: Acrylonitrile-butadiene rubber.
- E. PE: Polyethylene plastic.
- F. PVC: Polyvinyl chloride plastic.
- G. TPE: Thermoplastic elastomer.

1.03 SYSTEMS DESCRIPTIONS

- A. Sanitary waste and vent piping system materials are scheduled on the Drawing.

1.04 ACTION SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.

1.05 CLOSEOUT SUBMITTALS

- A. Field quality-control inspection and test reports.

1.06 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Cast-iron soil pipe shall be marked with the collective trademark of Cast Iron Soil Pipe Institute (CISPI).
- C. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping;

"NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

1.07 **PROJECT CONDITIONS**

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

PART 2 PRODUCTS

2.01 **MANUFACTURERS**

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

2.02 **HUBLESS CAST-IRON SOIL PIPE AND FITTINGS**

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. CISPI, Hubless-Piping Couplings:
1. Manufacturers:
 - a. ANACO-Husky; McWane Plumbing Group.
 - b. Ferguson Enterprises, Inc.; ProFlo (Private labeled IDEAL-TRIDON).
 - c. IDEAL-TRIDON.
 - d. MIFAB, Inc.
 - e. Mission Rubber Company; a division of MCP Industries, Inc.
 - f. Tyler Pipe; McWane Plumbing Group.
 2. Standards: CISPI 310.
 3. Description: NSF certified for compliance with CISPI 310. Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.03 **PVC PIPE AND FITTINGS**

- A. Solid-Wall PVC Pipe: Schedule 40, ASTM D 2665, drain, waste, and vent.
1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

2.04 **SPECIALTY PIPE FITTINGS**

- A. Flexible, Nonpressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.
1. Manufacturers:
 - a. Dallas Specialty & Mfg. Co.
 - b. Fernco, Inc.
 - c. Logan Clay Products Company (The).
 - d. Mission Rubber Co.
 - e. NDS, Inc.
 - f. Plastic Oddities, Inc.
 2. Sleeve Materials:
 - a. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
 - b. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
 - c. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
- B. Shielded Nonpressure Pipe Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
1. Manufacturers:
 - a. Cascade Waterworks Mfg. Co.

- b. Mission Rubber Co.
- C. Rigid, Unshielded, Nonpressure Pipe Couplings: ASTM C 1461, sleeve-type reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.
 - 1. Manufacturers:
 - a. ANACO.
- D. Pressure Pipe Couplings: AWWA C219 metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
 - 1. Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Dresser, Inc.; DMD Div.
 - c. Ford Meter Box Company, Inc. (The); Pipe Products Div.
 - d. JCM Industries, Inc.
 - e. Smith-Blair, Inc.
 - f. Viking Johnson.
 - 2. Center-Sleeve Material: Manufacturer's standard.
 - 3. Gasket Material: Natural or synthetic rubber.
 - 4. Metal Component Finish: Corrosion-resistant coating or material.
- E. Wall-Penetration Fittings: Compound, ductile-iron coupling fitting with sleeve and flexing sections for up to 20-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
 - 1. Manufacturers:
 - a. SIGMA Corp.

PART 3 EXECUTION

3.01 EXCAVATION

- A. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.02 PIPING SYSTEM INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Sanitary sewer piping outside the building is specified in Division 22 Section "Sanitary Sewerage."
- C. Basic piping installation requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."
- D. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- E. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.
- F. Install underground, ductile-iron, force-main piping according to AWWA C600. Install buried piping inside the building between wall and floor penetrations and connection to sanitary sewer piping outside the building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.
- G. Install underground, ductile-iron, special pipe fittings according to AWWA C600.
- H. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 20 Section "Basic Mechanical Materials and Methods."
- I. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction

- of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- K. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
 - L. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
 - 1. Building Sanitary Drain: 1/8-inch per foot downward in direction of flow, unless otherwise noted.
 - 2. Horizontal Sanitary Drainage Piping: 1/8-inch per foot downward in direction of flow, unless otherwise noted.
 - 3. Vent Piping: 1/8-inch per foot down toward vertical fixture vent or toward vent stack.
 - M. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
 - N. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.
 - O. Install underground PVC soil and waste drainage piping according to ASTM D 2321.
 - P. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- 3.03 **JOINT CONSTRUCTION**
- A. Basic piping joint construction requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."
 - B. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
 - C. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
 - D. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
 - E. Join stainless-steel pipe and fittings with gaskets according to ASME A112.3.1.
 - F. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.
- 3.04 **SPECIALTY PIPE FITTING INSTALLATION**
- A. Transition Couplings:
 - 1. Install transition couplings at joints of piping with small differences in OD's.
 - 2. In Drainage Piping: Unshielded nonpressure transition couplings.
 - 3. In Aboveground Force Main Piping: Fitting-type transition couplings.
 - 4. In Underground Force Main Piping:
 - a. NPS 1-1/2 and Smaller: Fitting-type transition couplings.
 - b. NPS 2 and Larger: Pressure transition couplings.
- 3.05 **VALVE INSTALLATION**
- A. General valve installation requirements are specified in Division 20 Section "Valves."
 - B. Backwater Valves: Install backwater valves in piping subject to sewage backflow.
 - 1. Horizontal Piping: Horizontal backwater valves. Use normally closed type, unless otherwise indicated.
 - 2. Floor Drains: Drain outlet backwater valves, unless drain has integral backwater valve.
 - 3. Install backwater valves in accessible locations.
 - 4. Backwater valves are specified in Division 22 Section "Drainage Piping Specialties."
- 3.06 **HANGER AND SUPPORT INSTALLATION**
- A. Pipe hangers and supports are specified in Division 20 Section "Hangers and Supports." Install the following:
 - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 2. Install individual, straight, horizontal piping runs according to the following:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Install supports according to Division 20 Section "Hangers and Supports."
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
- E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
 2. NPS 3: 60 inches with 1/2-inch rod.
 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
 4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
 5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.
- F. Install supports for vertical cast-iron soil piping every 15 feet.
- G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 1-1/4: 84 inches with 3/8-inch rod.
 2. NPS 1-1/2: 108 inches with 3/8-inch rod.
 3. NPS 2: 10 feet with 3/8-inch rod.
 4. NPS 2-1/2: 11 feet with 1/2-inch rod.
 5. NPS 3: 12 feet with 1/2-inch rod.
 6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
 7. NPS 6 and NPS 8: 12 feet with 3/4-inch rod.
 8. NPS 10 and NPS 12: 12 feet with 7/8-inch rod.
- H. Install supports for vertical steel piping every 15 feet.
- I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.07 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect drainage and vent piping to the following:
 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
 4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.
- D. Connect force-main piping to the following:
 1. Sanitary Sewer: To exterior force main or sanitary manhole.

3.08 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Division 20 Section "Mechanical Identification."

3.09 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
 - D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
 - 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
 - 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 - 6. Prepare reports for tests and required corrective action.
 - E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 2. Cap and subject piping to static-water pressure of 150 psig, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - 3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 - 4. Prepare reports for tests and required corrective action.
- 3.10 **CLEANING**
- A. Clean interior of piping. Remove dirt and debris as work progresses.
 - B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
 - C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION

SECTION 22 1319 - DRAINAGE PIPING SPECIALTIES

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 22 Section "Plumbing Fixtures" for hair interceptors.
 - 4. Division 22 Section "Healthcare Plumbing Fixtures" for plaster sink interceptors.

1.02 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. FRP: Fiberglass-reinforced plastic.
- C. HDPE: High-density polyethylene plastic.
- D. PE: Polyethylene plastic.
- E. PP: Polypropylene plastic.
- F. PVC: Polyvinyl chloride plastic.

1.03 ACTION SUBMITTALS

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

1.04 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For drainage piping specialties to include in operation and maintenance manuals.

1.05 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary and storm piping specialty components.

1.06 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 size and location of roof penetrations.

PART 2 PRODUCTS

2.01 BACKWATER VALVES

- A. Horizontal, Cast-Iron Backwater Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.; Model 7012.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 2. Standard: ASME A112.14.1.
 3. Size: Same as connected piping.
 4. Body: Enameled or epoxy-coated cast iron.
 5. Cover: Cast iron with bolted or threaded access check valve.
 6. End Connections: Hub and spigot or hubless.
 7. Type Check Valve: Removable, bronze, swing check, factory assembled or field modified to hang closed.
 8. Extension: ASTM A 74, Service class; full-size, cast-iron, soil-pipe extension to field-installed cleanout at floor; replaces backwater valve cover.
- B. Drain-Outlet Backwater Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.
 - c. Watts Drainage Products Inc.
 - d. Zurn Plumbing Products Group; Specification Drainage Operation.
 2. Size: Same as floor drain outlet.
 3. Body: Cast iron or bronze made for vertical installation in bottom outlet of floor drain.
 4. Check Valve: Removable ball float.
 5. Inlet: Threaded.
 6. Outlet: Threaded or spigot.
- C. Horizontal, Plastic Backwater Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Canplas LLC.
 - b. IPS Corporation.
 - c. NDS Inc.
 - d. Oatey.
 - e. Plastic Oddities; a division of Diverse Corporate Technologies.
 - f. Sioux Chief Manufacturing Company, Inc.; ProCheck.
 - g. Zurn Plumbing Products Group; Light Commercial Operation.
 2. Size: Same as connected piping.
 3. Body: PVC.
 4. Cover: Same material as body with threaded access to check valve.
 5. Check Valve: Removable swing check.
 6. End Connections: Socket type.
 7. Deep-Bury Adapters: Same material as body, with solvent weld connections to extension.
 8. Extension: NPS 6, Schedule 40 PVC extension to backwater valve cover at floor.
- D. Access Hand Holes:
1. Description: Comply with SCTE 77.
 - a. Color: Gray.
 - b. Configuration: Units shall be designed for flush burial and have open bottom, unless otherwise indicated.
 - c. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
 - d. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 - e. Cover Legend: Molded lettering, as indicated for each service.

- f. Piping Entrance Provisions: Precast in enclosure wall.
- g. Yard Boxes: 12 inches wide by 24 inches long.
- 2. Polymer Concrete Yard Boxes with Polymer Concrete Cover: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Armorcast Products Company.
 - 2) Carson Industries LLC.
 - 3) CDR Systems Corporation.
 - 4) NewBasis.
 - 5) QUAZITE; Hubbell Lenior City, Inc.

2.02 **CAST-IRON CLEANOUTS**

- A. Size: Cleanouts shall be same nominal size as the pipe they serve up to 4 inches. For pipes larger than 4 inches nominal size, minimum size of cleanout shall be 4 inches.
- B. Exposed Cast-Iron Cleanouts:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.; Series 58910.
 - b. MIFAB, Inc.; C1460.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; 4510 Series.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 - 2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
 - 3. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch or hubless, cast-iron soil pipe test tee as required to match connected piping.
 - 4. Closure: Countersunk or raised-head, brass or bronze plug with tapered threads.
- C. Cast-Iron Floor Cleanouts (On-Grade Interior Floor Areas):
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.; C1220-R.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 4023S-F.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products Inc.
 - g. Zurn Plumbing Products Group; Specification Drainage Operation.
 - 2. Standard: ASME A112.36.2M.
 - 3. Type: Adjustable housing.
 - 4. Body or Ferrule: Cast iron.
 - 5. Clamping Device: Not required.
 - 6. Outlet Connection: Spigot.
 - 7. Closure: Brass, bronze, or plastic plug with tapered threads.
 - 8. Adjustable Housing Material: Cast iron with threads, set-screws or other device.
 - 9. Frame and Cover Material and Finish: Nickel-bronze, copper alloy with scoriated cover in service areas, and recessed cover to accept floor finish material in finished floor areas.
 - 10. Frame and Cover Shape: Round.
 - 11. Top Loading Classification: Medium Duty.
 - 12. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
- D. Cast-Iron Wall Cleanouts (Finished Wall Areas):
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.; Model 58790-20.
 - b. MIFAB, Inc.; C1460-RD.

- c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
- d. Tyler Pipe; Wade Div.
- e. Watts Drainage Products Inc.
- f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M. Include wall access.
3. Body: Hub-and-spigot, cast-iron soil pipe T-branch or hubless, cast-iron soil pipe test tee as required to match connected piping.
4. Closure: Countersunk or raised-head, drilled-and-threaded bronze or brass plug with tapered threads.
5. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.

2.03 **FLOOR DRAINS**

A. Cast-Iron Floor Drains (Toilet Rooms, Labs, and Janitor's Closet) FD-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Sioux Chief Manufacturing Company, Inc.; Finish Line Adjustable Drainage System.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 2005Y-A.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products Inc.
 - g. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.7.
3. Pattern: Floor drain.
4. Body Material: Gray iron.
5. Seepage Flange: Required.
6. Clamping Device: Required.
7. Outlet: Bottom unless otherwise noted.
8. Coating on Interior and Exposed Exterior Surfaces: Enamel.
9. Top or Strainer Material: Nickel bronze.
10. Top of Body and Strainer Finish: Nickel bronze.
11. Top Shape: Round, with vandal proof screws.
12. Dimensions of Top or Strainer: 7 inch diameter.
13. Top Loading Classification: Light Duty.
14. Inlet Fitting: Gray iron, with spigot outlet.

2.04 **AIR-ADMITTANCE VALVES**

A. Fixture Air-Admittance Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ayrlett, LLC.
 - b. Durgo, Inc.
 - c. Oatey.
 - d. ProSet Systems Inc.
 - e. RectorSeal.
 - f. Studor, Inc.
2. Standard: ASSE 1051, Type A for single fixture or Type B for branch piping.
3. Housing: Plastic.
4. Operation: Mechanical sealing diaphragm.
5. Size: Same as connected fixture or branch vent piping.

B. Stack Air-Admittance Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Durgo, Inc.
 - b. Oatey.
 - c. Studor, Inc.
2. Standard: ASSE 1050 for vent stacks.

3. Housing: Plastic.
 4. Operation: Mechanical sealing diaphragm.
 5. Size: Same as connected stack vent or vent stack.
- C. Wall Box:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Durgo, Inc.
 - b. Oatey.
 - c. RectorSeal.
 - d. Studor, Inc.
 2. Description: White plastic housing with white plastic grille, made for recessed installation. Include bottom pipe connection and space to contain one air-admittance valve.
 3. Size: About 9 inches wide by 8 inches high by 4 inches deep.
- 2.05 **ROOF FLASHING ASSEMBLIES**
- A. Roof Flashing Assemblies:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Engineering Company; Elmdor/Stoneman Div.
 - b. Thaler Metal Industries Ltd.
 - B. Description: Manufactured assembly consisting of metal flashing collar and skirt extending at least 6 inches from pipe, with boot reinforcement and counterflashing fitting.
 1. Open-Top Vent Cap: Without cap.
 2. Low-Silhouette Vent Cap: With vandal-proof vent cap.
 3. Extended Vent Cap: With field-installed, vandal-proof vent cap.
- 2.06 **TRAP SEAL PROTECTION DEVICES**
- A. Barrier Type Trap Seal Protection Devices:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Smith, Jay R. Mfg. Co.; Quad Close Trap Seal Device Fig. 2692.
 - b. Rectorseal; a CSW Industrials Company; SureSeal Plus Inline Floor Drain Trap Sealer.
 2. Standard: ASSE 1072-2007.
 3. Sealing Element: Neoprene rubber or chemically resistant elastomer.
 4. Size: 2 inch, 3 inch, 3-1/2 inch, or 4 inch.
 5. Gravity Drain Outlet Connection: Compression fit sealing gasket 80 durometer.
- 2.07 **MISCELLANEOUS DRAINAGE PIPING SPECIALTIES**
- A. Hub Outlets:
1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.
 2. Size: Same as connected waste piping with increaser fitting of size indicated.
- B. Deep-Seal Traps:
1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
 2. Size: Same as connected waste piping.
 - a. NPS 2: 4-inch- minimum water seal.
 - b. NPS 2-1/2 and Larger: 5-inch- minimum water seal.
- C. Air-Gap Fittings:
1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
 2. Body: Bronze or cast iron.
 3. Inlet: Opening in top of body.
 4. Outlet: Larger than inlet.
 5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

- D. Sleeve Flashing Device:
 - 1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
 - 2. Size: As required for close fit to riser or stack piping.
 - E. Stack Flashing Fittings:
 - 1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
 - 2. Size: Same as connected stack vent or vent stack.
 - F. Vent Caps:
 - 1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
 - 2. Size: Same as connected stack vent or vent stack.
 - G. Expansion Joints:
 - 1. Standard: ASME A112.21.2M.
 - 2. Body: Cast iron with bronze sleeve, packing, and gland.
 - 3. End Connections: Matching connected piping.
 - 4. Size: Same as connected soil, waste, or vent piping.
- 2.08 **FLASHING MATERIALS**
- A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
 - 1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
 - 2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
 - 3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.
 - B. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:
 - 1. General Applications: 12 oz./sq. ft.
 - 2. Vent Pipe Flashing: 8 oz./sq. ft.
 - C. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.
 - D. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.
 - E. Fasteners: Metal compatible with material and substrate being fastened.
 - F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
 - G. Solder: ASTM B 32, lead-free alloy.
 - H. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for piping joining materials, joint construction, and basic installation requirements.
- B. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.
 - 1. Installation of Access Hand Holes:
 - a. Install boxes level and plumb and with orientation and depth coordinated with connecting piping to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of piping, and seal joint between box and extension as recommended by the manufacturer.
 - b. Unless otherwise indicated, support units on a 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. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 - 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 - 2. Locate at each change in direction of piping greater than 45 degrees.
 - 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 - 4. Locate at base of each vertical soil and waste stack.
- D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- F. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 - 1. Position floor drains for easy access and maintenance.
 - 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
 - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
 - c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
 - 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 - 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- G. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface, unless otherwise indicated.
- H. Assemble stainless-steel channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.
- I. Assemble FRP channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.
- J. Assemble plastic channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.
- K. Install fixture air-admittance valves on fixture drain piping.
- L. Install stack air-admittance valves at top of stack vent and vent stack piping.
- M. Install air-admittance-valve wall boxes recessed in wall.
- N. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- O. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
- P. Assemble open drain fittings and install with top of hub 2 inches above floor.
- Q. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- R. Install floor-drain, trap-seal primer fittings on floor drains that require trap-seal primer connection.
- S. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- T. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- U. Install vent caps on each vent pipe passing through roof.
- V. Install frost-resistant vent terminals on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.
- W. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- X. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.
- Y. Install wood-blocking reinforcement for wall-mounting-type specialties.

- Z. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
 - AA. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.
 - BB. Install through-penetration firestop assemblies for penetrations of fire- and smoke-rated assemblies.
 - 1. Comply with requirements in Division 07 Section "Penetration Firestopping."
- 3.02 **CONNECTIONS**
- A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
 - B. Install piping adjacent to equipment to allow service and maintenance.
- 3.03 **FLASHING INSTALLATION**
- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 - 1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
 - 2. Copper Sheets: Solder joints of copper sheets.
 - B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
 - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
 - C. Set flashing on floors and roofs in solid coating of bituminous cement.
 - D. Secure flashing into sleeve and specialty clamping ring or device.
 - E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing and Trim."
 - F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.
 - G. Fabricate and install flashing and pans, sumps, and other drainage shapes.
- 3.04 **PROTECTION**
- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
 - B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

SECTION 22 3300 - ELECTRIC DOMESTIC WATER HEATERS

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PART 1 GENERAL

- 1.01 **RELATED DOCUMENTS**
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
B. Related Sections include the following:
1. Division 20 Section "Mechanical General Requirements."
2. Division 20 Section "Basic Mechanical Materials and Methods."
- 1.02 **ACTION SUBMITTALS**
A. Product Data: For each type and size of water heater indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- 1.03 **INFORMATIONAL SUBMITTALS**
A. Shop Drawings: Detail water heater assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
1. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
B. Product Certificates: For each type of electric water heater, signed by product manufacturer.
C. Source quality-control test reports.
- 1.04 **CLOSEOUT SUBMITTALS**
A. Field quality-control test reports.
B. Operation and Maintenance Data: For electric water heaters to include in operation and maintenance manuals.
C. Warranty: Special warranty specified in this Section.
- 1.05 **QUALITY ASSURANCE**
A. Source Limitations: Obtain same type of electric water heaters through one source from a single manufacturer.
B. Product Options: Drawings indicate size, profiles, and dimensional requirements of electric water heaters and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a NRTL acceptable to authorities having jurisdiction, and marked for intended use.
D. ASME Compliance: Where indicated, fabricate and label commercial water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
E. ASHRAE Standards: Comply with performance efficiencies prescribed for the following:
1. ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings," for commercial water heaters.

- F. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," for all components that will be in contact with potable water.

1.06 **COORDINATION**

- A. Coordinate size and location of concrete bases with Architectural and Structural Drawings.

PART 2 PRODUCTS

2.01 **MANUFACTURERS**

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

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

- B. Standard, Storage Electric Water Heaters: Comply with UL 174.

- 1. Manufacturers:

- a. Bock Water Heaters, Inc.
- b. Bradford White Corporation.
- c. Lochinvar Corporation.
- d. Smith, A. O. Water Products Company.

- 2. Storage-Tank Construction: Steel.

- a. Tappings: ASME B1.20.1 pipe thread.
- b. Pressure Rating: 150 psig.
- c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.

- 3. Factory-Installed Storage-Tank Appurtenances:

- a. Anode Rod: Replaceable magnesium.
- b. Dip Tube: Provide unless cold-water inlet is near bottom of tank.
- c. Drain Valve: ASSE 1005.
- d. Insulation: Comply with ASHRAE/IESNA 90.1 or ASHRAE 90.2.
- e. Jacket: Steel with enameled finish.
 - 1) Standard: Cylindrical shape.
- f. Heat Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
- g. Heating Elements: Two; electric, screw-in immersion type with 12 kW or less total, and wired for non-simultaneous operation, unless otherwise indicated.
- h. Temperature Control: Adjustable thermostat for each element.
- i. Safety Control: High-temperature-limit cutoff device or system.
- j. Relief Valve: ASME rated and stamped and complying with ASME PTC 25.3 for combination temperature and pressure relief valves. Include relieving capacity at least as great as heat input and include pressure setting less than water heater working-pressure rating. Select relief valve with sensing element that extends into storage tank.

- 4. Capacity and Characteristics: Refer to Schedule on Drawings.

2.02 **EXPANSION TANKS**

- A. Description: Steel pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air pre-charge to minimum system-operating pressure at tank.

- 1. Manufacturers:

- a. AMTROL Inc.
- b. Armstrong Pumps, Inc.
- c. Bell & Gossett; Xylem Inc.
- d. Taco, Inc.
- e. Wessels Co.

- 2. Construction:

- a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1, pipe thread.
- b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
- c. Air-Charging Valve: Factory installed.

- 3. Capacity and Characteristics:

- a. Refer to Schedule on Drawings.
 - B. Description: Steel, pressure-rated tank, ASME-code constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air pre-charge to minimum system-operating pressure at tank.
 - 1. Manufacturers:
 - a. AMTROL Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett; Xylem Inc.
 - d. Taco, Inc.
 - e. Wessels Co.
 - 2. Construction:
 - a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
 - b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - c. Air-Charging Valve: Factory installed.
 - 3. Capacity and Characteristics: Refer to Schedule on Drawings.
- 2.03 **WATER HEATER ACCESSORIES**
- A. Combination Temperature and Pressure Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3. Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.
 - B. Water Heater Stand and Drain-Pan Units: High-density-polyethylene-plastic, 18-inch- high, enclosed-base stand complying with IAPMO PS 103 and IAS No. 2. Include integral or separate drain pan with raised edge and NPS 1 drain outlet with ASME B1.20.1 pipe thread.
 - C. Water Heater Stands: Water heater manufacturer's factory-fabricated steel stand for floor mounting and capable of supporting water heater and water. Include dimension that will support bottom of water heater a minimum of 18 inches above the floor.
 - D. Water Heater Mounting Brackets: Water heater manufacturer's factory-fabricated steel bracket for wall mounting and capable of supporting water heater and water.
 - E. Drain Pans: Corrosion-resistant metal with raised edge. Include dimensions not less than base of water heater and include drain outlet not less than NPS 3/4.
 - F. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1 or ASHRAE 90.2.
 - G. Water Regulators: ASSE 1003, water-pressure reducing valve. Set at 25-psig- maximum outlet pressure, unless otherwise indicated.
 - H. Shock Absorbers: ASSE 1010 or PDI WH 201, Size A water hammer arrester.

2.04 **SOURCE QUALITY CONTROL**

- A. Test and inspect water heater storage tanks, specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.
- B. Hydrostatically test water heater storage tanks before shipment to minimum of one and one-half times pressure rating.
- C. Prepare test reports.

PART 3 EXECUTION

3.01 **WATER HEATER INSTALLATION**

- A. Install commercial water heaters on concrete bases.
 - 1. Exception: Omit concrete bases for commercial water heaters if installation on stand, bracket, suspended platform, or direct on floor is indicated.
 - 2. Concrete base construction requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."
- B. Install water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
- C. Install combination temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-

valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

- D. Install combination temperature and pressure relief valves in water piping for water heaters without storage. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- E. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for water heaters that do not have tank drains. Refer to Division 20 Section "Valves" for hose-end drain valves.
- F. Install thermometer on outlet piping of water heaters. Refer to Division 20 Section "Meters and Gages" for thermometers.
- G. Install pressure gage(s) on outlet of commercial electric water- heater piping. Refer to Division 20 Section "Meters and Gages" for pressure gages.
- H. Assemble and install inlet and outlet piping manifold kits for multiple water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each water heater. Include shutoff valve, thermometer in each water heater inlet and outlet, and throttling valve in each water heater outlet. Refer to Division 20 Section "Valves" for general-duty valves and to Division 20 Section "Meters and Gages" for thermometers.
- I. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks without integral or fitting-type heat traps.
- J. Fill water heaters with water.
- K. Charge compression tanks with air.

3.02 CONNECTIONS

- A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to water heaters to allow service and maintenance. Arrange piping for easy removal of water heaters.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding."
- D. Connect wiring according to Division 26 Section "Conductors and Cables."

3.03 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
 - 1. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, confirm proper operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove water heaters that do not pass tests and inspections. Replace with water heaters meeting Contract requirements and retest as specified above.

3.04 DEMONSTRATION

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

END OF SECTION

TMP Architecture, Inc.
Peter Basso Associates, Inc.

TMP22103D & 22104E
PBA2023.0155.01 & 2023.0156.01

SECTION 22 4200 - PLUMBING FIXTURES

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 10 Section "Toilet and Bath Accessories."
 - 2. Division 20 Section "Mechanical General Requirements."
 - 3. Division 20 Section "Basic Mechanical Materials and Methods."
 - 4. Division 22 Section "Security Plumbing Fixtures."
 - 5. Division 22 Section "Drinking Fountains and Water Coolers."
 - 6. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers; individual-fixture, water tempering valves; and specialty fixtures not included in this Section.
 - 7. Division 22 Section "Drainage Piping Specialties" for floor drains, and specialty fixtures not included in this Section.

1.02 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- C. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.
- D. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.
- E. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.
- F. FRP: Fiberglass-reinforced plastic.
- G. PMMA: Polymethyl methacrylate (acrylic) plastic.
- H. PVC: Polyvinyl chloride plastic.
- I. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.

1.04 **INFORMATIONAL SUBMITTALS**

- A. Shop Drawings: Diagram power, signal, and control wiring.
- B. Coordination Drawings: Counter cutout templates for mounting of counter-mounted plumbing fixtures.

1.05 **CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For plumbing fixtures and trim to include in operation and maintenance manuals.

1.06 **QUALITY ASSURANCE**

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
 - 1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.
- C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities" for plumbing fixtures for people with disabilities.
- D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- E. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.
- F. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," and NSF 372 Drinking Water System Components – Lead Content for potable domestic water piping and components.
- G. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- H. Comply with applicable ANSI, ASME, ASSE, ASTM, ICC, NSF, and UL standards and other requirements specified for plumbing fixtures, trim, fittings, components, and features.

PART 2 PRODUCTS

2.01 **SERVICE SINKS**

- A. Service Sinks, SS-1:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard Companies, Inc.; Florwell Cast Iron Service Sink.
 - b. Kohler Co.; Whitby K 6710.
 - c. Zurn Plumbing Products Group; Z5850.
 - 2. Description: Floor-mounting, enameled, cast-iron fixture with front apron, raised back, and coated, wire rim guard.
 - a. Size: 28 by 28 inches.
 - b. Color: White.
 - c. Faucet: Sink SF-7.
 - d. Drain: Grid with NPS 3 outlet.

2.02 **SINK FAUCETS**

- A. Sink Faucets, SF-7:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard Companies, Inc.
 - b. Chicago Faucets; Model 897.
 - c. Delta Faucet Company; Model 28C2383.
 - d. Ferguson Enterprises, Inc.; ProFlo PF1118.
 - e. Kohler Co.
 - f. Moen Commercial.
 - g. Speakman Company; SC5811-RCP-LEV-5H-WHK.
 - h. Symmons Industries, Inc.

- i. T & S Brass and Bronze Works, Inc.
- j. Zurn Plumbing Products Group.
- 2. Description: Service sink faucet with stops in shanks, vacuum breaker, hose-thread outlet, and pail hook. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor. Include 5 foot rubber hose and wall mounted hose clamp.
 - a. Body Material: Commercial, solid brass.
 - b. Finish: Polished chrome plate.
 - c. Maximum Flow Rate: 2.5 gpm, unless otherwise indicated.
 - d. Mixing Valve: Two handle.
 - e. Centers: 8 inches.
 - f. Mounting: Back/wall.
 - g. Handle(s): Lever.
 - h. Inlet(s): NPS 1/2.
 - i. Spout Type: Rigid, solid brass with wall brace and pail hook.
 - j. Spout Outlet: Hose thread.
 - k. Vacuum Breaker: Required.
 - l. Operation: Noncompression, manual.

2.03 **FIXTURE SUPPLIES**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. BrassCraft; a Masco Company.
 - 2. McGuire Mfg. Co., Inc.
 - 3. Any of the approved plumbing fixture manufacturers.
- B. Description: Chrome-plated brass, loose-key or screwdriver angle stops with brass stems; rigid, chrome-plated copper risers; and chrome-plated wall flanges.

PART 3 EXECUTION

3.01 **EXAMINATION**

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.
- B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 **INSTALLATION**

- A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
 - 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
 - 2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
 - 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.
- D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
- E. Install wall-mounting fixtures with tubular waste piping attached to supports.
- F. Install wall-mounting urinals with PVC-DWV piping from urinal outlet to first change in piping direction.
- G. Install counter-mounting fixtures in and attached to casework.
- H. Install fixtures level and plumb according to roughing-in drawings. Install accessible fixtures at heights required by local codes.
- I. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
 - 1. Exception: Fixtures with flushometer valves, and faucets or valves with integral stops.

- J. Install ASSE 1070 water-temperature limiting devices on supplies for lavatories and sinks that will be used for handwashing, and where specified. Refer to Division 20 Section "Domestic Water Piping Specialties."
 - K. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
 - L. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
 - M. Install protective shielding guards PSG-1 on exposed traps and supplies of lavatories, and sinks used for hand washing.
 - N. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.
 - O. Install toilet seats on water closets.
 - P. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
 - Q. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
 - R. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
 - S. Install shower flow-control fittings with specified maximum flow rates in shower arms.
 - T. Install traps on fixture outlets.
 - 1. Exception: Omit trap on fixtures with integral traps.
 - 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
 - U. Install disposer in outlet of each sink indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.
 - V. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 20 Section "Basic Mechanical Materials and Methods."
 - W. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."
- 3.03 **CONNECTIONS**
- A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
 - B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
 - C. Individual water line branches, waste lines, vents, and traps for connection to individual fixtures, fixture fittings and specialties shall be in accordance with the schedule on the Drawings.
 - D. Ground equipment according to Division 26 Section "Grounding and Bonding."
 - E. Connect wiring according to Division 26 Section "Conductors and Cables."
- 3.04 **FIELD QUALITY CONTROL**
- A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
 - B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
 - C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
 - D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.
- 3.05 **ADJUSTING**
- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
 - B. Replace washers and seals, or cartridges of leaking and dripping faucets and stops.
- 3.06 **CLEANING**
- A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:

1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
 2. Remove sediment and debris from drains.
- B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.
- 3.07 **PROTECTION**
- A. Provide protective covering for installed fixtures and fittings.
 - B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.
- END OF SECTION**

SECTION 22 4600 - SECURITY PLUMBING FIXTURES

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 10 Section "Toilet and Bath Accessories."
 - 2. Division 20 Section "Mechanical General Requirements."
 - 3. Division 20 Section "Basic Mechanical Materials and Methods."
 - 4. Division 22 Section "General-Duty valves for Plumbing."
 - 5. Division 22 Section "Plumbing Fixtures."
 - 6. Division 22 Section "Drinking Fountains, Water Coolers and Cuspidors."

1.02 DEFINITIONS

- A. Accessible Fixture: Security plumbing fixture that can be approached and used by people with disabilities.
- B. Back-Mounting-Type Fixture: Security plumbing fixture designed to mount on wall sleeve built into wall so installation and removal of fixture and piping and other components are only accessible from service space behind wall.
- C. Front-Mounting-Type Fixture: Security plumbing fixture designed to mount on fixture support with installation and removal from fixture side of wall, and piping and other components are accessible from access panels in fixture or wall.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include furnished specialties and accessories.

1.04 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: Diagram power, signal, and control wiring.

1.05 CLOSEOUT SUBMITTALS

- A. Field quality-control test reports.
- B. Operation and Maintenance Data: For security plumbing fixtures to include in operation and maintenance manuals.

1.06 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

- B. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," and NSF 372 Drinking Water System Components – Lead Content for potable domestic water piping and components.
- C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities about security plumbing fixtures for people with disabilities.
- D. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.
- E. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

PART 2 PRODUCTS

2.01 WATER CLOSETS

- A. Security Water Closets:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Engineering Company.
 - b. Metcraft Industries Inc.
 - c. Willoughby Industries, Inc.
 - 2. Description: IAPMO PS 61, front-mounting security plumbing fixture made for on-floor installation; fabricated from 0.078-inch minimum thickness, ASTM A 666, Type 304 stainless steel. Include SSINA No. 4 polished finish on exposed surfaces, and corrosion-resistant metal for internal piping and bracing.
 - a. Configuration: Standard design.
 - b. Bowl: Elongated, with top inlet, integral trap, siphon-jet design with floor outlet and contoured seat.
 - 1) Seat Surface: SSINA No. 7 polished finish.
 - c. Access to Internal Components: Vandal-resistant access panels.
 - d. Flushing Device: Exposed flushometer valve with oscillating lever-handle mechanism, and 1.28 GPF consumption. Refer to "Flushometer Valves" Article.
 - e. Support: Combination support and waste fitting assembly. Refer to "Fixture Supports" Article.

2.02 URINALS

- A. Security Urinals:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Engineering Company.
 - b. Metcraft Industries Inc.
 - c. Willoughby Industries, Inc.
 - 2. Description: Front-mounting security plumbing fixture; fabricated from 0.078-inch minimum thickness, ASTM A 666, Type 304 stainless steel. Include SSINA No. 4 polished finish on exposed surfaces, and corrosion-resistant metal for internal piping and bracing.
 - a. Type and Configuration: Washout type with top inlet and extended shields.
 - b. Drain: Strainer with NPS 2 tailpiece, trap under fixture, and drain piping complying with ASME A112.18.2.
 - c. Flushing Device: Exposed flushometer valve with oscillating lever-handle mechanism, and 0.125 gal./flush consumption. Refer to "Flushometer Valves" Article.
 - d. Support: Chair carrier. Refer to "Fixture Supports" Article.

2.03 FLUSHOMETER VALVES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Delany Products.
 - 2. Sloan Valve Company.
 - 3. Zurn Plumbing Products Group; Commercial Brass Operation.

- B. Description: Flushometer valves, trim, and components complying with ASSE 1037. Include brass body, check-stop inlet, diaphragm operation, vacuum breaker, tailpiece, chrome-plated finish on exposed components, and non-hold-open feature on trip mechanism. See fixture type for consumption.

2.04 **LAVATORIES**

A. Security Lavatories:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Engineering Company.
 - b. Metcraft Industries Inc.
 - c. Willoughby Industries, Inc.
2. Description: Back-mounting, accessible, security plumbing fixture; fabricated from 0.078-inch minimum thickness, ASTM A 666, Type 304 stainless steel. Include SSINA No. 4 polished finish on exposed surfaces, and corrosion-resistant metal for internal piping and bracing.
 - a. Receptor: Oval or rectangular bowl with integral soap depression and backsplash.
 - b. Hot- and Cold-Water Supply Valves: Mechanical-metering type with push-button actuation and individual check stop.
 - c. Filler Spout: Deck mounted.
 - d. Drain: Integral punched grid with NPS 1-1/4 minimum horizontal waste and trap complying with ASME A112.18.2.
 - e. Wall Sleeve: Galvanized-steel frame of dimensions required to match and support fixture.

2.05 **FIXTURE SUPPORTS**

A. Off-Floor, Plumbing Fixture Supports:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Description: ASME A112.6.1M carriers with dimensions and trim matching fixture.
 - a. Stainless-Steel, Front-Mounting Fixtures: With modifications.
 - 1) Drinking Fountains: Type I drinking fountain carrier.
 - 2) Lavatories: Type III lavatory carrier.
 - 3) Shampoo Bowls: Type II sink carrier.
 - 4) Urinals: Type I urinal carrier with inlet seal unless Type II is required.
 - 5) Water Closets: Combination support and waste fitting assembly.
 - b. Vitreous-China, Wall-Mounting Fixtures:
 - 1) Lavatories: Type III lavatory carrier.
 - 2) Water Closets: Combination support and waste fitting assembly.
 - c. Carriers: With vertical steel uprights with feet. Include tie rods, bearing plates, and mounting studs matching fixture to be supported.
 - d. Combination Support and Waste Fitting Assemblies: With feet and inlet seal.
 - e. Carriers for Accessible Fixtures: Include rectangular, vertical steel uprights instead of steel pipe uprights.

PART 3 EXECUTION

3.01 **EXAMINATION**

- A. Examine roughing-in for water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before security plumbing fixture installation.
- B. Examine floors and walls for suitable conditions where security plumbing fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 **SECURITY PLUMBING FIXTURE INSTALLATION**

- A. Install back-mounting-type, stainless-steel security plumbing fixtures as follows:
 - 1. Install wall sleeve in wall.
 - 2. Install fixture on wall sleeve; mount components on or attached to wall sleeve with access from accessible service space.
 - 3. Extend supply piping from service space to fixture.
 - 4. Install soil and waste piping from fixture and extend into service space.
 - 5. Install fixture trap in service space instead of below fixture drain.
- B. Install front-mounting-type, stainless-steel security plumbing fixtures as follows:
 - 1. Install fixture support or mounting bracket.
 - 2. Install fixture on support; mount components inside of or attached to fixture.
 - 3. Extend supply piping from pipe space to fixture.
 - 4. Install trap below fixture and extend soil and waste piping into pipe space.
- C. Install security plumbing fixture outlets with gasket seals.
- D. Install fixtures designated "accessible" according to ICC A117.1 for heights, dimensions, and clearances.
- E. Install fixtures level and plumb.
- F. Install shutoff valves in water-supply piping to fixtures. Use ball, gate, or globe valve if specific type valve is not indicated. Install valves in locations where they can be easily reached for operation. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing."
- G. Install dielectric fittings in water-supply piping to fixtures if piping and fixture connections are made of different metals. See Division 20 Section "Basic Mechanical Materials and Methods" for dielectric fittings.

3.03 **CONNECTIONS**

- A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect hot- and cold-water supply piping to security plumbing fixtures. Include supply stops, if specified, or ball valve on each supply. Ball valves are specified in Division 22 Section "General-Duty Valves for Plumbing."
- C. Connect soil and waste piping to security plumbing fixtures.

3.04 **FIELD QUALITY CONTROL**

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Testing: After installing security plumbing fixtures, test for compliance with requirements.
 - 2. Remove and replace malfunctioning security plumbing fixtures. Retest as specified above after repairs or replacements are made.

3.05 **ADJUSTING**

- A. Operate and adjust water-supply flushometers and flow-control valves on security plumbing fixtures.

3.06 **CLEANING**

- A. Clean security plumbing fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
 - 1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall spouts and strainers.
 - 2. Remove sediment and debris from drains.
- B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.07 **PROTECTION**

- A. Provide protective covering for installed security plumbing fixtures and fittings.
- B. Do not allow use of security plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 22 4700 - DRINKING FOUNTAINS, WATER COOLERS, AND CUSPIDORS

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."

1.02 DEFINITIONS

- A. Accessible Drinking Fountain or Water Cooler: Fixture that can be approached and used by people with disabilities.
- B. Cast Polymer: Dense, cast-filled-polymer plastic.
- C. Drinking Fountain: Fixture with nozzle for delivering stream of water for drinking.
- D. Fitting: Device that controls flow of water into or out of fixture.
- E. Fixture: Drinking fountain or water cooler.
- F. Remote Water Cooler: Electrically powered equipment for generating cooled drinking water.
- G. TDS: Total dissolved solids.
- H. Water Cooler: Electrically powered fixture for generating and delivering cooled drinking water.

1.03 ACTION SUBMITTALS

- A. Product Data: For each fixture indicated. Include rated capacities, furnished specialties, and accessories.

1.04 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: Diagram power, signal, and control wiring.

1.05 CLOSEOUT SUBMITTALS

- A. Field quality-control test reports.
- B. Operation and Maintenance Data: For fixtures to include in emergency, operation, and maintenance manuals.

1.06 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a NRTL acceptable to authorities having jurisdiction, and marked for intended use.
- B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities for fixtures for people with disabilities.
- C. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.
- D. AHRI Standard: Comply with AHRI's "Directory of Certified Drinking Water Coolers" for style classifications.

- E. AHRI Standard: Comply with AHRI 1010, "Self-Contained, Mechanically Refrigerated Drinking-Water Coolers," for water coolers and with AHRI's "Directory of Certified Drinking Water Coolers" for type and style classifications.
- F. ASHRAE Standard: Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants," for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant, unless otherwise indicated.

PART 2 PRODUCTS

2.01 DRINKING FOUNTAINS

- A. Drinking Fountains:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elkay Manufacturing Co.; EDFP217C.
 - b. Halsey Taylor; HRFSEBP.
 - c. Haws Corporation; 1119.
 - d. Murdock Manufacturing; A Member of Morris Group International; A152400B.
 - e. Oasis Corporation; MSSLPM.
 - f. Sunroc Corp.; SF-3700.
 - 2. Description: Accessible, Style W, dual-height, wall-mounting drinking fountain.
 - a. Material: Stainless steel.
 - b. Receptor Shape: Rectangular.
 - c. Back Panel: Stainless-steel wall plate behind drinking fountain.
 - d. Bubblers: One for each receptor, flexible or elastomeric overmolded, with adjustable stream regulator.
 - e. Control: Push button.
 - f. Supply: NPS 3/8 with isolation valve.
 - g. Drain: Grid with NPS 1-1/4 minimum horizontal waste and trap complying with ASME A112.18.2.
 - h. Support: Refer to "Fixture Supports" Article.

2.02 FIXTURE SUPPORTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Josam Co.
 - 2. MIFAB Manufacturing, Inc.
 - 3. Smith, Jay R. Mfg. Co.; A Member of Morris Group International.
 - 4. Tyler Pipe; Wade Div.
 - 5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
 - 6. Zurn Plumbing Products Group; Specification Drainage Operation.
- B. Description: ASME A112.6.1M, water cooler carriers. Include vertical, steel uprights with feet and tie rods and bearing plates with mounting studs matching fixture to be supported.
 - 1. Type I: Hanger-type carrier with two vertical uprights.
 - 2. Type II: Bilevel, hanger-type carrier with three vertical uprights.
 - 3. Supports for Accessible Fixtures: Include rectangular, vertical, steel uprights instead of steel pipe uprights.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine roughing-in for water and waste piping systems to verify actual locations of piping connections before fixture installation. Verify that sizes and locations of piping and types of supports match those indicated.
- B. Examine walls and floors for suitable conditions where fixtures are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 APPLICATIONS

- A. Use carrier off-floor supports for wall-mounting fixtures, unless otherwise indicated.
- B. Use mounting frames for recessed water coolers, unless otherwise indicated.
- C. Set freestanding and pedestal drinking fountains on floor.

- D. Set remote water coolers on floor, unless otherwise indicated.
- E. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view. Plain copper tube, fittings, and valves may be used in concealed locations.

3.03 **INSTALLATION**

- A. Install off-floor supports affixed to building substrate and attach wall-mounting fixtures, unless otherwise indicated.
- B. Install mounting frames affixed to building construction and attach recessed water coolers to mounting frames, unless otherwise indicated.
- C. Install fixtures level and plumb. For fixtures indicated for children, install at height required by authorities having jurisdiction.
- D. Install water-supply piping with shutoff valve on supply to each fixture to be connected to water distribution piping. Install valves in locations where they can be easily reached for operation. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing."
- E. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- F. Install pipe escutcheons at wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding pipe fittings. Escutcheons are specified in Division 20 Section "Basic Mechanical Materials and Methods."
- G. Seal joints between fixtures and walls and floors using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.04 **CONNECTIONS**

- A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding."
- D. Connect wiring according to Division 26 Section "Conductors and Cables."

3.05 **FIELD QUALITY CONTROL**

- A. Water Cooler Testing: After electrical circuitry has been energized, test for compliance with requirements. Test and adjust controls and safeties.
 - 1. Remove and replace malfunctioning units and retest as specified above.
 - 2. Report test results in writing.

3.06 **ADJUSTING**

- A. Adjust fixture flow regulators for proper flow and stream height.
- B. Adjust water cooler temperature settings.

3.07 **CLEANING**

- A. After completing fixture installation, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

END OF SECTION

SECTION 23 0500 - COMMON WORK RESULTS FOR HVAC

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 23 Section "Testing, Adjusting, and Balancing."

1.02 SUMMARY

- A. This Section includes common requirements for fans and air moving equipment.

1.03 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Fan bearings.
 - 2. V-belt fan drives.
 - 3. Direct drive couplings.

1.04 QUALITY ASSURANCE

- A. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.
- B. Fan Performance Data: AMCA Standard 210.
- C. Sound Power Level Ratings:
 - 1. Ducted Fans - Rated per AMCA 301, when tested per AMCA 300.
 - 2. Nonducted Fans - Rated in Zones at 5 feet from acoustic center of fan rated per AMCA 301, tested per AMCA 300 and converted per AMCA 302.

1.05 ENVIRONMENTAL REQUIREMENTS

- A. Do not operate equipment for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

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

2.02 FAN SHAFTS

- A. Fan Shafts: Ground from solid cold rolled steel, and proportioned to run at least 25 percent below the first critical speed.

2.03 FAN POWER TRANSMISSION

- A. V-Belt Type Fan Drives: In accordance with Engineering Standard Specification for Drives Using Multiple V-Belts, sponsored by the Mechanical Power Transmission Association and the Rubber Manufacturer's Association.
- B. A given manufacturer's V-belt drive, as applied to specific equipment provided under the Contract, shall conform to the equipment manufacturer's published recommendations, except as otherwise specified.
- C. Base horsepower rating of drive on minimum pitch diameter of small sheave.
- D. Locate belt drives outboard of bearings. Align drive and driven shafts by the four-point method.
- E. Adjust belt tension in accordance with the manufacturer's recommendations.
- F. Perform alignment and final belt tensioning in the presence of the Architect.

2.04 SHEAVES

- A. Furnish sheaves of machined cast iron or carbon steel, bushing type of fixed bore, secured to the shaft by key and keyway.
- B. For all constant speed fans at or above 2 inches of total static pressure, Contractor shall provide and install two sets of fixed sheaves. First set shall be installed for initial start-up and shall be based on scheduled data. The second set shall be installed after system balance is complete and shall be based on actual field conditions.
- C. For all constant speed fans below 2 inches total static pressure, Contractor shall provide and install two sets of adjustable sheaves. First set shall be installed for initial start-up and shall be based on scheduled data. The second set shall be installed after the balance is complete and shall be based on actual field conditions, and selected at mid-range of the sheave.
- D. Set pitch diameters of fixed pitch and adjustable or variable pitch sheaves when adjusted as specified, at not less than that recommended by NEMA Standard MG1-14.42.
- E. For companion sheaves for adjustable or variable pitch drives, furnish wide groove spacing to match driving sheaves.
- F. For all variable frequency controller (VFC) operated fans, contractor shall provide and install one set of fixed sheaves sized to allow full utilization of fan motor horsepower provided, with VFC at 100 percent of fan motor RPM.

2.05 V-BELT FAN DRIVES

- A. Fan Drives: Multiple V-belt style with adjustable pitch driver sheaves for fans up to 2 inches of total static pressure and fixed pitch driver sheaves for fans at or above 2 inches of total static pressure and up. Sheaves shall have split, taper style bushings. Drives shall be selected for a 150 percent service factor and shall provide for adjustment of both belt tension and alignment.
- B. Manufacturers:
 - 1. Emerson Power Transmission; Browning.
 - 2. Rockwell Automation; Dodge.
 - 3. T.B. Wood's Incorporated.

2.06 FAN DRIVE, SHAFT, AND COUPLING GUARDS

- A. Safety Provisions: Include guards and screens for power transmission equipment, but do not negate vibration isolation provision.
- B. Furnish ANSI and OSHA compliant mechanical power transmission apparatus guards except where superseded by other governing codes, and except as modified and supplemented. Requirements specified apply to all types of fans.
- C. Fabricate mechanical power transmission device guards such that the completed structure is capable of withstanding a load of at least 200 pounds applied in any direction.

- D. Furnish a guard enclosure for each V-belt drive, coupling, shaft, and rotating component. Secure guards in place, easily removable for maintenance. Guard fasteners used for maintenance access shall be "captive type." Locate holes on each guard for tachometer readings on both the motor and fan shafts. Fabricate guard of minimum 16 gage sheet metal with hemmed edges at openings for shafts. Weld four mounting lugs or feet of 10 gage material to the guard. Fabricate guards for couplings five inches in diameter and larger of 12 gage sheet metal. Furnish holes in mounting feet sized for suitable machine screws.
 - E. Centrifugal exhaust fans shall be provided with shaft seals.
- 2.07 **BELT DRIVE GUARDS**
- A. Belt Guards: ANSI and OSHA compliant with provision for readily viewing belt tension and measuring shaft speeds. Guards shall be installed with quick release pins, so that removal of three to five clip pins, will allow the guard to be removed from fan housing.
 - B. Fabricate guards which completely enclose moving parts of the particular drive. Design and construct guards of such rigidity as to contain a belt which breaks during operation. Minimum material thickness, 16 gage sheet metal. Where ventilation is required, perforated metal shall be used for the sides. Fabricate top of solid sheet metal.
- 2.08 **V-BELTS**
- A. Notched or cogged style, endless type, of Dacron reinforced elastomer construction, with cross-section to suit sheave grooves. Determine the number of V-belts from the motor horsepower to which apply the service factor to obtain the design horsepower. Determine the corrected horsepower per belt by multiplying the nominal horsepower per belt by an arc of contact factor not greater than 0.85. Divide the design horsepower by the corrected horsepower per belt to obtain the number of belts required. In any case, furnish not less than two belts for each drive.
 - B. Furnish belts that have been factory or factory-authorized distributor matched and measured on a belt-matching machine. Selection by "code numbers," "sag numbers" or "match numbers" is not acceptable. Bind each belt set with wire and tag with equipment identification.
 - C. Manufacturers:
 - 1. Emerson Power Transmission; Browning; AX, BX, and CX Series and 3VX and 5VX Series.
 - 2. Rockwell Automation; Dodge; Classic Cog and Narrow Cog V-Belts.
 - 3. T.B. Wood's Incorporated; Classical Cog and Narrow Cog V-Belts.
- 2.09 **V-BELT DRIVE MOTOR BASES**
- A. Furnish fan motors with slide or adjustable pivoted bases wherever equipment configuration permits proper installation.
 - B. Provide for adjustment of both belt tension and alignment.
- 2.10 **AIR HANDLING SYSTEM BALANCING PROVISIONS**
- A. Provide extra sheaves, sized as recommended by the Balancing Agent, for the adjustment of fan speed for each air handling system during air quantity balancing operations. Furnish sheaves as specified in this Section.
- 2.11 **FLEXIBLE COUPLINGS (DIRECT DRIVE)**
- A. Fan shaft shall be connected to the motor shaft through a flexible coupling. The flexible member shall be a tire shape, in shear, or a solid mass serrated edge disc shape, made of chloroprene materials and retained by fixed flanges. Flexible coupling shall act as a dielectric connector and shall not transmit sound, vibration or end thrust.
 - B. Manufacturer:
 - 1. Falk Corporation (The).
- 2.12 **MOTOR REQUIREMENTS**
- A. Furnish motors in accordance with Division 20 Section "Motors."
- 2.13 **FAN BEARINGS**
- A. Bearings: Anti-friction ball or roller type with provision for self-alignment and thrust load. Made in U.S.A. with ABMA L₁₀ minimum life of 200,000 hours. Use cast iron housings and dust-tight seals suitable for lubricant pressures.
 - 1. Lubrication Provisions - Use surface ball check type supply fittings. Provide extension tubes to allow safe maintenance while equipment is operating. Provide manual or automatic pressure relief fittings to prevent overheating or seal blow-out due to excess

lubricant or pressure. Arrange relief fittings opposite supply but visible for normal maintenance observation.

2. Bearings on Equipment with less than 1/2 horsepower rating or on shafts smaller than 1-3/4 inch in diameter: Permanently sealed, pre-lubricated anti-friction bearings per specified materials and ABMA L₁₀ life requirements.

2.14 **IDENTIFICATION**

- A. Nameplate: Affix metallic, corrosion-resistant data plate for each fan in a conspicuous location. Include selection point capacity conditions.

2.15 **ACCESSORIES**

- A. Bird Screens: Of material to match adjacent contact construction, 1/2 inch mesh or equal expanded metal. Use on inlet or outlet of each nonducted fan.

PART 3 EXECUTION

3.01 **INSTALLATION**

- A. Field Rigging: Do not negate balancing. Do not bend shaft. Use lifting eyes.
- B. Install sheaves where recommended by Testing, Adjusting, and Balancing agency.
- C. Refer to individual Division 23 HVAC equipment Sections for additional requirements.

END OF SECTION

SECTION 23 0593 - TESTING, ADJUSTING, AND BALANCING

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 23 Section "Common Work Results for HVAC."

1.02 SUMMARY

- A. This Section includes testing, adjusting, and balancing to produce design objectives for the following:
 - 1. Air Systems:
 - a. Constant-volume air systems.
 - 2. HVAC equipment quantitative-performance settings.
 - 3. Verifying that automatic control devices are functioning properly.
 - 4. Reporting results of activities and procedures specified in this Section.
- B. Include rebalancing of air systems, or system portions affected by recommended sheave changes.

1.03 DEFINITIONS

- A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- B. AHJ: Authority having jurisdiction.
- C. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.
- D. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.
- E. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.
- F. NC: Noise criteria.

- G. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
 - H. RC: Room criteria.
 - I. Report Forms: Test data sheets for recording test data in logical order.
 - J. Smoke-Control System: An engineered system that uses fans to produce airflow and pressure differences across barriers to limit smoke movement.
 - K. Smoke-Control Zone: A space within a building that is enclosed by smoke barriers and is a part of a zoned smoke-control system.
 - L. Stair Pressurization System: A type of smoke-control system that is intended to positively pressurize stair towers with outdoor air by using fans to keep smoke from contaminating the stair towers during an alarm condition.
 - M. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.
 - N. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
 - O. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
 - P. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
 - Q. TAB: Testing, adjusting, and balancing.
 - R. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
 - S. Test: A procedure to determine quantitative performance of systems or equipment.
 - T. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.
- 1.04 **INFORMATIONAL SUBMITTALS**
- A. Qualification Data: Within 30 days from Contractor's Notice to Proceed, submit copies of evidence that TAB firm and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
 - B. Contract Documents Examination Report: Within 30 days from Contractor's Notice to Proceed, submit copies of the Contract Documents review report as specified in Part 3.
 - C. Strategies and Procedures Plan: Within 60 days from Contractor's Notice to Proceed, submit copies of TAB strategies and step-by-step procedures as specified in Part 3 "Preparation" Article. Include a complete set of report forms intended for use on this Project.
- 1.05 **CLOSEOUT SUBMITTALS**
- A. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.
 - B. Warranties specified in this Section.
- 1.06 **QUALITY ASSURANCE**
- A. TAB Firm Qualifications: Engage a TAB firm certified by either AABC or NEBB.
 - B. Approved Balancing Agencies.
 - 1. The TAB firm selected shall be from the following list:
 - a. Airflow Testing Inc.; Lincoln Park, MI.
 - b. Barmatic Inspecting Co., Inc.; Lincoln Park, MI.
 - c. Ener-Tech Testing; Holly, MI.
 - d. Enviro-Aire/Total Balance Co.; St. Clair Shores, MI.
 - e. International Test & Balance Inc.; Southfield, MI.
 - f. Quality Air Service; Portage, MI.
 - C. TAB Conference: Meet with Owner's and Architect's representatives on approval of TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, HVAC controls installers, and other support personnel. Provide seven days' advance notice of scheduled meeting time and location.
 - 1. Agenda Items: Include at least the following:
 - a. Submittal distribution requirements.

- b. The Contract Documents examination report.
 - c. TAB plan.
 - d. Work schedule and Project-site access requirements.
 - e. Coordination and cooperation of trades and subcontractors.
 - f. Coordination of documentation and communication flow.
- D. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:
- 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 - 2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.
- E. TAB Report Forms: Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems." TAB firm's forms approved by Architect.
- F. Instrumentation Type, Quantity, and Accuracy: As described in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."
- G. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.
- 1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.
- 1.07 **PROJECT CONDITIONS**
- A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.
- 1.08 **COORDINATION**
- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.
- B. Notice: Provide seven days advance notice for each test. Include scheduled test dates and times.
- C. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.
- 1.09 **WARRANTY**
- A. National Project Performance Guarantee: If AABC standards are used, provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:
- 1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
 - 2. Systems are balanced to optimum performance capabilities within design and installation limits.
- B. Special Guarantee: If NEBB standards are used, provide a guarantee on NEBB forms stating that NEBB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee shall include the following provisions:
- 1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
 - 2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.

- B. Examine system and equipment test reports.
- C. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- D. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- E. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible and their controls are connected and functioning.
- F. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.
- G. Examine strainers for clean screens and proper perforations.
- H. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- I. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- J. Examine system pumps to ensure absence of entrained air in the suction piping.
- K. Examine equipment for installation and for properly operating safety interlocks and controls.
- L. Examine automatic temperature system components to verify the following:
 - 1. Dampers, valves, and other controlled devices are operated by the intended controller.
 - 2. Dampers and valves are in the position indicated by the controller.
 - 3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
 - 4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
 - 5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
 - 6. Sensors are located to sense only the intended conditions.
 - 7. Sequence of operation for control modes is according to the Contract Documents.
 - 8. Controller set points are set at indicated values.
 - 9. Interlocked systems are operating.
 - 10. Changeover from heating to cooling mode occurs according to indicated values.
- M. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.02 **PREPARATION**

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Perform the following field tests and inspections according to SMACNA's "HVAC Air Duct Leakage Test Manual" and prepare test reports:
 - 1. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.
 - 2. Maximum Allowable Leakage: Leakage rates are scheduled on the Drawings.
 - 3. Maximum Allowable Leakage: 5 percent.
- C. Complete system readiness checks and prepare system readiness reports. Verify the following:
 - 1. Permanent electrical power wiring is complete.
 - 2. Hydronic systems are filled, clean, and free of air.
 - 3. Automatic temperature-control systems are operational.
 - 4. Equipment and duct access doors are securely closed.
 - 5. Balance, smoke, and fire dampers are open.
 - 6. Isolating and balancing valves are open and control valves are operational.
 - 7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.

8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.03 **GENERAL PROCEDURES FOR TESTING AND BALANCING**

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.
- B. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.
- C. Take and report testing and balancing measurements in inch-pound (IP) units.

3.04 **GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS**

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts, or use reduced scale contract documents with notations.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
- E. Cut insulation, and drill ducts for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes with neat patches, neoprene plugs, threaded plugs, or threaded twist-on metal caps, and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.
- F. Check air flow within intake plenums and mixing boxes of air handling units for uneven flow and temperature stratification and prepare a report with profile elevations (temperature and velocity) on each coil or filter face for Architect.
- G. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- H. Verify that motor starters are equipped with properly sized thermal protection.
- I. Check dampers for proper position to achieve desired airflow path.
- J. Check for airflow blockages.
- K. Check condensate drains for proper connections and functioning.
- L. Check for proper sealing of air-handling unit components.
- M. Check for proper sealing of air duct system.

3.05 **PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS**

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 1. Measure fan static pressures to determine actual static pressure as follows:
 - a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
 3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.
 4. Select required sheave sizes and advise installing contractor to change drive sheaves accordingly. Refer to Division 23 Section "Common Work Results for HVAC" for additional requirements.

5. Do not recommend fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.
 - B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
 1. Measure airflow at a point downstream from the balancing damper and adjust volume dampers until the proper airflow is achieved.
 - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
 - C. Measure terminal outlets and inlets without making adjustments.
 1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
 - D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.
 1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 2. Adjust patterns of adjustable outlets for proper distribution without drafts.
- 3.06 **PROCEDURES FOR MOTORS**
- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 1. Manufacturer, model, and serial numbers.
 2. Motor horsepower rating.
 3. Motor rpm.
 4. Efficiency rating.
 5. Power factor.
 6. Nameplate and measured voltage, each phase.
 7. Nameplate and measured amperage, each phase.
 8. Starter size.
 9. Starter thermal-protection-element rating.
 10. Fuse number and size.
 - B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.
- 3.07 **TOLERANCES**
- A. Set HVAC system airflow and water flow rates within the following tolerances:
 1. Air handling equipment and outlets: Plus or minus 5 percent.
 - a. Where terminal units serve 6 or more outlets within a common room, individual outlets may vary up to plus or minus 10 percent of design flow rates if overall room supply is within plus or minus 5 percent.
- 3.08 **REPORTING**
- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
 - B. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems

found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.09 **FINAL REPORT**

- A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.
- B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
 - 1. Include a list of instruments used for procedures, along with proof of calibration.
- C. Final Report Contents: In addition to certified field report data, include the following:
 - 1. Pump curves.
 - 2. Fan curves.
 - 3. Manufacturers' test data.
 - 4. Field test reports prepared by system and equipment installers.
 - 5. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.
- D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
 - 1. Title page.
 - 2. Name and address of TAB firm.
 - 3. Project name.
 - 4. Project location.
 - 5. Architect's name and address.
 - 6. Engineer's name and address.
 - 7. Contractor's name and address.
 - 8. Report date.
 - 9. Signature of TAB firm who certifies the report.
 - 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 - 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 - 12. Nomenclature sheets for each item of equipment.
 - 13. Notes to explain why certain final data in the body of reports varies from indicated values.
 - 14. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outside-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.
 - h. Other system operating conditions that affect performance.
- E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
 - 1. Quantities of outside, supply, return, and exhaust airflows.
 - 2. Water flow rates.
 - 3. Terminal units.
 - 4. Balancing stations.
- F. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:
 - 1. Unit Data:
 - a. System identification.
 - b. Location.
 - c. Coil identification.

- d. Capacity in Btuh.
- e. Number of stages.
- f. Connected volts, phase, and hertz.
- g. Rated amperage.
- h. Airflow rate in cfm.
- i. Face area in sq. ft.
- j. Minimum face velocity in fpm.
2. Test Data (Indicated and Actual Values):
 - a. Heat output in Btuh.
 - b. Airflow rate in cfm.
 - c. Air velocity in fpm.
 - d. Entering-air temperature in deg F.
 - e. Leaving-air temperature in deg F.
 - f. Voltage at each connection.
 - g. Amperage for each phase.
- G. Fan Test Reports: For supply, return, and exhaust fans, include the following:
 1. Fan Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and size.
 - e. Manufacturer's serial number.
 - f. Arrangement and class.
 - g. Sheave make, size in inches, and bore.
 - h. Sheave dimensions, center-to-center, and amount of adjustments in inches.
 2. Motor Data:
 - a. Make and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Sheave dimensions, center-to-center, and amount of adjustments in inches.
 - g. Number of belts, make, and size.
 3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Suction static pressure in inches wg.
- H. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
 1. Report Data:
 - a. System and air-handling unit number.
 - b. Location and zone.
 - c. Traverse air temperature in deg F.
 - d. Duct static pressure in inches wg.
 - e. Duct size in inches.
 - f. Duct area in sq. ft.
 - g. Indicated airflow rate in cfm.
 - h. Indicated velocity in fpm.
 - i. Actual airflow rate in cfm.
 - j. Actual average velocity in fpm.
 - k. Barometric pressure in psig.
- I. Air-Terminal-Device Reports:
 1. Unit Data:

- a. System and air-handling unit identification.
 - b. Location and zone.
 - c. Test apparatus used.
 - d. Area served.
 - e. Air-terminal-device make.
 - f. Air-terminal-device number from system diagram.
 - g. Air-terminal-device type and model number.
 - h. Air-terminal-device size.
 - i. Air-terminal-device effective area in sq. ft.
 2. Test Data (Indicated and Actual Values):
 - a. Airflow rate in cfm.
 - b. Air velocity in fpm.
 - c. Preliminary airflow rate as needed in cfm.
 - d. Preliminary velocity as needed in fpm.
 - e. Final airflow rate in cfm.
 - f. Final velocity in fpm.
 - g. Space temperature in deg F.
- J. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:
1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Service.
 - d. Make and size.
 - e. Model and serial numbers.
 - f. Water flow rate in gpm.
 - g. Water pressure differential in feet of head or psig.
 - h. Required net positive suction head in feet of head or psig.
 - i. Pump rpm.
 - j. Impeller diameter in inches.
 - k. Motor make and frame size.
 - l. Motor horsepower and rpm.
 - m. Voltage at each connection.
 - n. Amperage for each phase.
 - o. Full-load amperage and service factor.
 - p. Seal type.
 2. Test Data (Indicated and Actual Values):
 - a. Static head in feet of head or psig.
 - b. Pump shutoff pressure in feet of head or psig.
 - c. Actual impeller size in inches.
 - d. Full-open flow rate in gpm.
 - e. Full-open pressure in feet of head or psig.
 - f. Final discharge pressure in feet of head or psig.
 - g. Final suction pressure in feet of head or psig.
 - h. Final total pressure in feet of head or psig.
 - i. Final water flow rate in gpm.
 - j. Voltage at each connection.
 - k. Amperage for each phase.
- K. Instrument Calibration Reports:
1. Report Data:
 - a. Instrument type and make.
 - b. Serial number.
 - c. Application.
 - d. Dates of use.
 - e. Dates of calibration.

3.10 INSPECTIONS

A. Initial Inspection:

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

B. Final Inspection:

1. After initial inspection is complete and evidence by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Architect.
2. TAB firm test and balance engineer shall conduct the inspection in the presence of Architect.
3. Architect shall randomly select measurements documented in the final report to be rechecked. The rechecking shall be limited to either 10 percent of the total measurements recorded, or the extent of measurements that can be accomplished in a normal 8-hour business day.
4. If the rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
6. TAB firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.
7. Request a second final inspection. If the second final inspection also fails, Owner shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment.

3.11 ADDITIONAL TESTS

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

END OF SECTION

TMP Architecture, Inc.
Peter Basso Associates, Inc.

TMP22103D & 22104E
PBA2023.0155.01 & 2023.0156.01

SECTION 23 0933 - TEMPERATURE CONTROLS

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 23 Section "Testing, Adjusting, and Balancing."

1.02 SUMMARY

- A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.

1.03 DEFINITIONS

- A. BACnet: Communications open protocol for building automation system networks and control (developed by ASHRAE and documented per ANSI/ASHRAE Standard 135-2012).
- B. BAS: Building Automation System
- C. CAD: Computer Aided Design.
- D. DDC: Direct-digital controls.
- E. LonWorks (aka LonTalk): Communications open protocol as developed by Echelon Corporation that is utilized with building automation system networks and control.
- F. TC: Temperature Control.

1.04 SYSTEM DESCRIPTION

- A. Temperature control building automation system consisting of direct digital control system controllers, sensors, transducers, relays, switches, data communication network, etc. and all associated control wiring and raceway systems.
- B. BAS/DDC system programming, database generation. Graphic display generation accessible through Building Network Supervisory Controller or at the remote operator workstation (when applicable for project).
- C. Electric thermostats, control valves, dampers, operators, control wiring, etc.

- D. Gauges, indicating devices, electric and electronic control accessories, and other control system devices.
- 1.05 **SEQUENCE OF OPERATION**
 - A. Control sequences for HVAC systems, subsystems, and equipment are indicated on project drawings.
- 1.06 **SUBMITTALS**
 - A. Submit under Division 20 and 23 provisions of respective project and as supplemented in this section.
 - B. All control submittal requirements shall be submitted at one time with exception to control valves, automated dampers, and initial phases of work associated with fast-track projects (when required). Early submittals of control valves and automated dampers shall be incorporated with the complete temperature controls submittal.
 - C. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
 - 1. Each control device labeled with setting or adjustable range of control
 - D. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - E. Shop Drawings:
 - 1. Shop drawings shall be done on CAD. Minimum size 11" x 17".
 - 2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
 - 3. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
 - 4. Details of control enclosure including panel faces and interior, including controls, instruments, terminations blocks and component labeling.
 - 5. Written sequence of operation for each controlled system.
 - 6. Schedule of dampers including size, leakage, and flow characteristics (Refer to Design Data).
 - 7. Schedule of valves including leakage and flow characteristics (Refer to Design Data).
 - 8. Complete bill of materials to identify and quantify all control components.
 - F. Design Data: Provide indicated component selection and sizing criteria for the following component categories:
 - 1. Dampers:
 - a. Component tag.
 - b. Equipment served/function.
 - c. Overall damper size (inch width x inch height).
 - d. Quantity of damper sections with respective size(s):
 - e. Material and gauge of thickness.
 - f. Mounting orientation (horizontal or vertical).
 - g. Blade configuration (parallel or opposed)
 - h. Pressure drop (in. WG).
 - i. Shut-off rating/differential pressure rating (in. wg).
 - j. Leakage rating (CFM/sq.ft. at 4 in. wg).
 - k. Normal position (normally open, normally closed, floating).
 - l. Actuator spring range (where applicable).
 - m. Actuator power requirement.
 - n. Actuator torque requirement.
 - o. Actuator quantity.
 - p. Damper manufacturer/model number.
 - q. Actuator manufacturer/model number.
 - G. Wall mounted temperature sensor, thermostat and/or other temperature control device cover color shall be coordinated to match color of wall mounted electrical device components and cover plates – coordinate with electrical contractor. Provide samples of available temperature control

device cover colors to Architect upon request or if available temperature control device colors do not match electrical device colors so a desired color selection may be determined. Provide sample of temperature sensor / thermostat guard upon request of Architect, Engineer or Owner.

- H. Qualification Data: For firms and persons specified in "Quality Assurance" Article.
- I. Submit field reports indicating operating conditions after detailed check out of systems at Date of Substantial Completion.
- J. Project Record Documents: Include the following:
 - 1. Revise Shop Drawings to reflect actual installation and operating sequences.
 - 2. Record actual locations of control components, including control units, thermostats, and sensors.
- K. Software and Firmware Operational Documentation: Include the following:
 - 1. DDC controller keypad operating instructions and DDC controller override features, where applicable.
 - 2. Device address list.
 - 3. Program Software Backup: On a magnetic media or compact disc, complete with data files.
- L. Maintenance Manuals: Include the following:
 - 1. Product data with installation details, maintenance instructions and lists of spare parts for each type of control device.
 - 2. Keypad illustrations and step-by-step procedures indexed for each operator function, where applicable.
 - 3. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
 - 4. Calibration records and list of set points.

1.07 REFERENCES

- A. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.
- B. ANSI/ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure fittings.
- C. ANSI/ASTM B32 - Solder Metal.
- D. ANSI/NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- E. ASTM B280 - Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
- F. ASTM B75 - Seamless Copper Tube for General Engineering Purposes.
- G. ASTM D1693 - Environmental Stress - Cracking of Ethylene Plastics.
- H. ASTM E1 - Specification for ASTM Thermometers.
- I. MMC – Michigan Mechanical Code, version applicable for project.
- J. NEMA DC 3 - Low-Voltage Room Thermostats.
- K. UL 1820 - Fire Test of Pneumatic Tubing for Flame and Smoke Characteristics Only.

1.08 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who of the automatic control system manufacturer for both installation and maintenance of units required for this Project.
- B. Manufacturer Qualifications: A firm experienced in manufacturing automatic temperature-control systems similar to those indicated for this Project and with a record of successful in-service performance.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with all applicable code requirements for project.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Factory-Mounted Components: Where control devices specified in this Section are indicated or optional to be factory mounted on equipment, arrange for shipping of control devices to unit manufacturer.

1.10 COORDINATION

- A. Coordinate work under Division 20 and 23 provisions and as supplemented in this section.
- B. Coordinate location of space temperature sensors, space humidity sensor, thermostats, humidistats, and other exposed control sensors with plans and room details before installation.

- C. Coordinate installation of system components with installation of mechanical systems and equipment to achieve compatibility.
 - D. Ensure installation of components is complementary to installation of similar components in other systems.
 - E. Coordinate control wiring requirements, including actual terminal block numbers, with mechanical equipment manufacturers or suppliers.
 - F. Ensure control system installation is complete, checked, tested and functioning properly prior to system balancing and Owner/Engineer system checkout.
 - G. Cooperate fully with the Test and Balance Contractor and provide labor to operate the temperature control system as required to meet the scope of work defined in Division 23 Section "Testing, Adjusting and Balancing."
- 1.11 **WARRANTY**
- A. Provide warranty per Division 20 Section "Mechanical General Requirements" and as supplemented in this section.
 - B. Provide 24 hour per day emergency service during warranty period, with maximum response period of four (4) hours. Provide phone number(s) for quick assistance by a Service Engineer regarding hardware or software problems.
 - C. Provide scheduled maintenance service during warranty period to inspect, calibrate, and adjust controls. Make a minimum of one eight-hour service call. Notify Owner prior to each scheduled inspection trip. Submit written reports upon completion of service.
- 1.12 **PROTECTION OF PROPRIETARY INFORMATION**
- A. Non-disclosure agreement(s) that may be subject to proprietary manuals and software shall be submitted by the proprietary equipment manufacturer to the Owner for approval and signature during the warranty period.

PART 2 PRODUCTS

2.01 DAMPERS - AUTOMATED

- A. Performance: Test in accordance with AMCA 500.
- B. Frames: Galvanized steel, minimum 16 gauge, minimum 2 inches in width, welded or riveted with corner reinforcement for 12 gage structural equivalence.
- C. Blades: Galvanized steel, minimum 14 gauge, maximum blade size 8 inches wide, 60 inches long, attached to minimum 1/2 inch shafts. Dampers which are required to have a static pressure rating over 4 inch W.G. shall have minimum 3/4 inch solid shafts.
- D. Blade Seals: Synthetic elastomeric or Neoprene, mechanically attached, field replaceable.
- E. Jackshafts (where required): Minimum 1/2 inch galvanized steel.
- F. Jamb Seals: Stainless steel.
- G. Bearings: Oil impregnated sintered bronze or lubricant free, solid stainless steel. Provide thrust washers at bearings for all dampers which are to be mounted with blades in the vertical position.
- H. Linkages: Accessible for maintenance. Linkages may be located in airstream. Linkages located in damper frame shall be external to the duct, accessible for maintenance. Linkages located in the airstream shall be zinc-plated.
- I. Leakage: Less than 8 CFM per square foot based on 4 inches W.G. pressure differential.
- J. Static Pressure Rating: As scheduled on the drawings, or if not scheduled, minimum 4" W.G.
- K. Maximum Velocity: As scheduled on the drawings, or design for maximum velocity to be encountered in location where installed.
- L. Temperature Limits: -40 to 200 deg F.
- M. Manufacturers:
 - 1. American Warming & Ventilating.
 - 2. Arrow United Industries.
 - 3. Greenheck.
 - 4. Honeywell.
 - 5. Johnson Controls.
 - 6. Louvers & Dampers, Inc.
 - 7. Ruskin.
 - 8. Tamco.
 - 9. Vent Products.

2.02 DAMPERS, INSULATED OUTDOOR AIR / RELIEF AIR / EXHAUST AIR - AUTOMATED

- A. Performance: AMCA certified for Air Performance and Air Leakage.
- B. Frames: Extruded aluminum, .080-inch thickness minimum, 4 inches deep minimum, thermally broken, and insulated with polystyrene or polyurethane foam insulation.
- C. Blades: Extruded aluminum, internally insulated, and thermally broken. Maximum blade size 8 inches wide, 60 inches long.
- D. Shafts: Minimum 7/16 inch hexagonal or square corrosion resistant zinc plated steel.
- E. Blade Seals: Extruded EPDM, silicone, or synthetic elastomeric, mechanically attached.
- F. Jamb Seals: Silicone, or synthetic elastomeric, mechanically attached.
- G. Bearings: Dual bearing assembly of durable synthetic polymer resulting in no metal-to-metal contact. Provide thrust washers at bearings for all dampers which are to be mounted with blades in the vertical position.
- H. Linkage: Linkage shall be installed in the frame side and shall be constructed of aluminum and/or corrosion resistant zinc plated steel.
- I. Leakage: Less than 3 CFM per square foot at 1 inch W.G. pressure differential at minus 40 deg F.
- J. Static Pressure Rating: As scheduled on the drawings, or if not scheduled, minimum 4 inches W.G.
- K. Maximum Velocity: As scheduled on the drawings, or design for maximum velocity to be encountered in location where installed.
- L. Temperature Limits: Minus 40 to 155 deg F.
- M. Manufacturers:
 - 1. Greenheck ICD-45.
 - 2. Ruskin TED50 Series.
 - 3. Tamco Series 9000 BF.

2.03 DAMPER OPERATORS - ELECTRIC

- A. Electric damper motor shall be 24 or 120 volt two-position or modulating as required with spring return type and sized to operate the damper with sufficient reserve power for smooth operation from full close to full open and tight shut-off. Damper motor shall have "O ring" gaskets for weatherproof operation.
- B. Number: Sufficient to achieve unrestricted movement throughout damper range. Provide sufficient number of operators such that one operator does not operate more than the maximum square footage of damper area as recommended in standard catalog of manufacturer.
- C. Manufacturers:
 - 1. Belimo.
 - 2. Delta Control Products.
 - 3. Honeywell.
 - 4. Schneider Electric Controls.
 - 5. Johnson Controls.
 - 6. Siemens.

2.04 ELECTRICAL REQUIREMENTS FOR CONTROLS WORK

- A. Electrical accessories such as relays, switches, contactors and control transformers shall meet the requirements of the Division 26 Specifications of respective project.
- B. Electrical wiring and conduit shall meet the requirements of the Division 26 Specifications.
- C. All control wiring in mechanical rooms and any other exposed areas shall be run in conduit. Low voltage temperature control wiring in concealed accessible locations (i.e., above lay-in ceilings), as well as low voltage temperature control wiring within partitions, may be run using plenum rated cable, neatly tie-wrapped and fastened to the building structure (not to ceiling or ceiling support wires).
- D. Conduits carrying control wiring shall be sized for a maximum fill of 40% of capacity.
- E. Where raceway is required, two separate raceway systems shall be provided; one for A.C. wiring and the other for D.C. wiring.
- F. Data transmission cabling and equipment grounding procedures shall meet the latest FCC guidelines for electromagnetic field generation.

- G. All control wiring sizes and types shall meet or exceed the equipment manufacturer's recommendations.
 - H. TC Contractor shall provide 24V power supply transformers for TC Contractor provided controllers. Maximum Transformer circuit for controls shall be 100VA serving controllers within mechanical room control panels or for remote terminal unit controllers served from common 24V power supply circuit. Transformers shall be located within enclosures provided by TC Contractor.
- 2.05 **LOCAL AND AUXILIARY CONTROL COMPONENT ENCLOSURE PANELS**
- A. Unitized cabinet type for each system under automatic control with relays and controls mounted in cabinet and temperature indicators, pressure gauges, pilot lights, pushbuttons and switches flush on cabinet panel face, or as detailed on drawings. Provide panel with locking door.
 - B. ANSI/NEMA 250, general purpose utility enclosures with enameled finished face panel, or as indicated on the drawings.
 - C. Panels shall be sized for a maximum fill of 50% capacity and shall not be smaller than 24" X 24".

PART 3 EXECUTION

3.01 INSTALLATION - CONTROL SYSTEMS

- A. Install in accordance with manufacturer's instructions.
- B. Check and verify location of temperature sensors, thermostats and other exposed control sensors with plans and room details before installation. Locate room temperature sensors and thermostats 48 inches above floor unless noted otherwise.
- C. The location of all control-related items to be mounted on the exterior of the building must be approved by the Architect prior to installation. Indicate proposed locations on the shop drawings.
- D. Caulk both sides of damper frames to duct walls to prevent leakage between damper frame and duct.
- E. Mount control panels adjacent to associated equipment on vibration free walls or free-standing angle iron supports. Sensors used for closed loop control must be connected to the same DDC controller as the associated output signal.
- F. Provide conduit and electrical wiring where required.
- G. All wiring in altered and unaltered areas shall be run concealed. "Wiremold" in finished areas shall be allowed when wiring cannot be run concealed in walls or partitions. Minimize "wiremold" routing.
- H. Splicing of DDC sensor cabling at junction boxes shall not be acceptable.
- I. All equipment which has moving parts and is remotely started by the control system shall be provided with warning labels no less than 2 inches in height, and in bright warning color, stating that the equipment is remotely started by automatic controls. Such labels shall be posted clearly in the area of any moving parts, such as belts, fans, pumps, etc.
- J. Coil and conceal excess capillary on remote element instruments.
- K. Install thermometers in air duct systems on flanges.
- L. Install all gauges and thermometers in locations where they are easily read from normal floor level. Provide tubing or wiring as required.
- M. Locate all control components and accessories such that they are easily accessible for adjustment, service and replacement.
- N. Locate, size and support sensing elements in airstreams so that they properly sense the representative condition. Controlling, transmitting and indicating elements shall be located to sense the average condition. Safety elements shall be located to sense the extreme condition.
- O. Locate and size sensing elements in liquid lines so that they are in moving liquid and not in stagnant or turbulent locations. Wells shall not obstruct the flow of the liquid being measured. Pipes one inch and smaller shall be increased at least one pipe size at the point of insertion.
- P. Locate pressure sensing taps in liquid lines in straight runs of pipe with at least 10 pipe diameters of straight pipe both upstream and downstream of pressure tap. Provide a shut-off cock in sensing line at each pressure tap.
- Q. Install pressure sensing elements in ducts and casings with clean, sharp taps to accurately read true static pressure, avoiding velocity influence and turbulence.
- R. Locate, support and install all control components and accessories so that they will not be subject to vibration, excessive temperatures, dirt, moisture or other harmful conditions beyond their rated limitations.

- S. Where insulation is penetrated due to the installation of sensing elements or tubing, reseal the openings air and vapor tight. Provide brackets for devices to be located on insulated surfaces so as to clear the finished surface of the insulation and to avoid puncturing the vapor seal.
 - T. Provide all necessary relays, switches, linkages, control devices, accessories and connections as required for a complete and operational control system as specified herein and shown.
 - U. All electric valve and damper operators shall be capable of moving from full closed to full open, or vice versa, within 120 seconds.
- 3.02 **TC CONTRACTOR DESIGN & INSTALLATION COORDINATION MEETINGS**
- A. Temperature Controls Shop Drawing Pre-submittal Meeting: TC Contractor's option to schedule a meeting at the Engineer's Office to review project design documentation for clarification purposes to aide in the TC Contractor development of TC/BAS shop drawings. For simple clarification items, TC Contractor may contact Engineer via telephone to discuss. For project scope questioning items, TC Contractor shall utilize the formal Request of Information (RFI) process.
 - B. Temperature Controls Shop Drawing Submittal Meeting: Project Design Engineer's option to schedule a meeting at the Engineer's Office to review the TC Contractor's formally submitted drawings to address Engineer's comments and concerns that indicate TC Contractor's shop drawings vary from project design intent. This meeting can be avoided if TC Contractor's shop drawing submittal is complete and Engineer is confident that documents are going to lead to an installation that meets project design intent.
 - C. Temperature Controls Installation Technician Meeting: Project Design Engineer's option to schedule a meeting at the project site to meet and discuss project expectations with the TC Contractor's field installation technician and/or project manager. Discussion may include
 1. Shop drawing review comments to ensure installation technician has the most up-to-date TC submittal.
 2. Graphics generation requirements including special Owner requirements and schedule for completion.
 3. Owner training agenda and scheduling.
 4. TC/BAS system acceptance procedures.
- 3.03 **IDENTIFICATION AND MARKING**
- A. All sensors, relays, switches, etc. shall be marked with the same identification number as used on the as-built shop drawings. Use Brother P-touch label maker or similar with black text on clear or white super adhesive tape. If label applied in wet environment, spray label with clear enamel for waterproofing.
 - B. Wire shall be color coded according to functional use. Identify color coding format on record drawings.
 - C. Identify each wire as to ID number at each controller termination, field device termination or on the field device.
 - D. All control panels and auxiliary enclosures shall be supplied with engraved phenolic nameplate permanently attached on the front exterior with panel identification to match details of temperature control submittals and include system(s) served and area(s) served on the labeling. Include labeling near 120VAC terminations within panel identifying power source panel ID and specific circuit breaker used.
 - E. Temperature control conduit and junction box covers shall be painted to signify that it is used for temperature controls. All junction box covers shall be painted and the conduit shall be painted with an mark (approximately 6 inches long) every 36" to 48", and on both sides of all penetrations.
- 3.04 **OWNER INSTRUCTION AND TRAINING**
- A. Provide a minimum of forty (40) hours of combined on-site and classroom instruction and training to the Owner on the operation of the control systems for the initial installation.
 - B. Instruction and training shall be performed by a competent Contractor representative familiar with the control systems operation, maintenance and calibration.
 - C. Training shall take place after check, test, start-up of temperature controls system at a time mutually agreed upon by the Owner and Contractor.

3.05 CALIBRATION AND START-UP

- A. After installation and connection of control components, test, adjust and re-adjust as required all control components in terms of function, design, systems balance and performance. Make systems ready for environmental equipment acceptance tests.
- B. After environmental equipment has been accepted and after the systems have operated in normal service for two weeks, check the adjustment on control components and recalibrate where required. Components not in calibration shall be recalibrated to function as required or shall be replaced. Control devices, linkages, and other control components shall be calibrated and adjusted for stable and accurate operation in accordance with the design intent and to obtain optimum performance from the equipment controlled. Cause every device to automatically operate as intended to ensure its proper functionality.

3.06 ACCEPTANCE PROCEDURE

- A. Upon successful completion of start-up and recalibration as indicated in this section, the Architect shall be requested in writing to inspect the satisfactory operation of the control systems.
- B. Demonstrate operation of all control systems, including each individual component, to the Owner and Architect.
- C. After correcting all items appearing on the punch list, make a second written request to the Owner and Architect for inspection and approval.
- D. After all items on the punch list are corrected and formal approval of the control systems is provided by the Architect, the Contractor shall indicate to the Owner in writing the commencement of the warranty period.

END OF SECTION

SECTION 23 3113 - METAL DUCTS

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 23 Section "Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.02 SUMMARY

- A. This Section includes metal ducts for supply, return, outside, relief air, and exhaust air-distribution systems.

1.03 DEFINITIONS

- A. Duct Sizes: Inside clear dimensions. For lined ducts, maintain sizes inside lining.
- B. Low Pressure: Up to and including 2 inch WG and velocities less than 1,500 fpm.
- C. Medium Pressure: Greater than 2 inch WG to 6 inch WG and velocities greater than 1,500 fpm and less than 2,500 fpm.
- D. High Pressure: Greater than 6 inch WG to 12 inch WG and velocities greater than 2,500 fpm.
- E. FRP: Fiberglass-reinforced plastic.
- F. PVC: Polyvinyl Chloride.

1.04 SYSTEM DESCRIPTION

- A. Duct system design, as indicated, has been used to select size and type of air-moving and -distribution equipment and other air system components. Changes to layout or configuration of duct system must be specifically approved in writing by Architect. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

1.05 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC

Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Application Schedule" Article.

1.06 **INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
1. Other systems installed in same space as ducts.
 2. Ceiling- and wall-mounting access doors and panels required to provide access to dampers and other operating devices.
 3. Ceiling-mounting items, including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

1.07 **CLOSEOUT SUBMITTALS**

- A. Field quality-control test reports.

1.08 **QUALITY ASSURANCE**

- A. NFPA Compliance:
1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
 2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

1.09 **COORDINATION**

- A. Sheet metal trades shall cooperate fully with the Test and Balance Contractor and provide all miscellaneous caps and any other materials required for structural integrity and leakage testing of the complete duct system in whole or in part. Refer to Division 23 Section "Testing, Adjusting and Balancing."
1. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
- B. Sheet metal trades shall participate in the above ceiling coordination program. Refer to Division 01 requirements.

PART 2 PRODUCTS

2.01 **MANUFACTURERS**

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

2.02 **SHEET METAL MATERIALS**

- A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation.
- C. Reinforcement Shapes and Plates:
1. Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.
 2. Compatible materials for aluminum and stainless-steel ducts.
- D. Tie Rods:
1. Galvanized Steel Duct: Galvanized steel, 3/8-inch minimum diameter.
 2. Ducts in Humid or Corrosive Atmospheres: Stainless steel, 1/4-inch diameter for lengths 36 inches or less; 3/8-inch diameter for lengths longer than 36 inches.

2.03 **SEALANTS AND GASKETS**

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Elastomeric Sealant Tape: 3 inches wide; modified butyl adhesive backed.
1. Manufacturers:
 - a. Hardcast; Foil-Grip 1402 and Foil-Grip 1402-181BFX.
- C. Water-Based Joint and Seam Sealant:
1. Manufacturers:
 - a. Design Polymeric; DP1010 Water Based Duct Sealant.

- b. Hardcast; Flex-Grip 550 and Versa-Grip 181.
 - c. Polymer Adhesives; No. 11.
 - d. United McGill.
 - 2. Application Method: Brush on.
 - 3. Solids Content: Minimum 63 percent.
 - 4. Shore A Hardness: Minimum 20.
 - 5. Water resistant.
 - 6. Mold and mildew resistant.
 - 7. VOC: Maximum 75 g/L (less water).
 - 8. Maximum Static-Pressure Class: 0-inch wg, positive and negative.
 - 9. Service: Indoor or outdoor.
 - 10. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
 - D. Flanged Joint Sealant: Comply with ASTM C 920.
 - 1. General: Single-component, acid-curing, silicone, elastomeric.
 - 2. Type: S.
 - 3. Grade: NS.
 - 4. Class: 25.
 - 5. Use: O.
 - E. Gaskets: Chloroprene elastomer, 40 durometer, 1/8 inch thick, full face, one piece vulcanized or dovetailed at joints.
 - F. Round Duct Joint O-Ring Seals:
 - 1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
 - 2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
 - 3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.
- 2.04 **HANGERS AND SUPPORTS**
- A. Building Attachments: Concrete inserts, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - B. Hanger Materials: Galvanized sheet steel or threaded steel rod.
 - 1. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
 - 2. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
 - 3. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."
 - 4. Galvanized-steel straps attached to aluminum ducts shall have contact surfaces painted with zinc-chromate primer.
 - C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials. Attachments for stainless steel and PVC-coated duct shall be stainless steel.
 - D. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.
 - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 - 2. Supports for Stainless-Steel Ducts: Stainless-steel support materials.
 - 3. Supports for Aluminum Ducts: Aluminum support materials unless materials are electrolytically separated from ducts.
 - E. Load Rated Cable Suspension System for Noncorrosive Environments: Tested to five times the Safe Working Loads and verified by the SMACNA Testing and Research Institute.
 - 1. Cable: Aircraft quality 7 x 7 and 7 x 19 wire rope.
 - a. Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
 - b. Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
 - 2. Fastener: One-piece, die-cast zinc housing with Type 302 S26 stainless steel hardened and tempered springs, and oil impregnated, sintered, hardened and tempered steel locking wedges.
 - 3. End Fixings: Loop, stud or toggle; or plain end suitable for wire rope beam clamp.

4. Manufacturers:
 - a. B-Line by Eaton; KwikWire.
 - b. Ductmate Industries, Inc.; Clutcher and EZ-Lock.
 - c. Duro Dyne Corp.; Dyna-Tite System.
 - d. Gripple Inc.; Hang-Fast System.
 - F. Stainless Steel Load Rated Cable Suspension System for Corrosive Environments: Tested to five times the Safe Working Loads and verified by the SMACNA Testing and Research Institute.
 1. Cable: Aircraft quality stainless steel 7 x 7 and 7 x 19 wire rope.
 - a. Stainless steel complying with ASTM A 492.
 2. Fastener: One-piece, stainless steel housing with Type 302 S26 stainless steel hardened and tempered springs, and ceramic locking wedges.
 3. End Fixings:
 - a. Loop End: Type 316L/A4 stainless steel.
 - b. Stud or Toggle End: Type 304L/A2 stainless steel.
 - c. Plain end suitable for stainless steel wire rope beam clamp.
 4. Manufacturers:
 - a. B-Line by Eaton; KwikWire.
 - b. Ductmate Industries, Inc.; Clutcher and EZ-Lock.
 - c. Duro Dyne Corp.; Dyna-Tite System.
 - d. Gripple Inc.; Hang-Fast System.
 - G. Welded Supports: Structural steel shapes with zinc rich paint. Equivalent, proprietary design, rolled steel structural support systems may be used in lieu of mill rolled structural steel.
- 2.05 **RECTANGULAR DUCT FABRICATION**
- A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" unless otherwise indicated. For metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals, comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible", unless otherwise indicated.
 1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
 2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
 3. Internal Tie Rods: As allowed by SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
 - B. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's and SMACNA guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.
 1. Manufacturers:
 - a. Ductmate Industries, Inc.
 - b. Nexus Inc.
 - C. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359 inch thick or less, with more than 10 sq. ft. of nonbraced panel area unless ducts are lined.

PART 3 EXECUTION

3.01 DUCTWORK APPLICATION SCHEDULE

- A. Ductwork materials and performance requirements are scheduled on the Drawing.

3.02 DUCT INSTALLATION

- A. Install ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
- B. Install ducts with fewest possible joints.
- C. Install fabricated fittings for changes in directions, size, and shape and for connections.
- D. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12 inches, with a minimum of 3 screws in each coupling.

- E. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.
 - F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
 - G. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
 - H. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.
 - I. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.
 - J. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.
 - K. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures.
 - L. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2 inches.
 - M. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire dampers, and sleeves. Fire and smoke dampers are specified in Division 23 Section "Duct Accessories."
 - 1. Where ducts not having fire dampers, smoke dampers, or combination fire and smoke dampers pass through fire-rated partitions, maintain indicated fire rating. Seal penetrations with firestop materials. Refer to Division 07 Specification Sections for materials and UL classified firestop systems.
 - N. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.
 - O. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."
 - 1. Intermediate level.
- 3.03 **INSTALLATION OF EXPOSED DUCTWORK**
- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
 - B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
 - C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
 - D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
 - E. Repair or replace damaged sections and finished work that does not comply with these requirements.
- 3.04 **DUCT SEALING**
- A. Seal duct seams and joints according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for duct pressure class indicated. Ducts must be properly cleaned and sealed in strict accordance with sealant manufacturer's instructions.
 - 1. Seal Class: Refer to Application Schedule on the Drawings.
 - 2. Seal ducts before external insulation is applied.
 - 3. After pressure testing, remake leaking joints until leakage is equal to or less than maximum allowable. Refer to Application Schedule on the Drawings for allowable leakage rates.
- 3.05 **HANGER AND SUPPORT INSTALLATION**
- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
 - B. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

- C. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
 - D. Install concrete inserts before placing concrete.
 - E. Support ductwork from building structure, not from roof deck, floor slab, pipe, other ducts, or equipment.
 - F. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.
 - G. Install roof mounted duct supports in accordance with manufacturer's instructions. Provide additional membrane layer or walkpads under support bases as required.
 - H. Use load rated cable suspension system for round duct in exposed locations.
- 3.06 **CONNECTIONS**
- A. Make connections to equipment with flexible connectors according to Division 23 Section "Duct Accessories."
 - B. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.
- 3.07 **PAINTING**
- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 painting Sections.
- 3.08 **FIELD QUALITY CONTROL**
- A. Duct System Cleanliness Tests:
 - 1. Visually inspect duct system to ensure that no visible contaminants are present.
 - B. Duct system will be considered defective if it does not pass tests and inspections.
 - C. Prepare test and inspection reports.
- 3.09 **START UP**
- A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing."
- END OF SECTION**

SECTION 23 3300 - DUCT ACCESSORIES

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 23 Section "Testing, Adjusting, and Balancing" for duct test holes.
 - 3. Division 23 Section "Temperature Controls" for motorized control dampers.
 - 4. Division 28 Section "Fire Alarm" for duct-mounting fire and smoke detectors.

1.02 DEFINITIONS

- A. NVLAP: National Voluntary Laboratory Accreditation Program.
- B. Low Pressure: Up to 2 inch WG and velocities less than 1,500 fpm. Construct for 2 inch WG positive or negative static pressure.
- C. Medium Pressure: Greater than 2 inch WG to 6 inch WG and velocities greater than 1,500 fpm and less than 2,500 fpm. Construct for 6 inch WG positive or negative static pressure.
- D. High Pressure: Greater than 6 inch WG to 12 inch WG and velocities greater than 2,500 fpm. Construct for 12 inch WG positive or negative static pressure.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. For turning vanes, include data for pressure loss generated sound power levels.
 - 2. For duct silencers, include pressure drop and dynamic insertion loss data.

1.04 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
 - 1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
 - a. Special fittings.
 - b. Manual volume damper installations.
 - c. Control damper installations.

- d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
- e. Duct security bars.
- f. Wiring Diagrams: Power, signal, and control wiring.
- B. Coordination Drawings: Reflected ceiling plans, drawn to scale and coordinating penetrations and ceiling-mounting items. Show ceiling-mounting access panels and access doors required for access to duct accessories.
- C. Source quality-control reports.
- 1.05 **CLOSEOUT SUBMITTALS**
 - A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.
- 1.06 **QUALITY ASSURANCE**
 - A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
 - B. Comply with AMCA 500-D testing for damper rating.
- 1.07 **EXTRA MATERIALS**
 - A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fusible Links: Furnish quantity equal to 10 percent of amount installed for each temperature rating.

PART 2 PRODUCTS

2.01 MANUFACTURERS

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

2.02 SHEET METAL MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.
- B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation.
- C. Stainless Steel: ASTM A 480/A 480M, Types 304 and 316 as indicated.
- D. Extruded Aluminum: ASTM B 221, alloy 6063, temper T6.
- E. Bird Screens: No. 2 mesh, 0.063 inch diameter galvanized wire screen with open area of not less than 72 percent. Conceal sharp edges by adding metal edging consisting of rod, flat or angle iron, or 16 gage galvanized sheet steel turned over at least 3/4 inch on both sides.

2.03 BACKDRAFT DAMPERS

- A. Manufacturers:
 - 1. American Warming and Ventilating; Mestek, Inc.
 - 2. Greenheck Fan Corporation.
 - 3. Ruskin Company.
- B. Description: Multiple-blade, parallel action counterbalanced, with blades of maximum 6-inch width, with sealed edges, assembled in rattle-free manner with 90-degree stop, steel ball bearings, and axles; adjustment device to permit setting for varying differential static pressure.
- C. Performance: Based on tests in accordance with AMCA Standard 500:
 - 1. Pressure drop not to exceed 0.15 inch wg at face velocity of 2500 fpm.
 - 2. Leakage not to exceed 9.2 cfm per square foot at 1 inch wg differential and temperature of 70 deg F
- D. Frame: 0.052-inch- thick, galvanized sheet steel or 0.063-inch- thick extruded aluminum, with welded corners and mounting flange.
- E. Blades: 0.025-inch- thick, roll-formed aluminum or 0.050-inch- thick aluminum sheet.
- F. Blade Seals: Manufacturer's standard seal material.
- G. Blade Axles: Nonferrous or galvanized steel.
- H. Tie Bars and Brackets: Aluminum or galvanized steel.

2.04 **LOW PRESSURE MANUAL VOLUME DAMPERS**

- A. Manufacturers:
1. American Warming and Ventilating; Mestek, Inc.
 2. Arrow United Industries; Mestek, Inc.
 3. Greenheck Fan Corporation.
 4. Krueger-HVAC; Air Distribution Technologies, Inc.; a JCI Company.
 5. Louvers and Dampers, Inc.; Mestek, Inc.
 6. Nailor Industries Inc.
 7. Ruskin Company.
 8. Vent Products Co., Inc.
 9. Young Regulator Co.
- B. General Description: Factory fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.
1. Except for dampers in round ductwork sized 12 inches and smaller, provide end bearings.
- C. Rectangular Volume Dampers: Multiple-opposed-blade design, AMCA certified for maximum leakage of 2 percent of total fan volume at shutoff, and suitable for horizontal or vertical applications.
- D. Round Volume Dampers 16-inch Diameter and Smaller: Single-blade design, AMCA certified for maximum leakage of 2 percent of total fan volume at shutoff, and suitable for horizontal or vertical applications.
- E. Round Volume Dampers Larger than 16-inch Diameter: Multiple-opposed-blade design AMCA certified for maximum leakage of 2 percent of total fan volume at shutoff, and suitable for horizontal or vertical applications.
- F. Damper Materials:
1. Steel Frames: Hat-shaped, galvanized sheet steel channels, minimum of 0.064 inch thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
 2. Roll-Formed Steel Blades: 0.064-inch- thick, galvanized sheet steel.
 3. Blade Axles: Galvanized steel.
 4. Bearings: Oil-impregnated bronze, molded synthetic, or stainless-steel sleeve type.
 5. Tie Bars and Brackets: Galvanized steel.
- G. Jackshaft: 1-inch- diameter, galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
1. Length and Number of Mountings: Appropriate to connect linkage of each damper in multiple-damper assembly.
- H. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.
1. Include elevated platform for insulated duct mounting on either round or rectangular duct.

2.05 **MOTORIZED CONTROL DAMPERS**

- A. Refer to Division 23 Section "Temperature Controls."

2.06 **TURNING VANES**

- A. Manufactured Turning Vanes:
1. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.
 2. Double-vane or airfoil-shaped, curved blades of galvanized sheet steel set into vane runners suitable for duct mounting.
 3. Generated sound power level shall not exceed 54 decibels in octave band 4 at 2000 fpm in a 24-inch by 24-inch duct.
 4. Manufacturers:
 - a. Aero-Dyne Sound Control; H-E-P Turning Vanes & Rail.
 - b. Ductmate Industries, Inc.
 - c. Duro Dyne Corporation.

- d. Ward Industries, Inc.; a JCI Company.
 - B. Manufactured Acoustic Turning Vanes:
 - 1. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.
 - 2. Double-vane curved blades of galvanized sheet steel with perforated faces and fibrous-glass fill set into vane runners suitable for duct mounting.
 - 3. Manufacturers:
 - a. Ductmate Industries, Inc.
 - b. Ward Industries, Inc.; a JCI Company.
- 2.07 **FLEXIBLE CONNECTORS**
- A. Manufacturers:
 - 1. ADSCO Manufacturing LLC.
 - 2. Duro Dyne Corp.
 - 3. Senior Flexonics Pathway.
 - 4. Ventfabrics, Inc.
 - B. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.
 - C. Metal-Edged Connectors: Factory fabricated with a fabric strip minimum 3-1/2 inches wide attached to two strips of 2-3/4-inch-wide, 0.028-inch-thick, galvanized sheet steel or 0.032-inch-thick aluminum sheets. Select metal compatible with ducts.
 - D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
 - 1. Minimum Weight: 26 oz./sq. yd.
 - 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 - 3. Service Temperature: Minus 20 to plus 200 deg F.
- 2.08 **DUCT ACCESSORY HARDWARE**
- A. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.
- 2.09 **FINISHES**
- A. Chemical Resistant Coating: P-403 manufactured by Heresite Chemical Company.

PART 3 EXECUTION

3.01 APPLICATION AND INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Provide duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts and PVC coated ducts; and aluminum accessories in aluminum ducts.
- C. Install control dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 1. Install steel volume dampers in steel ducts.
 - 2. Install stainless steel volume dampers in stainless steel ducts.
 - 3. Install aluminum volume dampers in aluminum ducts.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators.
- G. For fans developing static pressures of 5-inch wg and higher, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- H. Install turning vanes in rectangular duct elbows in excess of 45 degrees, and where indicated:
 - 1. Use manufactured double-vane turning vanes unless otherwise specified.
 - 2. Seat outboard-most vane in heel of duct elbow.
 - 3. Provide vanes for all runner punchings. Practice of eliminating every other vane is prohibited.

4. Use single-vane turning vanes in low pressure square elbows.

3.02 **FIELD QUALITY CONTROL**

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect turning vanes for proper and secure installation.

3.03 **ADJUSTING**

A. Adjust duct accessories for proper settings.

- B. Final positioning of manual-volume dampers is specified in Division 23 Section "Testing, Adjusting, and Balancing."

END OF SECTION

SECTION 23 3423 - POWER VENTILATORS

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PART 1 GENERAL

- 1.01 **RELATED DOCUMENTS**
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
B. Related Sections include the following:
1. Division 20 Section "Mechanical General Requirements."
2. Division 20 Section "Motors."
3. Division 23 Section "Common Work Results for HVAC" for common mechanical drive requirements for fans and air moving equipment.
- 1.02 **PERFORMANCE REQUIREMENTS**
A. Classify according to AMCA 99.
- 1.03 **ACTION SUBMITTALS**
A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
1. Certified fan performance curves with system operating conditions indicated.
2. Certified fan sound-power ratings.
3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
4. Material thickness.
5. Dampers, including housings, linkages, and operators.
6. Roof curbs.
7. Fan speed controllers.
- 1.04 **INFORMATIONAL SUBMITTALS**
A. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
1. Wiring Diagrams: Power, signal, and control wiring.
2. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.
3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.
- 1.05 **CLOSEOUT SUBMITTALS**
A. Field quality-control test reports.
B. Operation and Maintenance Data: For power ventilators to include in operation and maintenance manuals.

1.06 **QUALITY ASSURANCE**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.
- B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.
- C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.
- D. UL Standard: Power ventilators shall comply with UL 705.

1.07 **DELIVERY, STORAGE, AND HANDLING**

- A. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations, with protective crating and covering.
- B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.
- C. Lift and support units with manufacturer's designated lifting or supporting points.

1.08 **COORDINATION**

- A. Coordinate size and location of structural-steel support members.
- B. Coordinate delivery and placement of roof curbs, and equipment supports. Installation of roof curbs, equipment supports, and roof penetrations is specified in Division 07 Section "Roof Accessories."

1.09 **EXTRA MATERIALS**

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Belts: One set for each belt-drive unit.

PART 2 PRODUCTS

2.01 **IN-LINE CENTRIFUGAL FANS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Acme Engineering & Manufacturing.
 - 2. Aerovent.
 - 3. Greenheck Fan Corporation; SQ/BSQ Series.
 - 4. Loren Cook Company.
 - 5. Moffitt Corporation.
 - 6. PennBarry.
 - 7. Soler & Palau.
- B. Description: In-line, direct-driven centrifugal fans consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, motor and disconnect switch, drive assembly, mounting brackets, and accessories.
- C. Casing: Rectangular or cylindrical, flanged.
- D. Throat and Mounting Assembly: One-piece spun aluminum or continuously welded assembly.
 - 1. Stiffeners: Continuously welded.
 - 2. Bolts, nuts, rivets, and washers: Cadmium plated.
 - 3. Nuts: Self-locking type, vibration proof.
- E. Direct-Driven Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing.
- F. Fan Wheels: Aluminum, backward curved airfoil blades welded to aluminum hub.
- G. Accessories:
 - 1. Fan Guards: 1/2- by 1-inch mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
 - 2. Motor and Drive Cover: Aluminum.
- H. Capacities and Characteristics: Refer to schedule(s) on Drawings.
- I. Vibration Isolators: Refer to Division 20 Section "Mechanical Vibration Controls."

2.02 **MOTORS**

- A. Comply with requirements in Division 20 Section "Motors."

2.03 **SOURCE QUALITY CONTROL**

- A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

PART 3 EXECUTION

3.01 **INSTALLATION**

- A. Install power ventilators level and plumb.
B. Ceiling Units: Suspend units from structure; use steel wire or metal straps.
C. Support suspended units from structure using threaded steel rods and spring hangers having a static deflection of 1 inch. Vibration-control devices are specified in Division 20 Section "Mechanical Vibration Controls."
D. Install units with clearances for service and maintenance.
E. Label units according to requirements specified in Division 20 Section "Mechanical Identification."

3.02 **CONNECTIONS**

- A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Duct Accessories."
B. Install ducts adjacent to power ventilators to allow service and maintenance.
C. Ground equipment according to Division 26 Section "Grounding and Bonding."
D. Connect wiring according to Division 26 Section "Conductors and Cables."

3.03 **FIELD QUALITY CONTROL**

- A. Perform the following field tests and inspections and prepare test reports:
1. Verify that shipping, blocking, and bracing are removed.
 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 3. Verify that cleaning and adjusting are complete.
 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 5. Adjust damper linkages for proper damper operation.
 6. Verify lubrication for bearings and other moving parts.
 7. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
 8. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
 9. Shut unit down and reconnect automatic temperature-control operators.
 10. Remove and replace malfunctioning units and retest as specified above.
- B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.04 **ADJUSTING**

- A. Adjust damper linkages for proper damper operation.
B. Refer to Division 23 Section "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing procedures.
C. Replace fan and motor sheaves as required to achieve design airflow.
D. Lubricate bearings.

END OF SECTION

SECTION 23 3713 - DIFFUSERS, REGISTERS, AND GRILLES

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 23 Section "Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.02 ACTION SUBMITTALS

- A. Product Data: For each product indicated, include the following:
 - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static pressure drop, and noise ratings.
 - 2. Diffuser, Register, and Grille Schedule: Indicate Drawing designation, room location, quantity, model number, size, and accessories furnished.

PART 2 PRODUCTS

2.01 AIR DIFFUSION DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - 1. Krueger-HVAC; Air Distribution Technologies, Inc.; a JCI Company.
 - 2. Nailor Industries, Inc.
 - 3. Price Industries.
 - 4. Titus; Air Distribution Technologies, Inc.; a JCI Company.
 - 5. Tuttle & Bailey; Air Distribution Technologies, Inc.; a JCI Company.
- B. Terminal air diffusion devices have been chosen in terms of specific air distribution requirements, spacing, and sound characteristics.
- C. Provide plaster frames for units installed in plaster ceilings.
- D. Provide gaskets for supply terminal air devices mounted in finished surfaces.
- E. Finish:
 - 1. Device Face and Visible Trim: Standard off-white baked enamel finish unless noted otherwise.
 - 2. Device Interior Surfaces, Including Blank-Offs and Boots: Black matte finish.
- F. Air pattern adjustments shall be made from the face of the device.
- G. Refer to drawings and schedules for quantities, types, and finishes.
- H. Coordinate frame types with Architectural Reflected Ceiling Plan.

2.02 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."
- B. Acoustical Applications and Sound Evaluation: Based on ARI Standard 885-98, "Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets."

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 **INSTALLATION**

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Wall-Mounted Supply Registers: Install 6 inches below finished ceiling unless otherwise indicated.
- D. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.03 **ADJUSTING**

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

SECTION 23 3723 - AIR INTAKE AND RELIEF HOODS

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PART 1 GENERAL

- 1.01 **RELATED DOCUMENTS**
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
B. Related Sections include the following:
1. Division 20 Section "Mechanical General Requirements."
- 1.02 **PERFORMANCE REQUIREMENTS**
A. Structural Performance: Intake and relief ventilators shall be capable of withstanding the effects of gravity loads, wind loads, and thermal movements without permanent deformation of components, noise or metal fatigue, or permanent damage to fasteners and anchors.
- 1.03 **ACTION SUBMITTALS**
A. Product Data: For each type of product indicated.
- 1.04 **INFORMATIONAL SUBMITTALS**
A. Shop Drawings: For intake and relief ventilators. Include plans, elevations, sections, details, and ventilator attachments to curbs and curb attachments to roof structure.
B. Coordination Drawings: Roof framing plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
1. Structural members to which roof curbs and ventilators will be attached.
2. Sizes and locations of roof openings.
C. Samples for Verification: For each type of exposed finish required for intake and relief ventilators.
- 1.05 **QUALITY ASSURANCE**
A. Source Limitations: Obtain ventilators through one source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.
B. Product Options: Drawings indicate size, profiles, and dimensional requirements of intake and relief ventilators and are based on the specific equipment indicated. Refer to Division 01 Section "Product Requirements."
1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
2. AWS D1.2, "Structural Welding Code--Aluminum."
3. AWS D1.3, "Structural Welding Code--Sheet Steel."
- 1.06 **COORDINATION**
A. Coordinate installation of roof curbs and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 PRODUCTS

2.01 MANUFACTURERS

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

2.02 MATERIALS

- A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5 or T-52.
- B. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming or as otherwise recommended by metal producer for required finish.
- C. Galvanized-Steel Sheet: ASTM A 653/A 653M, G90 zinc coating, mill phosphatized.
- D. Fasteners: Same basic metal and alloy as fastened metal or 300 Series stainless steel, unless otherwise indicated. Do not use metals that are incompatible with joined materials.
 - 1. Use types and sizes to suit unit installation conditions.
 - 2. Use Phillips flat, hex-head or Phillips pan-head screws for exposed fasteners, unless otherwise indicated.
- E. Post-Installed Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed, for masonry, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
- F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.03 FABRICATION, GENERAL

- A. Factory or shop fabricate intake and relief ventilators to minimize field splicing and assembly. Disassemble units to the minimum extent as necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.
- B. Fabricate frames, including integral bases, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
- C. Fabricate units with closely fitted joints and exposed connections accurately located and secured.
- D. Fabricate supports, anchorages, and accessories required for complete assembly.
- E. Perform shop welding by AWS-certified procedures and personnel.

2.04 GRAVITY INTAKE AND RELIEF HOODS (RECTANGULAR)

- A. Manufacturers:
 - 1. Acme Engineering & Manufacturing.
 - 2. Greenheck Fan Corporation; Fabra-Hood.
 - 3. Loren Cook Company.
 - 4. Moffitt Corporation.
 - 5. PennBarry; Division of Air System Components.
- B. Factory or shop fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figures 5-6 and 5-7.
- C. Materials: Aluminum sheet, minimum 0.063-inch- thick base and 0.050-inch- thick hood; suitably reinforced.
- D. Bird Screening: Aluminum, 1/2-inch- square mesh, 0.063-inch wire.

2.05 ACCESSORIES

- A. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch- thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch chemically treated wood nailer. Size as required to suit roof opening and hood base.
 - 1. Manufacturers: Roof curbs shall be provided by the hood manufacturer, or one of the following:
 - a. Creative Metals.
 - b. The Pate Company.
 - c. Roof Products & Systems.
 - d. Thybar Corporation.
 - e. Any of the listed hood manufacturers.

2. Configuration: Built-in raised cant with step dimension matching insulation thickness, with mounting flange, and suitable for sloped roofs with uniform insulation thickness.
 3. Height: Curb shall extend a minimum 9-1/2 inches above top surface of roof insulation.
 4. Pitch Mounting: Manufacture curb for roof slope, top of curb shall be level.
 5. Metal Liner: Galvanized steel.
- B. Motorized Backdraft Damper: Refer to DAMPERS – AUTOMATED in Division 23 Section "Temperature Controls."

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install intake and relief hoods level, plumb, and at indicated alignment with adjacent work.
- B. Install intake and relief hoods with clearances for service and maintenance.
- C. Install perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- D. Install concealed gaskets, flashings, joint fillers, and insulation as installation progresses. Comply with Division 07 Section "Joint Sealants" for sealants applied during installation.
- E. Label intake and relief hoods according to requirements specified in Division 20 Section "Mechanical Identification."
- F. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.
- G. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

3.02 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories.

3.03 ADJUSTING

- A. Adjust damper linkages for proper damper operation.

END OF SECTION

SECTION 23 8241 - PROPELLER FAN UNIT HEATERS – STEAM, HOT WATER, ELECTRIC

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PART 1 GENERAL

- 1.01 **RELATED DOCUMENTS**
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
B. Related Sections include the following:
1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”
- 1.02 **SUMMARY**
A. This Section includes propeller fan unit heaters with electric-resistance coils.
- 1.03 **ACTION SUBMITTALS**
A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each unit type and configuration.
- 1.04 **INFORMATIONAL SUBMITTALS**
A. Shop Drawings: Submit the following for each unit type and configuration:
1. Plans, elevations, sections, and details.
2. Details of anchorages and attachments to structure and to supported equipment.
3. Wiring Diagrams: Power, signal, and control wiring.
4. Equipment schedules to include rated capacities, operating characteristics, furnished specialties, and accessories.
B. Coordination Drawings: Plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
1. Suspended ceiling components.
2. Structural members to which unit heaters will be attached.
3. Other items, including the following:
a. Lighting fixtures.
b. Sprinklers.
c. Ductwork.
- 1.05 **CLOSEOUT SUBMITTALS**
A. Field quality-control test reports.
B. Operation and Maintenance Data: For propeller unit heaters to include in emergency, operation, and maintenance manuals.

1.06 **QUALITY ASSURANCE**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

PART 2 PRODUCTS

2.01 **MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Electric Unit Heaters:
 - a. Berko Electric Heating; a division of Marley Engineered Products.
 - b. Brasch Manufacturing Company, Inc.
 - c. Chromalox Advanced Thermal Technologies; Spirax-Sarco Engineering plc.
 - d. Indeeco Heating Solutions; ASPEQ Heating Group.
 - e. Markel Products; a division of TPI Corporation.
 - f. Sterling Radiator; a Mestek Company.
 - g. Trane Inc.; a Trane Technologies Brand.

2.02 **UNIT HEATERS**

- A. Description: An assembly including casing, coil, fan, and motor in horizontal discharge configuration with adjustable discharge louvers.
- B. Comply with UL 2021.

2.03 **CASING**

- A. Cabinet: Removable panels for maintenance access to controls.
- B. Cabinet Finish: Manufacturer's standard baked enamel applied to factory-assembled and -tested propeller unit heater before shipping.
- C. Discharge Louver: Four-way adjustable louvers for horizontal units and adjustable pattern diffuser for projection units.

2.04 **ELECTRIC-RESISTANCE HEATING ELEMENTS**

- A. Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in steel or corrosion-resistant metallic sheath with fins no closer than 0.16 inch. Element ends shall be enclosed in terminal box. Fin surface temperature shall not exceed 550 deg F at any point during normal operation.
 - 1. Circuit Protection: One-time fuses in terminal box for overcurrent protection and limit controls for high-temperature protection of heaters.
 - 2. Wiring Terminations: Stainless-steel or corrosion-resistant material.

2.05 **FAN**

- A. Propeller type, aluminum wheel directly mounted on motor shaft in the fan venturi.

2.06 **FAN MOTORS**

- A. Comply with requirements in Division 20 Section "Motors."
- B. Motor Type: Permanently lubricated.

2.07 **CONTROLS**

- A. Control Devices:
 - 1. Unit-mounted fan-speed switch.
 - 2. Wall-mounting thermostat.

2.08 **CAPACITIES AND CHARACTERISTICS**

- A. Refer to Schedule on Drawings.

PART 3 EXECUTION

3.01 **EXAMINATION**

- A. Examine areas to receive propeller unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.

- B. Examine roughing-in for piping and electrical connections to verify actual locations before propeller unit-heater installation.
 - C. Proceed with installation only after unsatisfactory conditions have been corrected.
- 3.02 **INSTALLATION**
- A. Install propeller unit heaters level and plumb.
 - B. Install propeller unit heaters to comply with NFPA 90A.
 - C. Suspend propeller unit heaters from structure with all-thread hanger rods and spring hangers.
 - 1. Hanger rods and attachments to structure are specified in Division 20 Section "Hangers and Supports."
 - 2. Vibration hangers are specified in Division 20 Section "Mechanical Vibration Controls."
 - D. Install wall-mounting thermostats and switch controls in electrical outlet boxes at heights to match lighting controls.
- 3.03 **CONNECTIONS**
- A. Ground equipment according to Division 26 Section "Grounding and Bonding."
 - B. Connect wiring according to Division 26 Section "Conductors and Cables."
- 3.04 **FIELD QUALITY CONTROL**
- A. Testing: Perform the following field quality-control testing and report results in writing:
 - 1. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
 - 3. Test and adjust controls and safeties.
 - B. Remove and replace malfunctioning units and retest as specified above.
- 3.05 **DEMONSTRATION**
- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain propeller fan unit heaters. Refer to Division 20 Section "Mechanical General Requirements."

END OF SECTION

SECTION 23 8244 - CENTRIFUGAL FAN CABINET UNIT HEATERS (ELECTRIC)

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."

1.02 ACTION SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each product indicated.

1.03 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Plans, elevations, sections, and details.
 - 2. Location and size of each field connection.
 - 3. Location and arrangement of integral controls.
 - 4. Wiring Diagrams: Power, signal, and control wiring.
- B. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Perimeter moldings for exposed or partially exposed cabinets.

1.04 CLOSEOUT SUBMITTALS

- A. Field quality-control test reports.
- B. Operation and Maintenance Data: For cabinet unit heaters to include in operation and maintenance manuals.

1.05 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Berko Electric Heating; a division of Marley Engineered Products.
 - 2. Brasch Manufacturing Company, Inc.

3. Chromalox Advanced Thermal Technologies; Spirax-Sarco Engineering plc.
 4. Daikin Applied; a member of Daikin Industries, Ltd.
 5. Indeeco Heating Solutions; ASPEQ Heating Group.
 6. Markel Products; a division of TPI Corporation.
 7. QMark Electric Heating; a division of Marley Engineered Products.
- B. Description: A factory-assembled and -tested unit complying with AHRI 440.
1. Comply with UL 2021.
- C. Coil Section Insulation: ASTM C 1071; surfaces exposed to airstream shall have erosion-resistant coating to prevent erosion of glass fibers.
1. Thickness: Minimum 1/2 inch.
 2. Thermal Conductivity (k-Value): 0.26 Btu x in./h x sq. ft. at 75 deg F mean temperature.
 3. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
 4. Adhesive: Comply with ASTM C 916 and with NFPA 90A or NFPA 90B.
 5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- D. Cabinet: Steel with baked-enamel finish with manufacturer's standard paint, in color selected by Architect.
1. Vertical Unit, Exposed Front Panels: Minimum 0.0528-inch- thick, sheet steel, removable panels with channel-formed edges secured with tamperproof cam fasteners.
 2. Recessing Flanges for Units That Are Semirecessed or Fully Recessed: Steel, finished to match cabinet.
 3. Control Access Door: Key operated.
 4. Base for Surface, Vertical, Wall-Mounting Units: Minimum 0.0528-inch- thick steel, finished to match cabinet, 6 inches high with leveling bolts.
- E. Filters: Minimum arrestance according to ASHRAE 52.1 and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
1. Glass Fiber Treated with Adhesive: Throw-away type 80 percent arrestance and 5 MERV.
- F. Electric-Resistance Heating Coil: Non-glowing type. Steel fins brazed to high temperature resistance wire enclosed in incoloy sheath; with fuses in terminal box for overcurrent protection and limit controls for high-temperature protection. Terminate elements in stainless-steel machine-staked terminals secured with stainless-steel hardware.
- G. Fan and Motor Board: Removable.
1. Fan: Forward curved, double-width centrifugal; directly connected to motor. Thermoplastic or painted-steel wheels, and aluminum, painted-steel, or galvanized-steel fan scrolls.
 2. Motor: Permanently lubricated, multispeed; resiliently mounted on motor board. Comply with requirements in Division 20 Section "Motors."
 3. Wiring Terminations: Connect motor to chassis wiring with plug connection.
- H. Electrical Connection: Factory wire motors and controls for a single field connection.
- I. Capacities and Characteristics: Refer to Schedule on Drawings.
- 2.02 **UNIT CONTROLS**
- A. Basic Unit Controls:
1. Control voltage transformer.
 2. Wall-mounting thermostat with the following features.
 - a. Heat-off switch.
 - b. Fan on-auto switch.
 - c. Manual fan speed switch.
 - d. Adjustable deadband.
 - e. Exposed set point.
 - f. Deg F indication.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine areas to receive cabinet unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.

- B. Examine roughing-in for electrical connections to verify actual locations before cabinet unit heater installation.
 - C. Proceed with installation only after unsatisfactory conditions have been corrected.
- 3.02 **INSTALLATION**
- A. Install cabinet unit heaters to comply with NFPA 90A.
 - B. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.
 - C. Install new filters in each fan-coil unit within two weeks of Substantial Completion.
- 3.03 **CONNECTIONS**
- A. Ground equipment according to Division 26 Section "Grounding and Bonding."
 - B. Connect wiring according to Division 26 Section "Conductors and Cables."
- 3.04 **FIELD QUALITY CONTROL**
- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections. Report results in writing.
 - B. Perform the following field tests and inspections and prepare test reports:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
 - 3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
 - C. Remove and replace malfunctioning units and retest as specified above.
- 3.05 **DEMONSTRATION**
- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain cabinet unit heaters.

END OF SECTION

SECTION 26 0010 - ELECTRICAL GENERAL REQUIREMENTS

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes electrical general administrative and procedural requirements. The following requirements are included in this Section to supplement the requirements specified in Division 1 Specification Sections.

1.03 REFERENCES

- A. All materials shall be new. The electrical and physical properties of all materials, and the design, performance characteristics, and methods of construction of all items of equipment, shall be in accordance with the latest issue of the various, applicable Standard Specifications of the following recognized authorities:
 1. ANSI - American National Standards Institute; www.ansi.org.
 2. ASTM - ASTM International; www.astm.org.
 3. CSI - Construction Specifications Institute (The); www.csiresources.org.
 4. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
 5. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
 6. NEC - National Electrical Code
 7. NECA - National Electrical Contractors Association; www.necanet.org.

- a. NECA 1-2000, "Practices for Good Workmanship in Electrical Contracting (ANSI)."
 8. NEMA - National Electrical Manufacturers Association; www.nema.org.
 9. NETA - InterNational Electrical Testing Association; www.netaworld.org.
 10. UL - Underwriters Laboratories Inc.; www.ul.com.
- 1.04 **QUALITY ASSURANCE**
- A. Scope of Work: Furnish all labor, material, equipment, technical supervision, and incidental services required to complete, test, and leave ready for operation the electrical systems as specified in the Division 26 Sections and as indicated on Drawings.
 1. Contract Documents are complementary, and what is required by one shall be as binding as if required by all. In the event of inconsistencies or disagreements within the Construction Documents bids shall be based on the most expensive combination of quality and quantity of the work indicated.
 2. The Contractor understands that the work herein described shall be complete in every detail.
 - B. Ordinances and Codes: Perform all Work in accordance with applicable Federal, State, and local ordinances and regulations, the Rules and Regulations of NFPA, NECA, and UL, unless otherwise indicated.
 1. Notify the Architect/Engineer if revisions to the Drawings or Specifications are required to conform to applicable ordinances, codes, or regulations. Identify the cost associated with these revisions in the bid.
 - C. Source Limitations: All equipment of the same or similar systems shall be by the same manufacturer.
 - D. Tests and Inspections: Perform all tests required by state, city, county, and/or other agencies having jurisdiction. Provide all materials, equipment, etc., and labor required for tests.
 - E. Performance Requirements: Perform all work in a first class and workmanlike manner, in accordance with the latest accepted standards and practices for the trades involved.
 - F. Sequence and Schedule: Avoid interference with the work of other trades. Remove and relocate any work which in the opinion of the Owner's Representatives causes interference.
- 1.05 **CODES, PERMITS AND FEES**
- A. Unless otherwise indicated, all required permits, licenses, inspections, approvals, and fees for electrical work shall be secured and paid for by the Contractor. All work shall conform to all applicable codes, rules, and regulations.
 - B. Comply with rules of local utility companies. Coordinate with the utility company supplying service to the installation and determine all devices including, but not limited to, all current and potential transformers, meter boxes, C.T. cabinets, and meters which will be required and include the cost of all such items and all utilities costs in proposal.
 - C. All work shall be executed in accordance with the rules and regulations outlined in local and state codes. Prepare any detailed Drawings or diagrams which may be required by the governing authorities. Where the Drawings and/or Specifications indicate materials or construction that exceed code requirements, the Drawings and/or Specifications shall govern.
- 1.06 **DRAWINGS**
- A. The Drawings show the location and general arrangement of equipment, electrical systems, and related items. They shall be followed as closely as elements of the construction will permit.
 - B. Examine the Drawings of other trades and verify the conditions governing the work on the job site. Arrange work accordingly, providing such fittings, conduit, junction boxes, and accessories as may be required to meet such conditions.
 - C. Deviations from the Drawings, apart from minor changes in routing and other such incidental changes that do not affect the functioning or serviceability of the systems, shall not be made without the written approval of the Architect/Engineer.
 - D. The architectural and structural Drawings take precedence in all matters pertaining to the building structure, mechanical Drawings in all matters pertaining to mechanical trades, and electrical Drawings in all matters pertaining to electrical trades. Where there are conflicts or differences between the Drawings for the various trades, report such conflicts or differences to the Architect/Engineer for resolution.

- E. Drawings are not intended to be scaled for rough-in or to serve as shop drawings. Take all field measurements required to complete the Work.
- 1.07 **MATERIAL AND EQUIPMENT MANUFACTURERS**
- A. All items of equipment shall be furnished complete with all accessories normally supplied with the catalog items listed and all other accessories necessary for a complete and satisfactory operating system. All equipment and materials shall be new, be standard products of manufacturers regularly engaged in the production of electrical equipment and be of the manufacturer's latest design.
- B. If an approved manufacturer is other than the manufacturer used as the basis for design, the equipment or product provided shall be equal in size, quality, durability, appearance, capacity, and efficiency through all ranges of operation, shall conform with arrangements and space limitations of the equipment shown on the plans and/or specified, shall be compatible with the other components of the system and shall comply with the requirements for Items Requiring Prior Approval specified in this section of the Specifications. All costs to make these items of equipment comply with these requirements including, but not limited to, electrical work, and building alterations shall be included in the original Bid. Similar equipment shall be by one manufacturer.
- C. Where existing equipment is modified to include new switches, circuit breakers, metering, or other components, the new components shall be by the original equipment manufacturer and shall be listed for installation in the existing equipment. Where original equipment manufacturer components are not available, third-party aftermarket components shall be listed for the application and submitted to the engineer for approval. Reconditioned or salvaged components shall not be used unless specifically indicated on the drawings.
- 1.08 **INSPECTION OF SITE**
- A. Visit the site, examine, and verify the conditions under which the Work must be conducted before submitting Proposal. The submitting of a Proposal implies that the Contractor has visited the site and understands the conditions under which the Work must be conducted. No additional charges will be allowed because of failure to make this examination or to include all materials and labor to complete the Work.
- 1.09 **ITEMS REQUIRING PRIOR APPROVAL**
- A. Bids shall be based upon manufactured equipment specified. All items that the Contractor proposes to use in the Work that are not specifically named in the Contract Documents must be submitted for review prior to bids. Such items must be submitted in compliance with Division 1 specifications. Requests for prior approval must be accompanied by complete catalog information, including but not limited to, model, size, accessories, complete electrical information, and performance data in the form given in the equipment schedule on the drawings at stated design conditions. Where items are referred to by symbolic designations on the drawings, all requests for prior approval shall bear the same designations.
1. Equipment to be considered for prior approval shall be equal in quality, durability, appearance, capacity, and efficiency through all ranges of operation, shall fulfill the requirements of equipment arrangement and space limitations of the equipment shown on the plans and/or specified and shall be compatible with the other components of the system.
 2. All costs incurred to make equipment comply with other requirements, including providing maintenance, clearance, electrical, replacement of other components, and building alterations shall be included in the original bid.
- B. Voluntary alternates may be submitted for consideration, with listed addition or deduction to the bid.
- 1.10 **SHOP DRAWINGS/SUBMITTALS**
- A. Submit project-specific submittals for review in compliance with Division 1.
- B. All shop Drawings shall be submitted in groupings of similar and/or related items (lighting fixtures, switchgear, etc.). Incomplete submittal groupings will be returned unchecked.
- C. If deviations (not substitutions) from the Contract Documents are deemed necessary by the Contractor, the details of such deviations, the reason for the deviation, and the resulting changes shall be included with the submittal for approval.

- E. Submit for approval shop drawings for electrical systems or equipment indicated in other sections of electrical specs. Where items are referred to by symbolic designation on the Drawings and Specifications, all submittals shall bear the same designation (light fixtures).
- 1.11 **COORDINATION DRAWINGS**
 - A. Submit project specific coordination drawings for review in compliance with Division 1 Specification Sections.
- 1.12 **OPERATION AND MAINTENANCE INSTRUCTIONAL MANUALS**
 - A. Submit project specific Operation and Maintenance Instructional Manuals for review in compliance with Division 01 Specification Sections.
 - B. Provide complete operation and maintenance instructional manuals covering all electrical equipment herein specified, together with parts lists. Maintenance and operating instructional manuals shall be job specific to this project. Generic manuals are not acceptable. Manual shall be provided on electronic media. All literature shall be combined in one document and shall be properly bookmarked with all applicable sections. Maintenance and operating instructional manuals shall be provided when construction is approximately 75% complete.
 - C. The operating and maintenance instructions shall include a brief, general description for all electrical systems including, but not limited to:
 - 1. Routine maintenance procedures.
 - 2. Trouble-shooting procedures.
 - 3. Contractor's telephone numbers for warranty repair service.
 - 4. Submittals.
 - 5. Recommended spare parts list.
 - 6. Names and telephone numbers of major material suppliers and subcontractors.
 - 7. System schematic drawings on 8-1/2" x 11" sheets.
- 1.13 **RECORD DRAWINGS**
 - A. Submit record drawings in compliance with Division 01.
 - B. Contractor shall submit to the Architect/Engineer, record drawings on electronic media which have been neatly marked to represent as-built conditions for all new electrical work. Modifications to original drawings shall be marked with a contrasting color so the marks are readily apparent.
 - C. The Contractor shall keep accurate note of all deviations from the construction documents and discrepancies in the underground concealed conditions and other items of construction on field drawings as they occur. The marked up field documents shall be available for review by the Architect, Engineer, and Owner at their request during construction.
- 1.14 **INSTRUCTION OF OWNER PERSONNEL**
 - A. Before final inspection, instruct Owner's designated personnel in operation, adjustment, and maintenance of electrical equipment and systems at agreed upon times. A minimum of 8 hours of formal instruction to Owner's personnel shall be provided for each building. Additional hours are specified in individual specification sections.
 - B. Use operation and maintenance manuals as basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.
 - C. In addition to individual equipment training provide overview of each electrical system. Utilize the as-built documents for this overview.
 - D. Prepare and insert additional data in operation and maintenance manual when need for such data becomes apparent during instruction, or as requested by Owner.
- 1.15 **WARRANTY**
 - A. Warranty: Comply with the requirements in Division 01 Specification Sections. Contractor shall warranty that the electrical installation is free from defects and agrees to replace or repair, to the Owner's satisfaction, any part of this electrical installation which becomes defective within a period of one year (unless specified otherwise in other Division 26 sections) from the date of substantial completion following final acceptance, provided that such failure is due to defects in the equipment, material, workmanship, or failure to follow the contract documents.
 - B. Contractor shall be responsible for any temporary services including equipment and installation required to maintain operation as a result of any equipment failure or defect during warranty period.

- C. File with the Owner all warranties from the equipment manufacturers including the operating conditions and performance capacities they are based on.
- 1.16 **USE OF EQUIPMENT**
- A. The use of any equipment, or any part thereof for purposes other than testing even with the Owner's consent, shall not be construed to be an acceptance of the work on the part of the Owner, nor be construed to obligate the Owner in any way to accept improper work or defective materials.
 - B. Do not use Owner's lamps for temporary lighting except as allowed and directed by the Owner. Equip lighting fixtures with new lamps when the project is turned over to the Owner.
- 1.17 **COORDINATION**
- A. Coordinate arrangement, mounting, and support of electrical equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. To allow right of way for piping and conduit installed at required slope.
 - 4. To ensure that connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions; and to maintain the working and access space of other equipment.
 - B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
 - C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 8 Section "Access Doors and Frames."
 - D. Coordinate electrical testing of electrical, mechanical, and architectural items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.01 **COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION**

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange, and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to raceways and piping systems installed at a required slope.

3.02 **DEMOLITION WORK**

- A. All demolition of existing electrical equipment and materials will be done by this Contractor unless otherwise indicated. Include all items related to the existing systems that are being removed such as, but not limited to, electrical equipment, cabinets, devices, lighting fixtures, conduit, fittings, boxes, wiring, and supports. No abandoned components of the electrical systems indicated to be removed shall remain.
 - 1. Where electrically powered equipment is included in the demolition scope of other trades, disconnect electrical wiring connections and remove circuit wiring complete.
- B. In general, demolition work is indicated on the Drawings. However, the Contractor shall visit the job site to determine the full extent and character of this work.
- C. Unless specifically noted otherwise, removed materials shall not be reused in the work.
 - 1. Materials indicated to be salvaged shall be carefully removed, stored, and protected from damage.
 - 2. Salvaged materials intended to be re-used shall be thoroughly cleaned, refurbished if necessary, and determined to be fully functional prior to placing back into service.
 - 3. Salvaged materials of value that are not to be reused shall remain the property of the Owner unless such ownership is waived. Items that the Owner has waived ownership shall

become the property of the Contractor, who shall remove and legally dispose of same, away from the premises.

- D. Where equipment or fixtures are removed, outlet boxes that remain recessed in walls shall be properly blanked off, and conduits capped. After alterations are complete, the entire installation shall present a "finished" look, as approved by the Architect/Engineer. The original function of the present electrical systems remaining in service shall not be changed unless specifically indicated as part of the project scope.
 - E. Reroute signal wires, lighting, and power wiring as required to maintain services that are to remain and/or unaffected by the renovations. Where walls and ceilings are to be removed as shown on the Drawings, the conduit is to be cut off by the Electrical Trades so that the abandoned conduit in these walls and ceilings may be removed with the walls and ceilings by the Architectural Trades. All dead-end conduit runs shall be plugged at the remaining line outlet boxes or the panels.
 - F. Where new walls and/or floors are installed which interfere with existing outlets, devices, etc., the Electrical Trades shall adjust, extend and reconnect such items as required to maintain continuity of same.
 - G. All electrical work in altered and unaltered areas shall be run concealed wherever possible. Use of surface raceway or exposed conduits will be permitted only where specifically indicated on the drawings or approved by the Architect/Engineer.
 - H. Existing lighting shall be reused where indicated on plans. Reused fixtures shall be detergent cleaned, re-lamped, and reconditioned suitable for satisfactory operation and appearance.
- 3.03 **INSTALLATION OF EQUIPMENT**
- A. Install all equipment in strict accordance with all directions and recommendations furnished by the manufacturer. Where such directions conflict with the Drawings and Specifications, report such conflicts to the Architect/Engineer for resolution.
 - B. Device Location:
 - 1. Allow for wiring devices, control devices, and fire alarm devices to be relocated within a 10' radius to accommodate final coordination with furnishings and other finish elements. Devices relocated prior to installation shall be done without additional cost to the project.
- 3.04 **WORK IN EXISTING BUILDINGS**
- A. The Owner will provide access to existing buildings as required. Access requirements to occupied buildings shall be identified on the project schedule. The Contractor, once Work is started in the existing building, shall complete same without interruption to return work areas as soon as possible to Owner.
 - B. Adequately protect and preserve all existing and newly installed Work. Promptly repair any damage to same at Contractor's expense.
 - C. Consult with the Owner's Representative as to the methods of carrying on the Work so as not to interfere with the Owner's operation any more than necessary. Accordingly, all service lines shall be kept in operation as long as possible and the services shall only be interrupted at such time as will be designated by the Owner's Representative.
 - D. Prior to starting work in any area, obtain approval for doing so from a qualified representative of the Owner who is designated and authorized by the Owner to perform testing and abatement of all hazardous materials including but not limited to, asbestos. The Contractor shall not perform any inspection, testing, containment, removal, or other work that is related in any way whatsoever to hazardous materials under the Contract.
- 3.05 **TEMPORARY SERVICES**
- A. Provide and remove upon completion of the project, following the general conditions and as described in Division 01, a complete temporary electrical and telephone service during construction.
- 3.06 **DISPOSAL**
- A. Fluorescent Lamps
 - 1. Fluorescent lamps are known to contain mercury and are classified as hazardous material. All fluorescent lamps shall be assumed to contain mercury unless tested and confirmed otherwise with a toxicity characteristic leaching procedure (TCLP).

2. Hazardous materials (fluorescent lamps), shall be sent to a lamp recycling facility. The materials shall be properly packaged with labels that meet the Department of Transportation Regulations and stored in a secure location before transportation.
 3. The Contractor shall identify the costs of the lamp disposal process including, but not limited to, the lamp packaging, storage, transportation, disposal, and any profile fees.
 4. Upon completion of the project, provide documentation to verify that the lamps have been properly disposed of in accordance with all local, state, and federal guidelines.
- B. Ballasts
1. Lighting ballasts manufactured prior to 1979 have been known to contain polychlorinated biphenyls (PCBs). Unless specifically noted on the ballast as containing "No PCBs," the ballast shall be assumed to contain components with PCB materials.
 2. Hazardous materials (ballasts with PCBs), shall be disposed of at a hazardous waste incineration facility, or at a recycling facility in accordance with the Code of Federal Regulations as administered by the EPA in regards to this issue. The ballasts shall be packaged/stored in fifty-five gallon steel drums with labels that meet the Department of Transportation Regulations.
 3. The Contractor shall identify the costs of the ballast disposal process including, but not limited to, the packaging, storage, transportation, disposal, and any profile fees.
 4. Provide at completion of the project documentation (manifests) to verify that the ballasts have properly been disposed of in accordance with all local, state, and federal guidelines.
- 3.07 **CHASES AND RECESSES**
- A. Provided by the architectural trades, but the Contractor shall be responsible for their accurate location and size.
- 3.08 **CUTTING, PATCHING AND DAMAGE TO OTHER WORK**
- A. Refer to General Conditions for requirements.
 - B. All cutting, patching, and repair work shall be performed by the Contractor through approved, qualified subcontractors. Contractor shall include full cost of same in bid.
- 3.09 **EXCAVATION AND BACKFILLING**
- A. Provide all excavation, trenching, tunneling, dewatering, and backfilling required for the electrical work. Coordinate the work with other excavating and backfilling in the same area.
 - B. Where conduit is installed less than 2'6" below the surface of pavement, provide concrete encasement, 4" minimum coverage, all around or as shown on the electrical Drawings.
 - C. Backfill all excavations with well-tamped granular material. Backfill all excavations under wall footings with lean mix concrete up to underside of footings and extend concrete within excavation a minimum of four (4) feet each side of footing. Granular backfill shall be placed in layers not more than 8 inches in thickness, 95 percent compaction throughout with approved compaction equipment. Tamp, roll as required. Excavated material shall not be used.
 - D. Backfill all excavations inside building, under drives, and parking areas with well-tamped granular material. Granular backfill shall be placed in layers not more than 8 inches in thickness, 95 percent compaction throughout with approved compaction equipment. Tamp, roll as required. Excavated material shall not be used.
 - E. Backfill outside building with granular material to a height 12 inches over top of pipe compacted to 95 percent compaction as specified above. Backfill remainder of excavation with unfrozen excavated material in such a way as to prevent settling.
- 3.10 **EQUIPMENT CONNECTIONS**
- A. Make connections to equipment and other items included in the work in accordance with the approved shop Drawings and rough-in measurements furnished by the manufacturers of the particular equipment furnished. All additional connections not shown on the Drawings, but called out by the equipment manufacturer's shop Drawings shall be provided.
- 3.11 **CLEANING**
- A. All debris shall be removed daily as required to maintain the work area in a neat, orderly condition.
 - B. Final cleanup shall include, but not be limited to, washing of fixture lenses or louvers, switchboards, substations, motor control centers, panels, etc. Fixture reflectors and lenses or louvers shall be left with no water marks or cleaning streaks.

3.12 **PROTECTION AND HANDLING OF EQUIPMENT AND MATERIALS**

- A. Equipment and materials shall be protected from theft, injury, or damage.
- B. Protect conduit openings with temporary plugs or caps.
- C. Provide adequate storage for all equipment and materials delivered to the job site. Location of the space will be designated by the Owner's representative or Architect/Engineer. Equipment set in place in unprotected areas must be provided with temporary protection.

3.13 **EXTRA WORK**

- A. For additional electrical work which may be proposed or requested, furnish an itemized cost breakdown of material and labor required to complete the work. Proceed only after receiving a written authorization.
- B. Before providing an itemized break-down for additional electrical work, submit unit prices for the following items: 1/2", 3/4", 1", 1-1/2" EMT conduit; #12, #10, #8, #6, #2 building wire; duplex receptacles, GFCI receptacles, data box and raceway, and other common electrical work which may be anticipated for any future revisions. These unit costs, once agreed to, shall be applied to additions and deducts for all project change orders.

3.14 **DRAWINGS AND MEASUREMENTS**

- A. The Drawings are not intended to be scaled for rough-in measurements nor to serve as Shop Drawings. Field measurements necessary for ordering materials and fitting the installation to the building construction and arrangement are the Contractor's responsibility. The Contractor shall check latest Architectural Drawings and locate light switches from same where door swings are different from Electrical Drawings.

END OF SECTION

TMP Architecture, Inc.
Peter Basso Associates, Inc.

TMP22103D & 22104E
PBA2023.0155.01 & 2023.0156.01

SECTION 26 0519 - CONDUCTORS AND CABLES

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PART 1 GENERAL

- 1.01 **RELATED DOCUMENTS**
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- 1.02 **SUMMARY**
A. Section includes:
1. Building wires and cables rated 600V and less.
2. Connectors, splices, and terminations rated 600 V and less.
- 1.03 **SUBMITTALS**
A. Field Quality-Control Test Reports
B. Submit letter of compliance (intent) for general building wire and cable. Provide product data for the following:
1. Metal-Clad Cable, Type MC
- 1.04 **QUALITY ASSURANCE**
A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
B. Comply with NFPA 70.

PART 2 PRODUCTS

- 2.01 **COPPER BUILDING WIRE**
A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
B. Standards:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
C. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.
D. Conductor Insulation:
1. Type THHN/THWN-2: Comply with UL 83.
2. Type THW/THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
3. Type XHHW-2: Comply with UL 44.

2.02 METAL-CLAD CABLE, TYPE MC

- A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.
- B. Manufacturers:
 - 1. AFC Cable Systems
 - 2. Alpha Wire Company
 - 3. American Bare Conductor
 - 4. Belden
 - 5. Encore
 - 6. General Cable
 - 7. Okonite
 - 8. Service Wire Co.
 - 9. Southwire Company
- C. Standards:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 - 2. Comply with UL 1569.
 - 3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Circuits:
 - 1. Single circuit and multi-circuit with color-coded conductors for branch circuit distribution.
 - 2. Power-Limited Fire-Alarm Circuits: Comply with UL 1424.
- E. Conductors:
 - 1. Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.
- F. Ground Conductor: Insulated. Ground conductor sized as indicated on drawings (reduced ground conductor is not acceptable).
- G. Conductor Insulation:
 - 1. Type TFN/THHN/THWN-2: Comply with UL 83.
 - 2. Type XHHW-2: Comply with UL 44.
- H. Armor: Aluminum, interlocked.
- I. Jacket: PVC applied over armor.

2.03 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 EXECUTION

3.01 CONDUCTOR MATERIAL APPLICATIONS

- A. Refer to application schedule on the drawings
- B. Feeders and Branch Circuits: Solid or stranded for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.
- C. Each feeder shall be of the same conductor and insulation material (phase, neutral, and parallel).
- D. Use conductor not smaller than 14 AWG for control circuits,

3.02 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Refer to application schedule on the drawings
- B. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel wire-mesh strain relief device at terminations to suit application.
- C. Class 1 Control Circuits: Type THHN/THWN-2, in raceway.
- D. Class 2 Control Circuits: Type THHN/THWN-2, in raceway.

3.03 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 26 0533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
 - D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
 - E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
 - F. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."
 - G. Complete cable tray systems installation according to Section 26 0536 "Cable Trays for Electrical Systems" prior to installing conductors and cables.
 - H. Support communication cables above accessible ceiling, using spring metal clips or plastic cable ties to support cables from structure. Do not rest cable on ceiling panels.
 - I. Neatly train and lace wiring inside boxes, equipment, and panelboards.
 - J. Provide a separate neutral conductor for each circuit unless multi-wire branch circuits are specifically indicated on the drawings.
 - K. Electrical Contractor shall be responsible for de-rating of conductors as required by N.E.C. when more than three current carrying conductors are installed in a single raceway or cable. Neutral conductors shall be considered current carrying conductors.
 - L. Type MC cable shall be supported and secured at intervals not exceeding 4'-0" in new construction
 - M. Where MC cable is permitted by the specifications, AC/MC cable shall not be bundled.
 - N. Between support, hangers and termination no more than 3" deflection from the bottom of the cable to a horizontal line between the support/hanger or termination.
 - O. Do not route conductors across roof without prior approval from engineer.
- 3.04 **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.
 - B. 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.
 - C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.
 - D. Clean conductor surfaces before installing lugs and connectors.
 - E. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
 - F. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and larger.
 - G. Use Sta-Kon connectors to terminate stranded conductors #10 AWG and smaller to screw terminals.
 - H. Use insulated spring wire connectors with plastic caps (wire nuts) for copper conductor splices and taps, 10 AWG and smaller. Push-in style connectors are not permitted.
 - I. Provide lugs suitable for bussing and conductor material used.
- 3.05 **IDENTIFICATION**
- A. Identify and color-code conductors and cables according to Section 26 0553 "Identification for Electrical Systems."
 - B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.
- 3.06 **SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS**
- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 26 0533 "Raceways and Boxes."
- 3.07 **FIRESTOPPING**
- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Penetration Firestopping".

3.08 FIELD QUALITY CONTROL

- A. Perform the following field quality control tests in accordance with Division 26 section "Electrical Testing"
 - 1. Visual and Mechanical Inspection
 - a. Inspect cables for physical damage and proper connection in accordance with the one line diagram.
 - b. Test cable mechanical connections with an infrared survey.
 - c. Check cable color-coding against project Specifications and N.E.C. requirements.
 - 2. Electrical Tests
 - a. Perform insulation resistance test on each conductor with respect to ground and adjacent conductors. Applied potential to be 1000 volts dc for 1 minute.
 - b. Perform continuity test to insure proper cable connection.
 - 3. Test Values
 - a. Minimum insulation resistance values shall be not less than fifty mega-ohms.
- B. Test Reports: Prepare a written report to record the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

END OF SECTION

SECTION 26 0526 - GROUNDING AND BONDING

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PART 1 GENERAL

- 1.01 **RELATED DOCUMENTS**
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- 1.02 **SUMMARY**
A. This Section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.
B. Related Sections include the following:
1. Division 26 Section "Electrical General Requirements".
2. Division 26 Section "Conductors and Cables".
- 1.03 **REFERENCES**
A. ASTM B 3: Specification for Soft or Annealed Copper Wire.
B. ASTM B 8: Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard or Soft.
C. ASTM B 33: Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes.
D. ASTM B 187: Specification for Copper, Bus Bar, Rod, and Shapes and General Purpose Rod, Bar, and Shapes.
E. IEEE 81: Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.
F. IEEE 142: Grounding of Industrial and Commercial Power Systems.
G. IEEE 837: Qualifying Permanent Connections Used in Substation Grounding.
H. IEEE 1100 – 1992: Recommended Practice for Powering and Grounding Sensitive Electronic Equipment.
I. IEEE C2: National Electrical Safety Code.
J. NETA MTS – 2001: Maintenance Testing Specifications.
K. NFPA 70: National Electrical Code.
L. NFPA 70B: Recommended Practice for Electrical Equipment Maintenance.
M. NFPA 99: Health Care Facilities.
N. NFPA 780: Lightning Protection Code.
O. TIA/EIA 607: Commercial Building Grounding and Bonding Requirements Standard.
P. UL 96: Lightning Protection Components.
Q. UL 467: Grounding and Bonding Equipment.
R. UL 486 A: Wire Connectors and Soldering Lugs for Use with Copper Conductors.
S. UL 486B: Wire Connectors for Use with Aluminum Conductors.
- 1.04 **SUBMITTALS**
A. Product Data: For the following:

1. Ground rods.
2. Compression-type connectors.
- B. Qualification Data: For firms and persons specified in "Quality Assurance" Article.
- C. Field Test Reports: Submit written test reports to include the following:
 1. Test procedures used.
 2. Test results that comply with requirements.
 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
 4. Indicate overall system resistance to ground.
 5. Indicate overall Telecommunications system resistance to ground.

1.05 **PROJECT RECORD DOCUMENTS**

- A. Submit under provisions of Division 26 "Electrical General Requirements".
- B. Accurately record actual locations of grounding electrodes and connections to building steel.

1.06 **QUALITY ASSURANCE**

- A. Testing Agency Qualifications: Refer to specification section "Electrical Testing."
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 1. Comply with UL 467.
- C. Comply with NFPA 70; for overhead-line construction and medium-voltage underground construction, comply with IEEE C2.
- D. Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system.
- E. Comply with ANSI/TIA/EIA-607 "Standard for Commercial Building Grounding and Bonding Requirements for Telecommunications".
- F. Comply with ANSI/IEEE 1100 -1992 "Powering and Grounding Sensitive Electronic Equipment".

PART 2 PRODUCTS

2.01 **MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Grounding Conductors and Cables:
 - a. Refer to Division 26 Section "Conductors and Cables".
 2. Grounding Rods:
 - a. American Electric-Blackburn.
 - b. Apache Grounding/Erco Inc.
 - c. Chance/Hubbell.
 3. Mechanical Connectors:
 - a. American Electric-Blackburn.
 - b. Burndy.
 - c. Chance/Hubbell.
 4. Exothermic Connections:
 - a. Cadweld.
 5. Compression-type Connectors:
 - a. Burndy HyGround
 - b. Blackburn EZ Ground.
 - c. Panduit.

2.02 **GROUNDING CONDUCTORS**

- A. For insulated conductors, comply with Division 26 Section "Conductors and Cables."
- B. Material: Aluminum, copper-clad aluminum, and copper.
- C. Equipment Grounding Conductors: Insulated with green-colored insulation.
- D. Isolated Ground Conductors: Insulated with green-colored insulation with yellow stripe. On feeders with isolated ground, use colored tape, alternating bands of green and yellow tape to provide a minimum of three bands of green and two bands of yellow.
- E. Grounding Electrode Conductors: Stranded cable.
- F. Underground Conductors: Bare, stranded, copper unless otherwise indicated.
- G. Bare Copper Conductors: Comply with the following:

1. Solid Conductors: ASTM B 3.
 2. Assembly of Stranded Conductors: ASTM B 8.
 - H. Copper Bonding Conductors: As follows:
 1. Bonding Conductor: Stranded copper conductor; size per the NEC.
 2. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; size per the NEC.
 3. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; size per the NEC.
 - I. Electrical Grounding Busbar
 1. 24" (min) x 2" x 1/4" tin plated, copper busbar with two rows of 1/4" x 20 tapped holes 1" on center.
- 2.03 **CONNECTOR PRODUCTS**
- A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.
 - B. Bolted Connectors: Bolted-pressure-type connectors, or compression type.
 - C. Welded Connectors: Exothermic-welded type, in kit form, and selected for the specific application per manufacturer's written instructions.
 - D. Compression-Type Connectors: Pure, wrought copper, per ASTM B187.
- 2.04 **GROUNDING ELECTRODES**
- A. Ground Rods: Copper-clad steel.
 1. Size: 5/8 in diameter.
 2. Length: 120 inches.

PART 3 EXECUTION

3.01 EQUIPMENT GROUNDING

- A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.
- B. Underground Grounding Conductors: No. 2/0 AWG minimum. Bury at least 24 inches below grade or bury 12 inches above duct bank when installed as part of the duct bank.
- C. In raceways, use insulated equipment grounding conductors. Install equipment grounding conductors in all feeders and circuits. Terminate each end on suitable lugs, bus or bushing.
 1. Where existing branch circuits are using conduit as equipment grounding conductor and are extended, provide grounding bushing on existing conduit and provide new equipment grounding conductor with new branch circuit.
- D. Install equipment grounding conductors in all feeders and circuits. Terminate each end on suitable lugs, bus or bushing.
- E. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.
- F. Air-Duct Equipment Circuits: Install an equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners and heaters. Bond conductor to each unit and to air duct.
- G. Water Heater, Heat-Tracing, and Anti-frost Heating Cables: Install a separate equipment grounding conductor to each electric water heater, heat-tracing, and anti-frost heating cable. Bond conductor to heater units, piping, connected equipment, and components.
- H. Verify specific equipment grounding requirements with the manufacturer's recommendations.

3.02 CONNECTIONS

- A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
 2. Make connections with clean, bare metal at points of contact.
 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.

4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
 - B. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections, except those at test wells. Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.
 - C. Equipment Grounding Conductor Terminations
 1. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and larger.
 2. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
 - D. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.
 - E. Connections at Test Wells: Use compression-type connectors on conductors and make bolted-and clamped-type connections between conductors and ground rods.
 - F. Tighten screws and bolts for grounding and bonding 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.
 - G. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Connections shall be non-reversible. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.
 - H. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.
- 3.03 **INSTALLATION**
- A. Equipotential Ground: Interconnect grounding electrodes to form one, electrically continuous, equipotential grounding electrode system. Grounding electrodes to be interconnected include:
 1. Ground rods.
 2. Ufer ground.
 3. Metal water service pipe.
 - B. Ground Rods: Install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes.
 1. Verify that final backfill and compaction has been complete before driving ground rods.
 2. Drive ground rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.
 3. Interconnect ground rods with grounding electrode conductors. Use exothermic welds or non-reversing compression-type connectors, except at test wells and as otherwise indicated. Make connections without exposing steel or damaging copper coating.
 - C. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70, Paragraph 250-81(c):
 1. Provide a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG. If concrete foundation is less than 20 feet long, coil excess conductor within the base of the foundation.
 2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts.
 3. Extend grounding conductor below grade and connect to building grounding grid or to a grounding electrode external to concrete.
 - D. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage. Install in conduit where routed above grade.

- E. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors or non-reversing compression-type connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.
 - F. Metal Water Service Pipes in direct contact with the earth for 10 feet: Provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to all metal water service entrances to building including fire protection water service entrance. Connect grounding conductors to metal water service pipes by grounding clamp connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 - G. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.
 - H. Bond interior metal piping systems, including any portions of metal piping systems separated by non-metal piping, and metal air ducts to equipment grounding conductors of associated pumps, fans, blowers, electric heaters, and air cleaners. Use braided-type bonding straps.
 - I. Separately Derived AC Power Systems: Ground separately-derived ac power system neutrals including distribution transformers to grounding electrodes per NFPA 70.
 - J. Grounding Bus:
 - 1. Install grounding bus in the locations listed below and elsewhere as indicated:
 - a. Electrical equipment rooms.
 - 2. Use insulated spacer; space 2 inch from wall and support from wall 12 inches above finished floor, unless otherwise indicated.
 - K. Equipment Grounding: Provide a permanent and continuous bonding of conductor enclosures, equipment frames, power distribution equipment ground busses, cable trays, metallic raceways, and other non-current carrying metallic parts of the electrical system.
- 3.04 **FIELD QUALITY CONTROL**
- A. Testing: Perform the following field quality control tests in accordance with Division 26 section "Electrical Testing"
 - 1. Inspect grounding and bonding system conductors and connections for tightness and proper installation and for compliance with the Drawings and Specifications.
 - 2. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
 - a. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal.
 - b. Measure ground resistance not less than two full days after the last trace of precipitation, and without the 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.
 - c. Perform ground-impedance measurements utilizing either the intersecting curves method of the slope method. (Ref. Nos. 40 and 41 in IEEE Std. 81).
 - 3. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION

TMP Architecture, Inc.
Peter Basso Associates, Inc.

TMP22103D & 22104E
PBA2023.0155.01 & 2023.0156.01

SECTION 26 0529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.
 - 2. Construction requirements for concrete bases.

1.03 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

1.04 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.05 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

1.06 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. These items are specified in Division 07 Section "Roof Accessories."

PART 2 PRODUCTS

2.01 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit; a part of Atkore International..
 - b. B-Line, by Eaton..
 - c. GS Metals Corp.
 - d. Pentair Electrical & Fastening Solutions.
 - e. Thomas & Betts Corporation.
 - f. Unistrut; a part of Atkore International.
 - g. Wesanco, Inc.
 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 3. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 4. Channel Dimensions: Selected for applicable load criteria.
 - B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
 - C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
 - D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
 - E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
 - F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Hilti Inc.
 - 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 3) MKT Fastening, LLC.
 - 4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) B-Line by Eaton.
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti Inc.
 - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 5) MKT Fastening, LLC.
 3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 6. Toggle Bolts: All-steel springhead type.
 7. Hanger Rods: Threaded steel.
- 2.02 **FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES**
- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
 - B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 EXECUTION

3.01 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to these supports with:
 - a. Two-bolt conduit clamps
 - b. Single-bolt conduit clamps
 - c. Single-bolt conduit clamps using spring friction action for retention in support channel.
- D. Support single runs of MC cable using spring-steel clamps from suspended ceiling hangers, hanger wire or building structure at intervals not to exceed three feet. Do not support MC cable from ceiling grid.

3.02 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT may be supported by openings through structure members, as permitted in NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
 - 6. To Steel:
 - a. Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
 - b. Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69
 - c. Spring-tension clamps.
 - 7. To Light Steel: Sheet metal screws.
 - 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel support systems attached to substrate.
- E. Slotted support systems applications:
 - 1. Indoor dry and damp Locations: Painted Steel
 - 2. Outdoors and interior wet locations: Galvanized Steel
- F. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.
- G. Do not fasten supports to pipes, ducts, mechanical equipment, and conduit.
- H. Obtain permission from Architect/Engineer before using powder-actuated anchors.

- I. Obtain permission from Architect/Engineer before drilling or cutting structural members.
 - J. Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.
 - K. Install surface-mounted cabinets and panelboards with minimum of four anchors.
 - L. In wet and damp locations use steel channel supports to stand cabinets and panelboards one inch off wall.
 - M. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.
 - N. The Contractor shall replace all supports and channels that sag, twist, and/or show signs of not providing proper structural support, to the equipment, it is intended for, as determined by the Owner and Architect/Engineer. All costs associated with replacing supports and steel channels shall be incurred by the Contractor.
- 3.03 **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.
- 3.04 **INSTALLATION OF ROOF MOUNTED SUPPORTS**
- A. Install in accordance with manufacturer's instructions.
 - B. If gravel top roof, gravel must be removed around and under support.
 - C. Consult roofing manufacturer for roof membrane compression capacities. If required, a compatible sheet of roofing material (rubber pad) may be required under rooftop support to disperse concentrated loads and add further membrane protection.
 - D. Utilize properly sized clamps and accessories to suit conduit sizes.
 - E. Provide vertical steel channel members as required for elevated conduit supports where required for clearances, coordination with other roof mounted systems or derating.
- 3.05 **CONCRETE BASES**
- A. Provide concrete bases for all floor mounted electrical equipment.
 - B. Base/Pad Construction:
 - 1. Construct per manufacturer's recommendations for particular equipment, including suggested piers and dowel rods.
 - 2. Interior concrete bases shall have a minimum depth of 4" unless other indicated or recommended by the manufacturer.
 - 3. Exterior concrete bases shall have a minimum depth of 8" unless other indicated or recommended by the manufacturer.
 - 4. Construct concrete bases for primary and secondary power distribution equipment per requirements of the electrical utility, where submitted for its review.
 - C. Anchor equipment to base per both supports and equipment manufacturer's instructions.
 - D. Coordinate conduit openings and sleeve locations in base with requirements of equipment to be supported.
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of the base.
 - 2. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
- 3.06 **PAINTING**
- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
 - B. 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.

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- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 26 0533 - RACEWAYS AND BOXES

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
- B. Related Sections include the following:
 - 1. Division 07 Section, "Penetration Firestopping" for firestopping materials and installation at penetrations through walls, ceilings, and other fire-rated elements.
 - 2. Division 26 Section "Wiring Devices" for devices installed in boxes and for floor-box service fittings, and for access floor boxes and service poles.
 - 3. Division 26 "Hangers and Supports for Electrical Systems" for concrete bases.

1.03 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. ENT: Electrical nonmetallic tubing.
- C. FMC: Flexible metal conduit.
- D. IMC: Intermediate metal conduit.
- E. LFMC: Liquidtight flexible metal conduit.
- F. LFNC: Liquidtight flexible nonmetallic conduit.
- G. RNC: Rigid nonmetallic conduit.
- H. PVC: Polyvinyl Chloride.
- I. HDPE: High Density Polyethylene.

1.04 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

1.05 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

1.06 **COORDINATION**

- A. Coordinate layout and installation of raceways, boxes, enclosures, cabinets, and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 PRODUCTS

2.01 **METAL CONDUIT AND TUBING**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AFC Cable Systems, Inc.
 2. Alflex Inc.
 3. Allied Tube Triangle Century.
 4. Anamet Electrical, Inc.; Anaconda Metal Hose.
 5. International Metal Hose.
 6. Electri-Flex Co
 7. Grinnell Co./Tyco International; Allied Tube and Conduit Div.
 8. LTV Steel Tubular Products Company – Manhattan/CDT/Cole-Flex.
 9. Maverick.
 10. O-Z Gedney; unit of General Signal.
 11. Wheatland.
- B. Rigid Steel Conduit: ANSI C80.1.
- C. Aluminum Rigid Conduit: ANSI C80.5.
- D. IMC: ANSI C80.6.
- E. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
1. Comply with NEMA RN 1.
 2. Coating Thickness: 0.040 inch, minimum.
- F. EMT: ANSI C80.3.
- G. FMC: Aluminum.
- H. LFMC: Flexible steel conduit with PVC jacket.
- I. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
 2. Fittings for EMT: Steel, set-screw type.
 3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch, with overlapping sleeves protecting threaded joints.

2.02 **NONMETALLIC CONDUIT AND TUBING**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. American International.
 2. Anamet Electrical, Inc.;
 3. Arnco Corp.
 4. Cantex Inc.
 5. Certainteed Corp.;
 6. Condux International.
 7. ElecSys, Inc.
 8. Electri-Flex Co.
 9. Integral.
 10. Kor-Kap.
 11. Lamson and Sessions: Carlon Electrical Products.
 12. Manhattan/CDT/Cole-Flex.
 13. RACO; Division of Hubbell, Inc.
 14. Scepter.
 15. Spiralduct, Inc./AFC Cable Systems, Inc.
 16. Thomas & Betts Corporation.
- B. ENT: NEMA TC 13.

- C. RNC: NEMA TC 2, Schedule 40 and Schedule 80 PVC.
 - D. ENT and RNC Fittings: NEMA TC 3; match to conduit or tubing type and material.
 - E. LFNC: UL 1660.
 - F. HDPE: UL 651, ASTM D 3350, ASTM D 1248 Schedule 40.
 - G. RTRC: Comply with UL 2515A and NEMA TC 14.
- 2.03 **METAL WIREWAYS**
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Hoffman.
 - 2. Square D.
 - B. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
 - C. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.
 - D. Wireway Covers: Screw-cover type.
 - E. Finish: Manufacturer's standard enamel finish.
- 2.04 **SURFACE RACEWAYS**
- A. Surface Metal Raceways: Galvanized steel with snap-on covers. Finish with manufacturer's standard prime coating.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Airey-Thompson Sentinel Lighting: Wiremold Company (The).
 - b. Thomas & Betts Corporation.
 - c. Walker Systems, Inc.; Wiremold Company (The).
 - d. Wiremold Company (The); Electrical Sales Division.
 - e. Mono-Systems, Inc.
- 2.05 **BOXES, ENCLOSURES, AND CABINETS**
- A. Sheet Metal Outlet and Device Boxes: NEMA OS 1. Shall be used within walls or ceiling.
 - B. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover. Shall be used in all exposed, non-recessed, locations.
 - C. Cabinets: NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage and include accessory feet where required for freestanding equipment.
- 2.06 **HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING**
- A. Description: Comply with ANSI/SCTE 77.
 - 1. Color of Frame and Cover: Gray for installations in concrete. Green for installation in grass.
 - 2. Configuration: Units shall be designed for flush burial and have open bottom, unless otherwise indicated.
 - 3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
 - 4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 - 5. Cover Legend: Molded lettering, "ELECTRIC", "COMMUNICATIONS" or as indicated for each system service.
 - 6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
 - 7. Handholes 12 inches wide by 24 inches long and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.
 - B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or a combination of the two.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hubbell: Quazite
 - b. Armorcast Products Company.
 - c. Carson Industries LLC.
 - d. CDR Systems Corporation.
 - e. NewBasis.
 - f. Christy Concrete Products.

2.07 **GROUT**

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.08 **SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES**

- A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes 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 a 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

3.01 **RACEWAY APPLICATION**

- A. Provide raceways in interior and exterior locations in accordance with the "Raceway Application Matrix" included on the drawings.
- B. Boxes and Enclosures, Exterior Aboveground: NEMA 250, Type 3R.
- C. Boxes, Enclosures, and Handholes:
 1. Handholes and Pull Boxes in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Non-deliberate Loading by Heavy Vehicles: Polymer concrete, SCTE 77, Tier 15 structural load rating.
 2. Handholes and Pull Boxes in Sidewalk and Similar Applications with a Safety Factor for Non-deliberate Loading by Vehicles: Polymer-concrete units, SCTE 77, Tier 8 structural load rating.
- D. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, nonmetallic in damp or wet locations.
- E. Minimum Raceway Size: 1/2-inch trade size.
- F. Raceway Fittings: Compatible with raceways and suitable for use and location.
 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.
 3. EMT: Use setscrew, cast-metal fittings. Comply with NEMA FB 2.10.
 4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- G. Install surface raceways only where indicated on Drawings.
- H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.02 **INSTALLATION**

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

- B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- E. Install temporary closures to prevent foreign matter from entering raceways.
- F. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.
- G. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.
- H. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- I. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
 - 1. Install concealed raceways with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.
- J. Support conduit within 12 inches of enclosures to which attached.
- K. Raceways Embedded in Slabs:
 - 1. Raceways embedded in slabs shall be limited to above grade concrete decks. Embedded conduit shall be limited to servicing floor boxes and equipment located in open spaces away from accessible walls.
 - 2. Install in middle 1/3 of slab thickness where practical and leave at least 2 inches of concrete cover.
 - 3. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
 - 4. Space raceways laterally to prevent voids in concrete.
 - 5. Run conduit larger than 1-inch trade size parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
 - 6. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 - 7. Conduits shall run flat. Do not allow conduits to cross.
 - 8. Change from non-metallic raceway to rigid steel before turning up out of the concrete and rising above the floor.
- L. Install exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.
 - 1. Run parallel or banked raceways together on common supports.
 - 2. Make parallel bends in parallel or banked runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.
- M. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- N. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- O. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- P. 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.
- Q. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- R. 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.
- S. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.

- T. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.
- U. Provide pull string and 25% spare capacity in every branch circuit conduit.
- V. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where otherwise required by NFPA 70.
- W. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6 inches above the floor. Install screwdriver-operated, threaded plugs flush with floor for future equipment connections.
- X. Expansion-Joint Fittings:
 - 1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
 - 2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
 - d. Attics: 135 deg F temperature change.
 - 3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
 - 4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
 - 5. 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.
- Y. Flexible Conduit Connections: Comply with NEMA RV3. Use maximum of 72 inches of flexible conduit for recessed and semi-recessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use LFMC in damp or wet locations. Install separate ground conductor across flexible connections.
- Z. 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.
- AA. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- BB. Locate boxes so that cover or plate will not span different building finishes.
- CC. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- DD. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- EE. Install hinged-cover enclosures and cabinets plumb. Support at each corner.
- FF. Do not route feeders across roof.
- GG. Provide a pull box (a handhole for outdoor applications) for each conduit run that exceeds 250 feet. Provide two pull boxes (handholes for outdoor applications) for runs that exceed 500 feet.
- HH. Route conduits in finished areas with exposed ceilings at underside of structural deck or as high as possible.

- II. Outlet boxes within hazardous locations shall be of the proper class and division as noted in the N.E.C.

3.03 **INSTALLATION OF UNDERGROUND CONDUIT**

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 2 Section "Earthwork" for pipe less than 6 inches in nominal diameter.
2. Install backfill as specified in Division 2 Section "Earthwork."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 2 Section "Earthwork."
4. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose and encase coupling with 3 inches of concrete.
 - b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
5. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits, placing them 24 inches o.c. Align planks along the width and along the centerline of conduit.

3.04 **INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES**

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a 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, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.
- D. Install handholes and boxes with bottom below the frost line, 42" below grade.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.

3.05 **FIRESTOPPING**

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Through-Penetration Firestop Systems."

3.06 **PROTECTION**

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.07 **CLEANING**

- A. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes.

END OF SECTION

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SECTION 26 0553 - ELECTRICAL IDENTIFICATION

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Underground-line warning tape.
 - 2. Warning labels and signs.
 - 3. Instruction signs.
 - 4. Equipment identification labels.
 - 5. Miscellaneous identification products.

1.03 QUALITY ASSURANCE

- A. Comply with ANSI A13.1 and ANSI C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.145.

1.04 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 PRODUCTS

2.01 RACEWAY AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Color for Printed Legend:
 - 1. Power Circuits: Black letters on an orange field.
 - 2. Legend: Indicate system or service and voltage, if applicable.
- C. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.02 CONDUCTOR, COMMUNICATION AND CONTROL CABLE IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

- B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- 2.03 **UNDERGROUND-LINE WARNING TAPE**
 - A. Description: Permanent, bright-colored, continuous-printed, polyethylene tape.
 - 1. Not less than 6 inches wide by 4 mils thick.
 - 2. Compounded for permanent direct-burial service.
 - 3. Embedded continuous metallic strip or core.
 - 4. Printed legend shall indicate type of underground line.
- 2.04 **WARNING LABELS AND SIGNS**
 - A. Comply with NFPA 70 and 29 CFR 1910.145.
 - B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.
 - C. Warning label and sign shall include, but are not limited to, the following legends:
 - 1. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."
- 2.05 **EQUIPMENT IDENTIFICATION LABELS**
 - A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. Black letters on a white background. Minimum letter height shall be 3/8 inch.
 - B. Outdoor Equipment Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.
- 2.06 **MISCELLANEOUS IDENTIFICATION PRODUCTS**
 - A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength: 50 lb, minimum.
 - 3. Temperature Range: Minus 40 to plus 185 deg F.
 - 4. Color: Black, except where used for color-coding.
 - B. Paint: Paint materials and application requirements are specified in Division 9 painting Sections.
 - C. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.
- 2.07 **WIRING DEVICE IDENTIFICATION**
 - A. Description: Self-adhesive label with black upper case letters on clear polyester label, font size 7.

PART 3 EXECUTION

3.01 APPLICATION

- A. Accessible Raceways and Cables of Auxiliary Systems: Identify the following systems with color-coded, self-adhesive vinyl tape applied in bands:
 - 1. Security System: Blue and yellow.
 - 2. Control Wiring: Green and red.
- B. Power-Circuit Conductor Identification: For conductors No. 1/0 AWG and larger in vaults, pull and junction boxes, manholes, and handholes use color-coding conductor tape and marker tape. Identify source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.
- C. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use marker tape. Identify each ungrounded conductor according to source and circuit number as indicated on Drawings. Identify control circuits by control wire number as indicated on shop drawings.
- D. Branch-Circuit Conductor Identification: Mark junction box covers in indelible ink with the panel and breaker numbers of other circuits contained within.
- E. Conductor Identification: Locate at each conductor at panelboard gutters, pull boxes, outlet and junction boxes, and each load connection or termination point.
- F. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable. Install underground-line warning tape for both direct-buried cables and cables in raceway.

- G. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply self-adhesive warning labels. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.
 - 1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, but not limited to, the following:
 - a. Power transfer switches.
 - b. Controls with external control power connections.
 - 2. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.
 - H. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
 - 1. Labeling Instructions:
 - a. Indoor Equipment: Engraved, laminated acrylic or melamine label mechanically secured.
 - b. Outdoor Equipment: Stenciled.
 - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
 - 2. Equipment to Be Labeled: If included on project. All items may not be on project.
 - a. Panelboards, electrical cabinets, and enclosures.
 - b. Transformers.
 - c. Disconnect switches.
 - d. Contactors.
 - e. Breakers or switches at distribution panels.
 - I. Wiring Device Identification Labels: On each faceplate install circuit designation label that is consistent with panelboard directories, and as-built plan drawings. Apply labels to receptacle faceplates centered below bottom outlet. Apply labels to toggle switch faceplates on backside.
- 3.02 **INSTALLATION**
- A. Verify identity of each item before installing identification products.
 - B. Location:
 - 1. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
 - C. Apply identification devices to surfaces after completing finish work.
 - D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
 - E. Attach nonadhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.
 - F. System Identification Color Banding for Raceways and Cables: Each color band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
 - G. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.
 - 1. Color shall be factory applied or, for sizes larger than No. 10 AWG if authorities having jurisdiction permit, field applied.
 - 2. Colors for 208/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - d. Grounded Conductor (Neutral): White.
 - 3. Colors for 480/277-V Circuits:

- a. Phase A: Brown.
- b. Phase B: Orange.
- c. Phase C: Yellow.
- d. Ground Conductor (Neutral): Grey.
- 4. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- H. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
- I. Label information arrangement for 3 lines of text.
 - 1. Line one shall describe the panel or equipment. Line one example: "DP-XX," RP-XX," "T-XX," "EF-XX," etc.
 - 2. Line two shall describe the first disconnecting means feeding this panel or equipment. Line two example: "Fed from DP-XX," "Fed from RP-XX," etc.
 - 3. Line three indicates that location of the disconnecting means as identified in line two. Line three example: "First Floor Elect. Rm #XXX."
 - 4. Line four shall include "Via T-XX" when panel or equipment is fed from a transformer.
- J. Examples:

RP-1A FED FROM DP-1A ELECTRICAL ROOM A100 VIA T-1A	EF-1 FED FROM MCC-1A MECHANICAL ROOM F101	LP-1A LOCATED IN ELECTRICAL ROOM A100
---	---	---
- K. Fusible Enclosed Switches and Distribution Equipment: Install self-adhesive vinyl label indicating fuse rating and type on the outside of door on each fused switch.
- L. Painted Identification: Prepare surface and apply paint according to Division 9 painting Sections.
- M. Degrease and clean surface to receive nameplates.
- N. Install nameplate and labels parallel to equipment lines.
- O. Secure nameplate to equipment front using screws.
- P. Secure nameplate to inside surface of door on panelboard that is recessed in finished locations.

END OF SECTION

TMP Architecture, Inc.
Peter Basso Associates, Inc.

TMP22103D & 22104E
PBA2023.0155.01 & 2023.0156.01

SECTION 26 0573 - OVERCURRENT DEVICE COORDINATION STUDY/ARC FLASH HAZARD ANALYSIS

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PART 1 GENERAL

- 1.01 **RELATED DOCUMENTS**
A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.
- 1.02 **SCOPE**
A. The contractor shall furnish short-circuit and protective device coordination studies as prepared by the electrical equipment manufacturer.
B. The contractor shall furnish an Arc Flash Hazard Analysis Study per the requirements set forth in NFPA 70E -Standard for Electrical Safety in the Workplace. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2018, Annex D prepared by the electrical equipment manufacturer.
C. The scope of the studies shall include all new distribution equipment supplied by the equipment manufacturer under this contract as well as all directly affected existing distribution equipment at the customer facility.
- 1.03 **REFERENCES**
A. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
1. IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems
2. IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
3. IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis
4. IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings
5. IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.
6. IEEE 1584 -Guide for Performing Arc-Flash Hazard Calculations
B. American National Standards Institute (ANSI):
1. ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
2. ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures
3. ANSI C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis
4. ANSI C 37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories.
C. The National Fire Protection Association (NFPA)

1. NFPA 70 -National Electrical Code, latest edition
2. NFPA 70E – Standard for Electrical Safety in the Workplace, latest edition.

1.04 **SUBMITTALS FOR REVIEW/APPROVAL**

- A. The short-circuit and protective device coordination studies shall be submitted to the design engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment drawings for manufacturing. If formal completion of the studies may cause delay in equipment manufacturing, approval from the engineer may be obtained for preliminary submittal of sufficient study data to ensure that the selection of device and characteristics will be satisfactory.

1.05 **SUBMITTALS FOR CONSTRUCTION**

- A. The results of the short-circuit, protective device coordination, and arc flash hazard analysis studies shall be summarized in a final report. Report shall be provided on electronic media. All literature shall be combined in one document and shall be properly bookmarked with all applicable sections.

- B. The report shall include the following sections:

1. Executive Summary.
2. Descriptions, purpose, basis and scope of the study.
3. Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short circuit duties.
4. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip unit settings, fuse selection.
5. Fault current calculations including a definition of terms and guide for interpretation of the computer printout.
6. Details of the incident energy and flash protection boundary calculations.
7. Recommendations for system improvements, where needed.
8. One-line diagram.

- C. Arc flash labels shall be provided in full size representation in PDF format and submitted with the study.

- D. The report shall be signed and sealed by the Professional Engineer supervising the study.

1.06 **QUALIFICATIONS**

- A. The short-circuit, protective device coordination and arc flash hazard analysis studies shall be conducted under the supervision and approval of a Registered Professional Electrical Engineer skilled in performing and interpreting the power system studies.

- B. The Registered Professional Electrical Engineer shall be a full-time employee of the equipment manufacturer.

- C. The Registered Professional Electrical Engineer shall have a minimum of five (5) years of experience in performing power system studies and registered in the state where the project is located.

- D. The equipment manufacturer shall demonstrate experience with Arc Flash Hazard Analysis by submitting names of at least ten actual arc flash hazard analysis it has performed in the past year.

1.07 **COMPUTER SOFTWARE PROGRAMS**

- A. Computer Software Programs: Subject to compliance with requirements, provide products by one of the following:

1. EDSA Micro Corporation.
2. SKM Systems Analysis, Inc.
3. ESA Inc.
4. CGI CYME.
5. Operation Technology, Inc.

PART 2 PRODUCTS

2.01 **STUDIES**

- A. Contractor to furnish short-circuit and protective device coordination studies as prepared by equipment manufacturer.

- B. The contractor shall furnish an Arc Flash Hazard Analysis Study per NFPA 70E -Standard for Electrical Safety in the Workplace, reference Article 130.3 and Annex D prepared by the equipment manufacturer.
- 2.02 **DATA COLLECTION**
- A. Contractor shall furnish all data as required by the power system studies. The Engineer performing the short-circuit, protective device coordination and arc flash hazard analysis studies shall furnish the Contractor with a listing of required data immediately after award of the contract. The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.
- B. Source combination may include present and future motors and generators.
- C. Load data utilized may include existing and proposed loads obtained from Contract Documents provided by Owner.
- D. If applicable, include fault contribution of existing motors in the study. The Contractor shall obtain required existing equipment data to satisfy the study requirements.
- 2.03 **SHORT-CIRCUIT AND PROTECTIVE DEVICE EVALUATION STUDY**
- A. Use actual conductor impedances if known. If unknown, use typical conductor impedances based on IEEE Standard 141-1993.
- B. Transformer design impedances shall be used when test impedances are not available.
- C. Provide the following:
1. Calculation methods and assumptions
 2. Selected base per unit quantities
 3. One-line diagram of the system being evaluated
 4. Source impedance data, including electric utility system and motor fault contribution characteristics
 5. Tabulations of calculated quantities
 6. Results, conclusions, and recommendations.
- D. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each:
1. Electric utility's supply termination point
 2. Incoming switchgear
 3. Unit substation primary and secondary terminals
 4. Low voltage switchgear
 5. Motor control centers
 6. Standby generators and automatic transfer switches
 7. Branch circuit panelboards
 8. Other significant locations throughout the system.
- E. 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.
- F. Protective Device Evaluation:
1. Evaluate equipment and protective devices and compare to short circuit ratings
 2. Adequacy of switchgear, motor control centers, and panelboard bus bars to withstand short-circuit stresses
 3. Notify design engineer in writing, of existing, circuit protective devices improperly rated for the calculated available fault current.
- 2.04 **PROTECTIVE DEVICE COORDINATION STUDY**
- A. Proposed protective device coordination time-current curves (TCC) shall be displayed on log-log scale graphs.
- B. Include on each TCC graph, a complete title and one-line diagram with legend identifying the specific portion of the system covered.
- C. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
- D. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
- E. Plot the following characteristics on the TCC graphs, where applicable:

1. Electric utility's overcurrent protective device
 2. Medium voltage equipment overcurrent relays
 3. Medium and low voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands
 4. Low voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands
 5. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves
 6. Conductor damage curves
 7. Ground fault protective devices, as applicable
 8. Pertinent motor starting characteristics and motor damage points, where applicable
 9. The largest feeder circuit breaker in each motor control center and applicable panelboard.
- F. Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.
- 2.05 **ARC FLASH HAZARD ANALYSIS**
- A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2018, Annex D.
 - B. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, busway and splitters) where work could be performed on energized parts.
 - C. The Arc-Flash Hazard Analysis shall include all significant locations in 240 volt and 208 volt systems fed from transformers equal to or greater than 125 kVA where work could be performed on energized parts.
 - D. Safe working distances shall be based upon the calculated arc flash boundary considering an incident energy of 1.2 cal./cm².
 - E. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations
 - F. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off). Conversely, the maximum calculation will assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable.
 - G. The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows:
 1. Fault contribution from induction motors should not be considered beyond 3-5 cycles.
 2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g., contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).
 - H. For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.
 - I. When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.

- J. Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.
- K. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584-2002 section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.

2.06 **REPORT SECTIONS**

- A. Input data shall include, but not be limited to the following:
 - 1. Feeder input data including feeder type (cable or bus), size, length, number per phase, conduit type (magnetic or non-magnetic) and conductor material (copper or aluminum).
 - 2. Transformer input data, including winding connections, secondary neutral-ground connection, primary and secondary voltage ratings, kVA rating, impedance, % taps and phase shift.
 - 3. Generation contribution data, (synchronous generators and Utility), including short-circuit reactance ($X''d$), rated MVA, rated voltage, three-phase and single line-ground contribution (for Utility sources) and X/R ratio.
 - 4. Motor contribution data (induction motors and synchronous motors), including short-circuit reactance, rated horsepower or kVA, rated voltage, and X/R ratio.
- B. Short-Circuit Output Data shall include, but not be limited to the following reports:
 - 1. Low Voltage Fault Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:
 - a. Voltage
 - b. Calculated fault current magnitude and angle
 - c. Fault point X/R ratio
 - d. Equivalent impedance
 - 2. Momentary Duty Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable 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
 - e. Equivalent impedance
 - 3. Interrupting Duty Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable 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
- C. Recommended Protective Device Settings:
- 1. Phase and Ground Relays:
 - a. Current transformer ratio
 - b. Current setting
 - c. Time setting
 - d. Instantaneous setting
 - e. Recommendations on improved relaying systems, if applicable.
 - 2. Circuit Breakers:
 - a. Adjustable pickups and time delays (long time, short time, ground)
 - b. Adjustable time-current characteristic
 - c. Adjustable instantaneous pickup
 - d. Recommendations on improved trip systems, if applicable.
- D. 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. Working distance
 - 6. Incident energy
 - 7. Hazard Risk Category
 - 8. Recommendations for arc flash energy reduction

PART 3 EXECUTION

3.01 FIELD ADJUSTMENT

- A. The contractor shall adjust relay and protective device settings according to the recommended settings table provided by the coordination study.
- B. Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.
- C. Notify design engineer in writing of any required major equipment modifications.

3.02 ARC FLASH WARNING LABELS

- A. The contractor shall provide a 3.5 in. x 5 in. thermal transfer type label of high adhesion polyester for each work location analyzed.
- B. All labels will be based on recommended overcurrent device settings and will be provided after the results of the analysis have been presented to the owner and after any system changes, upgrades or modifications have been incorporated in the system.
- C. The label for equipment where arc incident energy is calculated shall include the following, at a minimum:
 - 1. Location designation
 - 2. Nominal system voltage
 - 3. Arc flash boundary
 - 4. Incident energy
 - 5. Working distance
 - 6. Engineering report number, revision number and issue date.
- D. The label for equipment where arc incident energy is not calculated shall include the following, at a minimum:
 - 1. Location designation
 - 2. Nominal system voltage
 - 3. Arc flash boundary from NFPA 70E 2018 Table 130.7(C) 15(a)
 - 4. Arc flash PPE category from NFPA 70E 2018 Table 130.7(C) 15(a)
 - 5. Engineering report number, revision number and issue date.
- E. Labels shall be machine printed, with no field markings.

- F. Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings.
 - 1. For each 480 and 208 volt panelboard, one arc flash label shall be provided.
 - 2. For each low voltage switchboard, one arc flash label shall be provided.
- G. Labels shall be field installed by the contractor.

END OF SECTION

SECTION 26 0923 - LIGHTING CONTROL DEVICES

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following lighting control devices:
 - 1. Time controllers.
 - 2. Outdoor photoelectric control.
 - 3. Occupancy sensors.
 - 4. Lighting contactors.
- B. Related Sections include the following:
 - 1. Division 26 Section "Electrical General Requirements".
 - 2. Division 26 Section "Wiring Devices" for wall-box dimmers and manual light switches.

1.03 REFERENCES

- A. IEEE C62.41: Guide for Surge Voltages in Low-Voltage AC Power Circuits.
- B. IEEE C136.10: Standard for Roadway Lighting Equipment Locking-Type Photocontrol Devices and Mating Receptacle Physical and Electrical Interchangeability and Testing.
- C. NEMA ICS 2: Industrial Control and Systems Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC Part 8: Disconnect Devices for Use in Industrial Control Equipment.
- D. NFPA 70: National Electrical Code.
- E. UL 486A: Wire Connectors and Soldering Lugs for Use with Copper Conductors.
- F. UL 486B: Wire Connectors for Use with Aluminum Conductors.
- G. UL 773: Plug-in, Locking Photocontrols for Use with Area Lighting.
- H. UL 773A: Nonindustrial Photoelectric Switches for Lighting Control.
- I. UL 917: Clock Operated Switches.
- J. UL 1449: Surge Protective Devices.
- K. UL 1598: Luminaires.
- L. NECA 130-2010: Installing and Maintaining Wiring Devices.

1.04 DEFINITIONS

- A. LED: Light-emitting diode.

- B. PIR: Passive infrared.
 - C. ULTRASONIC: Active emission of at least 35 kHz sound waves, using Doppler reflectance to detect motion.
 - D. MICROPHONIC: Passive reception to listen for continued occupancy, with circuitry to filter out white noise.
 - E. MULTI-Tech: Using PIR and ultrasonic or microphonic technologies in one sensor.
- 1.05 **SUBMITTALS**
- A. Product Data: For each type of product indicated including physical data and electrical performance.
 - B. Shop Drawings: Show installation details for occupancy and light-level sensors.
 - 1. Lighting plan showing location, orientation, and coverage area of each sensor.
 - 2. Interconnection diagrams showing field-installed wiring.
 - C. Field quality-control test reports.
 - D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. Include the following:
 - 1. Description of operation and servicing procedures.
 - 2. List of major components.
 - 3. Recommended spare parts.
 - 4. Programming instructions and system operation procedures.
- 1.06 **QUALITY ASSURANCE**
- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- 1.07 **COORDINATION**
- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.
 - B. Coordinate interface of lighting control devices with temperature controls specified in Division 23.
- 1.08 **DELIVERY, STORAGE, AND HANDLING**
- A. Deliver products to the site under provisions of Division 26 Section "Electrical General Requirements".
 - B. Store and protect products under provisions of Division 26 Section "Electrical General Requirements".
- PART 2 PRODUCTS**
- 2.01 **GENERAL LIGHTING CONTROL DEVICE REQUIREMENTS**
- A. Line-Voltage Surge Protection: An integral part of the devices for 120- and 277-V solid-state equipment. For devices without integral line-voltage surge protection, field-mounting surge protection shall comply with IEEE C62.41 and with UL 1449.
- 2.02 **TIME CONTROLLERS**
- A. Manufacturers:
 - 1. Intermatic, Inc.
 - 2. TORK.
 - B. General
 - 1. Provide NEMA Type 1-general purpose steel enclosure with corrosion-resistant primer and baked enamel finish in manufacturer's standard color.
 - 2. Provide enclosure suitable for surface mounting with hinged front; padlock hasp; and side, bottom, and back knockouts for conduit connections.
 - 3. Provide heavy-duty pressure terminals suitable for wire sizes up to no. 8 AWG.
 - C. Digital Time Controller: Electronic, solid-state programmable units with alphanumeric display complying with UL 917.
 - 1. Contact Configuration: SPDT.
 - 2. Contact Rating Normally Open: (20-A inductive or resistive, 120-277-V ac, 20-A ballast load, 120-277 V ac.) (10-A inductive or resistive, 120-277-V ac, 10-A ballast load, 120 277 V ac.)

3. Contact Rating Normally Closed: 10-A inductive or resistive, 120-277-V ac, 10-A ballast load, 120-277 V ac.
4. Input Voltage: 120 volts.
5. Programs: 1 channel.
 - a. For each channel, 7 day or full year load control, minimum 1,000 on/off operations with one-minute programming resolution; minimum 99 holiday event scheduling; automatic adjustment for daylight savings (with disable); automatic leap year compensation; manual override ON and OFF to the next scheduled event; LCD display.
6. Circuitry: Allow connection of a photoelectric relay as substitute for on and off function of a program.
7. Astronomical Time: Provide astronomic feature adjustable from 10° to 60° Northern and Southern latitudes with 1-99 minute adjustable offset from sunrise to sunset.
8. Battery Backup: Field replaceable lithium battery with minimum 8 year life for schedules and time clock.

2.03 **OUTDOOR PHOTOELECTRIC CONTROL**

- A. Manufacturers:
 1. Intermatic, Inc.
 2. Square D.
 3. TORK.
- B. General
 1. Provide fully-gasketed, weathertight enclosure constructed of die cast zinc, with one-half inch conduit nipple for mounting purposes, and with positioning lug to permit full 360-degree adjustable orientation of photocell.
 2. Provide hermetically-sealed, one-inch-diameter, cadmium sulphide photoelectric cell with manual, light level selector.
 3. Provide photoelectric control suitable for an operating temperature range of minus 40 degrees F to plus 140 degrees F.
- C. Description: Solid state, with SPST dry contacts rated for 2000 W tungsten or 1800 VA ballasted load, to operate connected load, relay, contactor coils, or microprocessor input, and complying with UL 773A.
 1. Light-Level Monitoring Range: Adjustable turn-on range of 1 to 5 footcandle (11 to 54 lux) and adjustable turn-off range of 3 to 15 footcandle (32 to 1662 lux).
 2. Time Delay: Adjustable delay up to two minutes to prevent false operation.
 3. Contacts: Normally closed, fail on.
 4. Electrical: Provide photocell with operating voltage rated to switch the load directly unless otherwise indicated.
 5. Surge Protection: Metal-oxide varistor type, complying with IEEE C62.41 for Category A1 locations.
 6. Mounting: Twist lock complying with IEEE C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the North sky exposure.
 7. Provide hermetically-sealed, one inch diameter, cadmium sulphide photoelectric cell with manual, 2 to 50 footcandle, light level selector.

2.04 **OCCUPANCY SENSORS**

- A. General
 1. Coordinate occupancy sensor locations, coverages and required quantities with manufacturer's recommendations. Coverage areas indicated on the Drawings are for minor motion (6 to 8 inches of hand movement). Provide additional occupancy sensors and control units as required to achieve complete minor motion coverage of the space indicated.
 2. Adjust occupancy sensors and test that complete minor motion coverage is obtained in accordance with Part 3. Provide written confirmation of testing to owner, architect and engineer.
 3. Provide occupancy sensors with a bypass switch to override the "ON" function in the event of sensor failure.

4. Provide occupancy sensors with an LED indicator indicating when motion is being detected during testing and normal operation of the sensor.
5. Provide occupancy sensors and occupancy sensor control units from single manufacturer.
- B. Wall Switch Passive Infrared Occupancy Sensor
 1. Manufacturers:
 - a. Perfect Sense – PS-PWS
 - b. Wattstopper PW-100.
 - c. Hubbell Building Automation SOM 101.
 - d. Greengate OSW-P-0451-W.
 - e. Sensorswitch WSD.
 - f. Philips LRS2210.
 - g. Leviton ODS10-IDW.
 2. Description: Wall mounted, 180° coverage, passive infrared sensing occupancy sensor.
 - a. Electrical Characteristics: Capable of switching up to 800W fluorescent or incandescent lighting loads at 120V and 1200 watts fluorescent loads at 277V.
 - b. Functions: Automatic ON/Automatic OFF, or Manual ON/Automatic OFF operation, field selectable. Integral manual override pushbutton switch.
 - c. Adjustments: User adjustable sensitivity and time delay. Time delay shall be adjustable from 30 seconds to 30 minutes.
 - d. Device Body: White, plastic with momentary on/off override pushbutton designed to mount in a standard switch box with “decora” style switch plate.
- C. 360° Ceiling Mounted Dual Technology Occupancy Sensor
 1. Manufacturers:
 - a. Perfect Sense CDS.
 - b. Wattstopper DT 300
 - c. Hubbell Building Automation “OMNI-DT” Series.
 - d. Greengate OMC-DT-2000-R.
 - e. Sensorswitch CM-PDT-R.
 - f. Philips LRM2255.
 - g. Leviton OSC10-M0W.
 2. Description: Ceiling mounted, 360° coverage, multi-tech sensing occupancy sensor.
 - a. Housing: White, thermoplastic, tamper resistant ceiling mount.
 - b. Functions: Automatic ON must sense motion from both ultrasonic and infrared sensing elements. Either technology shall maintain ON, with adjustable time delays.
 - c. Adjustments: User adjustable sensitivity adjustment shall be provided for each sensing technology. Time delay shall be adjustable from 30 seconds to 30 minutes.
 - d. Sensor shall operate on 24V DC power through control unit which supplies DC power to the sensor and provides relay contacts to control the lighting load and auxiliary contacts.
 - e. Manual override function.
- D. 110° Wall Mounted Dual Technology Occupancy Sensor
 1. Manufacturers:
 - a. Wattstopper DT-200
 - b. Hubbell Building Automation “LO-DT” Series.
 - c. Sensorswitch WV-PDT-R/WV-BR.
 - d. Philips LRM2265.
 - e. Leviton OSW12-M0W.
 2. Description: Wall mounted, 110° coverage, multi-tech occupancy sensor.
 - a. Housing: White, thermoplastic, tamper resistant with swivel bracket for wall or ceiling mounting.
 - b. Functions: Automatic ON must sense motion from both sensing elements. Either technology shall maintain ON, with adjustable time delays.
 - c. Adjustments: User adjustable sensitivity adjustment shall be provided for each sensing technology. Time delay shall be adjustable from 30 seconds to 15 minutes.

- d. Sensor Orientation: Orient sensor in room such that sensor will not detect motion through open door which could cause false activation.
 - e. Sensor shall operate on 24V DC power through control unit which supplies DC power to the sensor and provides relay contacts to control the lighting load and auxiliary contacts.
 - f. Manual override function.
- E. 360° Ceiling Mounted Ultrasonic Occupancy Sensors
- 1. Manufacturers:
 - a. Perfect Sense WDS.
 - b. Wattstopper "WT" Series.
 - c. Hubbell Building Automation "OMNI-US" Series.
 - d. Greengate OPC-U-2000.
 - e. Sensorswitch CM MPT-10.
 - f. Philips LRM2255.
 - g. Leviton OSC20-U0W.
 - 2. Description: Ceiling mounted, 360° coverage, ultrasonic or microphonics sensing occupancy sensor.
 - a. Housing: White, thermoplastic, tamper resistant.
 - b. Adjustments: Adjustments: User adjustable sensitivity and time delay. Time delay shall be adjustable from 30 seconds to 15 minutes.
 - c. Sensor shall operate on 24V DC power through control unit which supplies DC power to the sensor and provides relay contacts to control the lighting load and auxiliary contacts.
 - d. Manual override function.
- F. Occupancy Sensor Control Units:
- 1. Description: Transformer and relay combined in single unit to provide 24DC power to sensors and provide 20A contact(s) for control of lighting loads at 120 or 277V. Control unit input power shall be from unswitched leg of lighting circuit it is controlling.
 - a. Control units shall be provided as required to power ceiling mounted occupancy sensors, control lighting loads and provide a minimum of one auxiliary contact.
 - b. Occupancy sensor control units shall mount external to 4" sq junction box in the ceiling space. Wiring between control unit and occupancy sensor shall be plenum rated.
 - c. Locate control unit in accessible location in gyp-board ceilings, adjacent to return air grilles, or provide access panel.
 - d. Additional auxiliary relay modules shall be provided as required to provide control of all lighting circuits and additional auxiliary contacts as required.
 - e. It is acceptable to provide controls and auxiliary contacts as required integral to the ceiling sensor, provided all required contacts are provided.
 - f. Maximum of 3 sensors per power pack. Verify exact quantities required with manufacturer.
- 2.05 **LIGHTING CONTACTORS**
- A. Manufacturers:
- 1. Cutler-Hammer; Eaton Corporation.
 - 2. Square D Co.
 - 3. General Electric.
 - 4. Siemens.
 - 5. Square D Co; class 8903.
- B. Contactor
- 1. Electrically-operated mechanically-held contactor, per NEMA ICS2, with 120 volt, 60 hertz coil and 240 volt, 60 hertz, 30 ampere contacts with number of poles indicated.
 - 2. Provide contacts to be 100 percent, continuously rated for all types of ballast and tungsten lighting and resistance loads without the need for in-rush current derating.

3. Provide NEMA type 1 hinged cover cabinet enclosure sized as required for contactors as indicated on drawings. Mount switches and indicating lights required on front of enclosure. Install terminal strips for connection of all external control wiring connections.
4. Provide solderless pressure wire terminals.
5. Provide corrosion-resistant primer treatment with light gray baked acrylic enamel finish.
6. Provide the following control and indicating devices:
 - a. Auxiliary contacts: One field convertible.
 - b. Auxiliary relay to convert maintained-contact type control circuit to momentary-contact type control circuit necessary for contactor control.
 - c. Green pilot light to indicate "power on" condition. Mount on front cover with legend plate.

PART 3 EXECUTION

3.01 LIGHTING CONTACTOR INSTALLATION

- A. Install lighting contactors as indicated on plan. Install at accessible locations. Switch controls where provided shall be no higher than 54" or lower than 48".
- B. Demonstrate proper operation of all lighting control functions to the Owner and Engineer.

3.02 OUTDOOR PHOTOELECTRIC CONTROL INSTALLATION

- A. Mount photocell on roof or parapet to 1/2" GRS conduit, supported to building structure below. Coordinate roof penetration with roofing contractor.
- B. Install photoelectric control oriented in the northeast direction and not within any potential shadows.
- C. Adjust photocell sensitivity and delay to meet owner's requirements. Multiple adjustments may be required, as needed.

3.03 OCCUPANCY SENSOR INSTALLATION

- A. Install wall mounted occupancy sensors as noted on plan. Arrange occupancy sensors with adjacent switch devices so that device plates line-up and are equally spaced.
- B. Install ceiling mounted sensors at approximate locations as indicated on plan. Sensor manufacturer shall provide quantity of sensors as required to provide complete coverage for rooms.
- C. Locate sensors such that motion through open doors will not falsely activate sensors.
- D. Do not locate ultrasonic sensors within six feet of supply air diffusers.
- E. Locate infrared sensors to avoid obstructions.
- F. Provide the services of a manufacturer's representative for commissioning of occupancy sensor installation. This shall include consultation on layout and location prior to installing sensors, testing of each sensor for compliance with Contract Documents and field adjustment and fine tuning after installation is complete. Provide written confirmation of testing to the Owner, Architect and Engineer.
- G. Field adjustments shall take place in the presence of the owner and the engineer. This shall include owner training on adjustment techniques for the occupancy sensors.

3.04 WIRING INSTALLATION

- A. Wiring Method: Comply with Division 26 Section "Conductors and Cables".
- B. 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.
- C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.
- E. 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.

3.05 IDENTIFICATION

- A. Identify components and power and control wiring according to Division 26 Section "Electrical Identification."
- B. Label time switches and contactors with a unique designation.

3.06 **FIELD QUALITY CONTROL**

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
 - 2. Operational Test: Verify actuation of each sensor and adjust time delays.
- B. Remove and replace lighting control devices where test results indicate that they do not comply with specified requirements.
- C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.07 **ADJUSTING**

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to site outside normal occupancy hours for this purpose.

END OF SECTION

SECTION 26 2200 - DRY-TYPE TRANSFORMERS (600 V AND LESS)

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 750 kVA:
 - 1. Distribution transformers.
- B. Related Section includes the following:
 - 1. Division 26 Section "Electrical General Requirements."
 - 2. Division 26 Section "Grounding and Bonding."
 - 3. Division 26 Section "Conductors and Cables."
 - 4. Division 26 Section "Raceways and Boxes."
 - 5. Division 26 "Hangers and Supports for Electrical Systems" for concrete bases.

1.03 REFERENCES

- A. ANSI/IEEE C57.12.9: Test Code for Dry-Type Distribution and Power Transformers
- B. NEMA 250: Enclosures for Electrical Equipment (1000 Volts Maximum)
- C. NEMA ST 1: Specialty Transformers
- D. NEMA ST 20: Dry Type Transformers for General Applications
- E. NEMA TP 1: Guide for Determining Energy Efficiency for Distribution Transformers
- F. NEMA TP 2: Standard Test Method for Measuring the Energy Consumption of Distribution Transformers
- G. NETA ATS: Acceptable Testing Specifications for Electrical Power Distribution Equipment and Systems
- H. NFPA 70: National Electrical Code
- I. UL 486A: Wire Connectors and Soldering Lugs for Use with Copper Conductors
- J. UL 486B: Wire Connectors for Use with Aluminum Conductors
- K. UL 506: Specialty Transformers
- L. UL 1561: Dry-Type General Purpose and Power Transformers

1.04 SUBMITTALS

- A. Product Data Include rated nameplate data, capacities, weights, dimensions, utility or manufacturer's anchorage and base recommendations, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.

1. Transformer Inrush: Provide time-current coordination curves demonstrating transformer inrush and ANSI damage curves with primary overcurrent device selections to clear inrush yet still protecting damage curve.
 - B. Shop Drawings: Wiring and connection diagrams.
 - C. Qualification Data: Testing agency.
 - D. Source quality-control test reports. Include loss data, efficiency at 25, 50, 75 and 100 percent rated load, and sound level.
 - E. Output Settings Reports: Record of tap adjustments specified in Part 3.
- 1.05 **QUALITY ASSURANCE**
- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined in OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 1. Transformer Inrush: Provide time-current coordination curves demonstrating transformer inrush and ANSI damage curves with primary overcurrent device selections to clear inrush yet still protecting damage curve.
 2. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise onsite testing specified in Part 3.
 - B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - C. Comply with IEEE C 57.12.91.
 - D. Comply with NFPA 70.
 - E. Energy-Efficient Transformers Rated 15 kVA and Larger: Certified as meeting doe 2016 efficiency levels when tested according to NEMA TP2.
- 1.06 **DELIVERY, STORAGE, AND HANDLING**
- A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.
 - B. Store, protect, and handle products to site under provisions of Division 26 section "Electrical General Requirements."
 - C. Deliver transformers individually wrapped for protection and mounted on shipping skids.
 - D. Accept transformers on site. Inspect for damage.
 - E. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
 - F. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.
- 1.07 **COORDINATION**
- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork shall meet load requirements. Requirements for concrete bases for electrical equipment are specified in Division 26 "Hangers and Supports for Electrical Systems."
 - B. Coordinate installation of wall-mounting and structure-hanging supports.
- PART 2 PRODUCTS**
- 2.01 **MANUFACTURERS**
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. [Square D/Groupe Schneider NA](#). (base bid – bid price shall include Square D equipment)
 2. [Acme](#).
 3. [Cutler-Hammer](#).
 4. [GE Electrical Distribution & Control](#).
 5. Siemens Industries, Inc.
 6. [Sola/Hevi-Duty Electric](#).

2.02 **MATERIALS**

- A. Cores: Grain-oriented, non-aging silicon steel.
- B. Coils: Continuous windings without splices, except for taps.
 - 1. Internal Coil Connections: Brazed or pressure type.
 - 2. Coil Material: Aluminum.
- C. Vibration Isolation: Isolate core and coil from enclosure using vibration-absorbing mounts.
- D. Grounding: Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

2.03 **DISTRIBUTION TRANSFORMERS**

- A. Description: Factory-assembled and tested, air cooled, dry-type transformer rated for 60 Hz operation. Comply with NEMA ST 20, and list and label as complying with UL 1561.
- B. Provide transformers with base KVA as indicated without the use of internal cooling fans.
- C. Cores: One leg per phase.
- D. Indoor Enclosure: Ventilated, NEMA 250, Type 2. Provide lifting eyes or brackets.
- E. Indoor Transformer Enclosure Finish: Comply with NEMA 250 for "Indoor Corrosion Protection."
 - 1. Finish Color: Gray.
- F. Insulation Class (15 kVA and larger): 220 deg C, UL-component-recognized insulation system with a maximum of 150 deg C rise above 40 deg C ambient temperature TP-1 compliant.
- G. Insulation Class (less than 15 kVA): 185 deg C, UL-component-recognized insulation system with a maximum of 115 deg C rise above 40 deg C ambient temperature.
- H. Basic Impulse Level: 10 kV.
- I. Taps for Transformers Smaller Than 3 kVA: None.
- J. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.
- K. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.
- L. Case Temperature: Do not exceed 35 degrees C rise above ambient at warmest point.
- M. Mounting: Suitable for mounting as indicated.
- N. Wall Brackets: Manufacturer's standard brackets.
- O. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.

2.04 **SOURCE QUALITY CONTROL**

- A. Test and inspect transformers according to IEEE C57.12.91.
- B. Provide the following factory tests on each unit provided in accordance with NEMA ST 20:
 - 1. Voltage ratio.
 - 2. Polarity and phase relation.
 - 3. No load losses.
 - 4. Impedance (501 kVA and larger).
 - 5. Applied and induced potential.
- C. Provide the factory tests on the actual transformers provided or on similar units identical to those provided in accordance with NEMA ST 20:
 - 1. Impedance (less than 501 kVA).
 - 2. Temperature rise.
 - 3. Audible sound level.
 - 4. Full load losses.

PART 3 EXECUTION

3.01 **EXAMINATION**

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.
- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
- C. Examine walls and floors for suitable mounting conditions where transformers will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 **INSTALLATION**

- A. Install Products in accordance with manufacturer's instructions.

- B. Install floor mounted transformers on and anchor to concrete bases according to manufacturer's recommendations.
 - 1. Mount transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure.
 - C. Identification: Engraved metal or laminated-plastic nameplate mounted with corrosion resistant screws. Provide nameplate according to Division 26 Section "Electrical Identification" indicating the following:
 - 1. Transformer designation (e.g., "T-1").
 - 2. Primary power characteristics (e.g., "480V, 3PH, 3W").
 - 3. Secondary power characteristics (e.g., "208Y/120V, 3PH, 4W").
 - 4. Power rating (e.g., "75 kVA").
 - 5. Power source (e.g., "Fed from DP-1").
- 3.03 **CONNECTIONS**
- A. Ground equipment according to Division 26 Section "Grounding and Bonding."
 - B. Connect wiring according to Division 26 Section "Conductors and Cables."
 - C. Provide conduit according to Division 26 Section "Raceways and Boxes" for connections to transformer case. Make conduit connections to side panel of enclosure.
 - 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.
 - E. Check for damage and tighten connections prior to energizing transformer.
- 3.04 **FIELD QUALITY CONTROL**
- A. Testing: Perform the following field quality control tests in accordance with Division 26 section "Electrical Testing" for transformers 75KVA and above:
 - 1. Visual and Mechanical Inspection
 - a. Inspect for physical damage, cracked insulators, tightness of connections, defective wiring and general mechanical and electrical conditions.
 - b. Verify proper core grounding.
 - c. Verify proper equipment grounding.
 - d. Compare equipment nameplate with single line diagram and report discrepancies.
 - 2. Electrical Tests
 - a. Perform insulation resistance tests, winding-to-winding and windings-to-ground, utilizing a meg-ohmmeter with test voltage output in accordance with N.E.T.A. Acceptance Testing Specifications, Table 10.5. Test duration shall be for 10 minutes with resistance values tabulated at 30 seconds, 1 minute, and 10 minutes. Calculate Polarization index.
 - b. Perform a turns ratio test between windings at every tap position. The final tap setting is to be set at the secondary system rated voltage at full load or as directed by the Architect/Engineer.
 - c. Verify proper secondary voltage phase-to-phase and phase-to-neutral after energization and prior to loading.
 - 3. Test Values
 - a. Perform insulation resistance tests in accordance with N.E.T.A. Acceptance Testing Specifications, Table 10.5. Results to be temperature corrected in accordance with Table 10.14.
 - b. The polarization index should be above 1.2 unless an extremely high value is obtained initially, such that when doubled will not yield a meaningful value.
 - c. Turns ratio test results shall not deviate more than one half percent (0.5%) from either the adjacent coils or the calculated ratio.

3.05 **ADJUSTING**

- A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 5 percent. Submit recording and tap settings as test results.
- B. Adjust buck-boost transformers to provide nameplate voltage of equipment being served, plus or minus 5 percent, at secondary terminals.
- C. Output Settings Report: Prepare a written report that records output voltages and tap settings.

END OF SECTION

SECTION 26 2416 - PANELBOARDS

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PART 1 GENERAL

- 1.01 **RELATED DOCUMENTS**
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- 1.02 **SUMMARY**
A. This Section includes the following:
1. Lighting and appliance branch-circuit panelboards.
- 1.03 **DEFINITIONS**
A. EMI: Electromagnetic interference.
B. GFCI: Ground-fault circuit interrupter.
C. GFEP: Ground-fault equipment protection.
D. RFI: Radio-frequency interference.
E. RMS: Root mean square.
F. SPDT: Single pole, double throw.
- 1.04 **SUBMITTALS**
A. Product Data: For each type of panelboard, overcurrent protective device, surge protective device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
B. Related Submittals:
1. Provide overcurrent device coordination study to demonstrate proper overcurrent device ratings, adjustments, and settings.
C. Shop Drawings: For each panelboard and related equipment.
1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:
a. Enclosure types and details for types other than NEMA 250, Type 1.
b. Bus configuration, current, and voltage ratings.
c. Short-circuit current rating of panelboards and overcurrent protective devices.
d. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
2. Wiring Diagrams: Power, signal, and control wiring.
D. Field quality-control test reports including the following:
1. Test procedures used.

2. Test results that comply with requirements.
 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
 - E. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.
 - F. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1, include the following:
 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 2. Time-current curves, including selectable ranges for each type of overcurrent protective device.
- 1.05 **QUALITY ASSURANCE**
- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories through one source from a single manufacturer.
 - B. Product Options: Drawings indicate size, profiles, and dimensional requirements of panelboards and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
 - C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - D. Comply with NEMA PB 1.
 - E. Comply with NFPA 70.
- 1.06 **PROJECT CONDITIONS**
- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:
 1. Ambient Temperature: Not exceeding 104 deg F.
 2. Altitude: Not exceeding 6600 feet.
 - B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
 1. Ambient temperatures within limits specified.
 2. Altitude not exceeding 6600 feet.
 - C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 1. Notify Construction Manager no fewer than seven days in advance of proposed interruption of electrical service.
 2. Do not proceed with interruption of electrical service without Construction Manager's written permission.
- 1.07 **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, and encumbrances to workspace clearance requirements.
 - B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.
- 1.08 **EXTRA MATERIALS**
- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Keys: Six spares for each type of panelboard cabinet lock.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Panelboards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:
 - a. Square D. (base bid – bid price shall include Square D equipment
 - b. Eaton Corporation; Cutler-Hammer Products.
 - c. GE by ABB.

- d. [Siemens Industries, Inc.](#)
- 2.02 **MANUFACTURED UNITS**
 - A. Enclosures: Mounting as noted on panel schedules. NEMA PB 1, Type 1.
 - 1. Cabinet Front: Flush or surface cabinet as noted on the Drawings.
 - a. Square D – Continuous piano hinge trim.
 - b. Eaton LTDD (Piano hinge trim)
 - c. GE – FGB (front hinge to box).
 - d. Siemens – Figure 4 hinge to box w/piano hinge.
 - 2. Finishes:
 - a. Panels 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: Same finish as panels and trim.
 - 3. Directory Card: With transparent protective cover, mounted in metal frame, inside panelboard door.
 - B. Phase and Ground Buses:
 - 1. Material: Aluminum.
 - 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.
 - C. Conductor Connectors: Suitable for use with conductor material.
 - 1. Main and Neutral Lugs: Mechanical type.
 - 2. Ground Lugs and Bus Configured Terminators: Compression type.
- 2.03 **PANELBOARD SHORT-CIRCUIT RATING**
 - A. Fully rated to interrupt symmetrical short-circuit current available at terminals.
- 2.04 **LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS**
 - A. Main bus bars, neutral and ground, shall be sized in accordance with U.L. Standards to limit temperature rise on any current carrying part to the maximums as indicated in UL67.
 - B. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- 2.05 **OVERCURRENT PROTECTIVE DEVICES**
 - A. Molded-Case Circuit Breaker: NEMA AB 3, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits.
 - a. Circuit Breakers 250A and Larger: Magnetic trip element with front-mounted, field-adjustable trip setting with restricted access cover.
 - 2. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
 - 3. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
 - B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.
 - 1. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - 2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
 - 3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - 4. Do not use tandem circuit breakers.
 - 5. Provide lock on devices for circuit breakers when called out on panel schedules with "LOD" designation.
 - 6. Provide type GFEP circuit breakers for all self-regulating heating (snow melting and heat trace) cables branch circuits and where noted on panel schedules with "GFEP" designation
 - 7. Provide GFCI circuit breaker when called out on panel schedules with "GFCI" designation.

8. Provide Arc-Fault Circuit Interrupters where indicated on panel schedule with "AFCI" designation.
 9. Provide permanent padlockable handle for circuit breakers when called out on panel schedules with "PL" designation.
 - C. Circuit Breaker Selection for Transformer Primary Protection:
 1. Circuit Breaker Selection for Transformer Primary Protection: Provide circuit breakers with time-current characteristics to clear transformer inrush currents while still providing protection for the ANSI through-fault protection curve. Provide circuit breakers with adjustable magnetic trip or electronic trip units as necessary to provide time-current curve shaping to achieve long time trip indicated on drawings, inrush coordination and damage protection.
- 2.06 **ACCESSORY COMPONENTS AND FEATURES**
- A. Furnish accessory set including tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
 - B. Provide permanent provisions for padlocking overcurrent devices in Branch Circuit Panelboards that serve equipment not provided with a local, lockable disconnecting means. Provisions shall remain in place whether or not lock is installed

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Comply with mounting and anchoring requirements specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- C. Mount top of trim 74 inches above finished floor, unless otherwise indicated.
- D. Mount plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.
- E. Install overcurrent protective devices and controllers.
 1. Set field-adjustable switches and circuit-breaker trip ranges.
- F. Install filler plates in unused spaces.
- G. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

3.02 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Electrical Identification."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads or created by retrofitting. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable. Coordinate final directory room names and numbers with Owner.
- C. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.03 CONNECTIONS

- A. Ground equipment according to Division 26 Section "Grounding and Bonding."
- B. Connect wiring according to Division 26 Section "Conductors and Cables."

3.04 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 2. Test continuity of each circuit.
- B. Testing: Perform the following field quality control tests in accordance with Division 26 section "Electrical Testing"
 1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters. Perform electrical tests on all breakers and switches 200A and above or that constitute a component of an emergency distribution system. Main circuit breakers in branch circuit panelboards 225A and below are not required to be tested.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.
1. Measure as directed during period of normal system loading.
 2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
 3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
 4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.
- 3.05 **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.

END OF SECTION

SECTION 26 2726 - WIRING DEVICES

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Single and duplex receptacles
 - 2. Ground-fault circuit interrupter receptacles
 - 3. Single- and double-pole snap switches.
 - 4. Device wall plates.

1.03 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. PVC: Polyvinyl chloride.
- D. RFI: Radio-frequency interference.
- E. UTP: Unshielded twisted pair.

1.04 REFERENCES

- A. DSCC W-C-596G: Federal Specification Connector, Electrical, Power, General Specification.
- B. DSCC W-C-896F: Federal Specification Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification).
- C. IEC 309-1, Part 1: General Requirements: Plugs, Socket-Outlets and Couplers for Industrial Purposes
- D. NEMA FB 11: Plugs, Receptacles, and Connectors of the Pin and Sleeve Type for Hazardous Locations.
- E. NEMA WD 1: General Requirements for Wiring Devices.
- F. NEMA WD 6: Wiring Device – Dimensional Requirements.
- G. UL 20: General-Use Snap Switches.
- H. UL 486A: Wire Connectors and Soldering Lugs for Use with Copper Conductors.
- I. UL 498: Electrical Attachment Plugs and Receptacles.
- J. UL 943: Ground Fault Circuit Interrupters.
- K. NECA 130-2010: Installing and Maintaining Wiring Devices.

1.05 SUBMITTALS

- A. Product Data: Provide manufacturer’s catalog information showing dimensions, colors, and configurations for each type of product indicated.

1.06 **QUALITY ASSURANCE**

- A. Source Limitations: Obtain each type of wiring device through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and source.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

1.07 **COORDINATION**

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
 - 1. Cord and Plug Sets: Match equipment requirements.

PART 2 PRODUCTS

2.01 **GENERAL WIRING DEVICE REQUIREMENTS**

- A. Comply with NFPA 70, NEMA WD 1, NEMA WD 6, and UL498.
- B. Devices for Owner-Furnished Equipment:
 - 1. Receptacles: Match plug configurations.
 - 2. Cord and Plug Sets: Match equipment requirements.
- C. Device Color:
 - 1. Wiring Devices Connected to Normal Power System: White, unless otherwise indicated or required by NFPA 70 or device listing.
 - 2. Wall Switches: White, unless otherwise indicated.

2.02 **STANDARD GRADE RECEPTACLES**

- A. Tamper-Resistant Duplex Receptacle, NEMA 5-20R:
 - 1. Safety mechanism to energize contacts only when both openings are simultaneously engaged.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hubbell Wiring Device-Kellems: 5362TR
 - b. Eaton/Arrow Hart Wiring Devices: AHTR5362
 - c. Leviton: 5362-SG
 - d. Legrand, Pass & Seymour: TR5362
- B. Weather- and Tamper-Resistant Duplex Receptacle, NEMA 5-20R:
 - 1. Safety mechanism to energize contacts only when both openings are simultaneously engaged.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hubbell Wire Device-Kellems: BR20WRTR
 - b. Eaton/Arrow Hart Wiring Devices: TWRBR20
 - c. Leviton: TWR20
 - d. Legrand, Pass & Seymour: WR5352TR

2.03 **GFCI RECEPTACLES**

- A. General:
 - 1. Comply with UL 943
- B. Tamper-Resistant Duplex GFCI Receptacle, NEMA 5-20R:
 - 1. Safety mechanism to energize contacts only when both openings are simultaneously engaged.
 - 2. Manufacturers: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell Wiring Device-Kellems: GFTRST20
 - b. Eaton/Arrow Hart Wiring Devices: TRSGF20
 - c. Leviton: GFTR2
 - d. Legrand, Pass & Seymour: 2097TR
- C. Tamper- and Weather-Resistant Duplex GFCI Receptacle, NEMA 5-20R:
 - 1. Safety mechanism to energize contacts only when both openings are simultaneously engaged.
 - 2. Manufacturers: Subject to compliance with requirements, provide one of the following:

- a. Hubbell Wiring Device-Kellems: GFTWRST20
- b. Eaton/Arrow Hart Wiring Devices: TWRS GF20
- c. Leviton: GFWT2
- d. Legrand, Pass & Seymour: 2097TRWR

2.04 **WALL SWITCHES**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Hubbell Wiring Device-Kellems: 1220 Series
 2. Eaton/Arrow Hart Wiring Devices: AH1220 Series
 3. Leviton: 1220 Series
 4. Legrand, Pass & Seymour: PS20AC Series
- B. Device body: Plastic handle.
- C. Single- and Double-Pole Switches: Comply with DSCC W-C-896F and UL 20.
- D. Snap Switches: Heavy Duty specification grade, quiet type; rated 20A., 120-277 V AC.
- E. Provide single-pole, two-pole, three-way and four-way switches as indicated.
- F. Provide pilot light where indicated. Switch shall be illuminated when the switch is on.
- G. Provide key type where indicated. Furnish four keys to Owner.
- H. Combination Switch and Receptacle: Both devices in a single gang unit with plaster ears and removable tab connector that permit separate or common feed connection.
 1. Switch: 20 A, 120/277-V ac.
 2. Receptacle: NEMA WD 6, Configuration 5-20R.

2.05 **WALL PLATES**

- A. Manufacturers:
 1. Provide wall plates and corresponding wiring devices from same manufacturer.
- B. Single and combination types to match corresponding wiring devices.
 1. Plate-Securing Screws: Metal with head color to match plate finish.
 2. Material for Finished Spaces:
 - a. 0.035-inch- thick, satin-finished stainless steel
 3. Material for Unfinished Spaces:
 - a. Galvanized steel
 4. Material for Wet Locations: Gasketed Cast aluminum with hinged cover and listed and labeled as Extra Duty Weatherproof While-In-Use.
 - a. Manufacturers:
 - 1) Hubbell: MX3200
 - 2) Red Dot Model: CKLSVU, Thomas & Betts
 - 3) Intermatic: WP3110MXD
 - 4) Leviton: IUM1V
 5. Material for Damp Locations: Gasketed Cast aluminum with hinged cover and listed and labeled as Weatherproof.
 - a. Manufacturers:
 - 1) Red Dot Model CCGV, ABB Installation Products
 - 2) Eaton/Arrow Hart WLRD1
 - 3) Legrand, Pass & Seymour
 - 4) Intermatic: WP3110MXD

PART 3 EXECUTION

3.01 **INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Prior to installation of devices, verify wall openings are neatly cut and will be completely covered by wall plates, clean debris from outlet boxes and provide extension rings to bring outlet boxes flush with finished surface.
- C. Install devices and assemblies level, plumb, and square with building lines.
- D. Arrangement of Devices:
 1. Coordinate locations of outlet boxes provided under Division 26 Section "Raceways and Boxes" to obtain mounting heights indicated on Drawings.

2. Unless otherwise indicated, mount flush, with long dimension vertical, and with grounding terminal of receptacles on top.
 3. Where multiple switches, dimmers, and/or occupancy sensors are adjacent to each other, provide a single cover plate. Custom fabricate, if required, for all combinations. Provide separate boxes or barriers as required for the application.
 4. Install horizontally mounted receptacles with grounding pole on the left.
 5. Install GFCI receptacles so that the "Push To Test" and "Reset" designations can be read correctly. If printed in both directions, install with ground pole on top.
 6. Install switches with OFF position down.
- E. Install cover plates on switch, receptacle, and blank outlets in finished areas.
- F. Install weather-resistant type receptacles in all damp and wet locations, including pool environments.
- G. Install weatherproof cover plates on receptacles in damp locations.
- H. Install weatherproof While-In-Use cover plates on receptacles in wet locations.
- I. Install tamper-resistant type receptacles in all locations indicated on plan.
- J. Use oversized plates for outlets installed in masonry walls.
- K. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.
- L. Remove wall plates and protect devices and assemblies during painting.
- M. Adjust devices and wall plates to be flush and level. Three corners of wall plates must be in contact with wall surfaces. Devices shall be solidly mounted against the box.
- 3.02 **IDENTIFICATION**
- A. Comply with Division 26 Section "Electrical Identification."
1. Receptacles: Identify panelboard and circuit number from which served. Use adhesive label as specified in Division 26 Section "Electrical Identification" with black-filled lettering on face of wall plate, and durable wire markers or tags inside outlet boxes.
 2. Wall Switches: Identify panelboard and circuit number from which served. Use adhesive label as specified in Division 26 Section "Electrical Identification" with black-filled lettering on back side of wall plate, and durable wire markers or tags inside outlet boxes.
- 3.03 **CONNECTIONS**
- A. Ground equipment according to Division 26 Section "Grounding and Bonding." Connect wiring device grounding terminal to outlet box with bonding jumper. Use of quick ground strap or screw is not acceptable.
- B. Connect wiring according to Division 26 Section "Conductors and Cables." Connect wiring devices by wrapping conductor around screw terminal or by using back wiring and tightening the screw securely.
- C. 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.
- 3.04 **FIELD QUALITY CONTROL**
- A. Perform the following field tests and inspections and prepare test reports:
1. Inspect each wiring device for defects.
 2. Operate each wall switch with circuit energized and verify proper operation.
 3. After installing wiring devices and after electrical circuitry has been energized, test each receptacle for proper polarity, ground continuity, and compliance with requirements.
 4. Test each GFCI receptacle for proper operation with both local and remote fault simulations according to manufacturer's written instructions.
- B. Remove malfunctioning units, replace with new units, and retest as specified above.
- END OF SECTION**

SECTION 26 2813 - FUSES

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Cartridge fuses rated 600 V and less for use in switchboards.

1.03 SUBMITTALS

- A. Product Data: Include the following for each fuse type indicated:
 - 1. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
 - 2. Let-through current curves for fuses with current-limiting characteristics.
 - 3. Time-current curves, coordination charts and tables, and related data.
- B. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals.

1.04 QUALITY ASSURANCE

- A. Source Limitations: Obtain fuses from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with:
 - 1. NEMA FU 1 – Low Voltage Cartridge Fuses.
 - 2. NFPA 70 – National Electrical Code.
 - 3. UL 198C – High-Interrupting-Capacity Fuses, Current-Limiting Types.
 - 4. UL 198E – Class R Fuses.
 - 5. UL 512 – Fuseholders.

1.05 PROJECT CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.06 COORDINATION

- A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size.

1.07 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fuses: Quantity equal to 10% percent of each fuse type and size, but no fewer than 3 of each type and size.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. [Cooper Bussmann, Inc.](#)
 2. [Eagle Electric Mfg. Co., Inc.](#); Cooper Industries, Inc.
 3. [Ferraz Shawmut, Inc.](#)
 4. Tracor, Inc.; [Littelfuse, Inc.](#) Subsidiary.

2.02 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class and current rating indicated; voltage rating consistent with circuit voltage.
1. Feeders: Class RK5, time delay.
 2. Motor Branch Circuits: Class RK5, time delay.
 3. Other Branch Circuits: Class RK5, time delay.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- B. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 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 energization 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 energization of the circuit in which it is applied.
- B. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.03 IDENTIFICATION

- A. Install labels indicating fuse rating and type on outside of the door on each fused switch.

END OF SECTION

SECTION 26 2816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 26 Section "Fuses".

1.02 SUMMARY

- A. This Section includes the following individually mounted, enclosed switches and circuit breakers:
 - 1. Fusible switches.
 - 2. Nonfusible switches.
 - 3. Enclosures.
- B. Related Sections:
 - 1. Division 26 "Hangers and Supports for Electrical Systems" for concrete bases.

1.03 DEFINITIONS

- A. GD: General duty.
- B. GFCI: Ground-fault circuit interrupter.
- C. HD: Heavy duty.
- D. RMS: Root mean square.
- E. SPDT: Single pole, double throw.

1.04 REFERENCES

- A. NECA 1: Practices for Good Workmanship in Electrical Contracting.
- B. NETA ATS: Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- C. NEMA 250: Enclosures for Electrical Equipment (1000 Volts Maximum).
- D. NEMA AB 1: Molded Case Circuit Breakers and Molded Case Switches.
- E. NEMA FU 1: Low Voltage Cartridge Fuses.
- F. NEMA KS 1: Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
- G. NEMA PB1.1: General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.
- H. NEMA PB2.1: General Instructions for Proper Installation, Operation, and Maintenance of Deadfront Switchboards Rated 600 Volts or Less.
- I. NFPA 70: National Electrical Code.

1.05 **SUBMITTALS**

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current rating.
 - 4. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Field quality-control test reports including the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- D. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Closeout Procedures," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
 - 2. Time-current curves, including selectable ranges for each type of circuit breaker.

1.06 **QUALITY ASSURANCE**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.07 **PROJECT CONDITIONS**

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:
 - 1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
 - 2. Altitude: Not exceeding 6600 feet.

1.08 **COORDINATION**

- A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 PRODUCTS

2.01 **MANUFACTURERS**

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

2.02 **FUSIBLE AND NONFUSIBLE SWITCHES**

- A. Manufacturers:
 - 1. Square D/Group Schneider. (base bid – bid price include Square D equipment)
 - 2. Eaton Corporation; Cutler-Hammer Products.
 - 3. General Electric Co.; Electrical Distribution & Control Division.
 - 4. Siemens Industries, Inc.
- B. Fusible Switch: NEMA KS 1, quick make, quick-break load interrupter enclosed knife switch Type HD, with clips or bolt pads to accommodate specified fuses, externally operable lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

- C. Nonfusible Switch: NEMA KS 1, quick make, quick-break load interrupter enclosed knife switch Type HD, externally operable lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
 - D. Accessories:
 - 1. Provide early break auxiliary contacts in motor disconnect switches for motors that are fed from variable frequency controllers.
 - 2. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 3. Neutral Kit: Internally mounted; insulated, capable of being grounded, and bonded; and labeled for copper and aluminum neutral conductors.
- 2.03 **TOGGLE DISCONNECT SWITCH**
- A. Manufacturers:
 - 1. Double Pole:
 - a. Hubbell 1372.
 - b. Leviton 3032-2W.
 - c. Pass & Seymour 7812.
 - d. Bryant 30102.
 - 2. Three Pole:
 - a. Hubbell 1379.
 - b. Leviton MS303-DSW.
 - c. Pass & Seymour 7813.
 - d. Bryant 30103.
 - B. Description: Heavy duty, 30A, 600 volt, double or three pole as required, single throw, motor rated switch without overload protection. Provide NEMA 1 enclosure and padlock attachment.
- 2.04 **ENCLOSURES**
- A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.
 - 1. Indoor Dry Locations: NEMA 250, Type 1.
 - 2. Outdoor Locations: NEMA 250, Type 3R.
 - 3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.
- B. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated.
- C. Install switches with off position down.
- D. Install NEMA KS 1 enclosed switch where indicated for motor loads ½ HP and larger and equipment loads greater than 30A.
- E. Install toggle disconnect switch, surface mounted, where indicated for motor loads less than ½ HP and equipment loads 30A. and less.
- F. Install fuses in fusible disconnect switches.
- G. Install flexible liquid tight conduit from toggle disconnect switch to portable equipment. Leave a 6'-0" whip.
- H. Install flexible liquid tight conduit from toggle disconnect switch to stationary equipment.
- I. Install control wiring from early break contacts in motor disconnect switch to variable frequency controllers to shut down controller when switch is open.
- J. Install equipment on exterior foundation walls at least one inch from wall to permit vertical flow of air behind breaker and switch enclosures.
- K. Support enclosures independent of connecting conduit or raceway system.

- L. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

3.03 **IDENTIFICATION**

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Electrical Identification."
- B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate as specified in Division 26 Section "Electrical Identification."
- C. Provide adhesive label as specified in Division 26 Section "Electrical Identification" on inside door of each switch indicating UL fuse class and size for replacement.

3.04 **FIELD QUALITY CONTROL**

- A. Prepare for acceptance testing as follows:
 - 1. Inspect mechanical and electrical connections.
 - 2. Verify switch and relay type and labeling verification.
 - 3. Verify rating of installed fuses.

3.05 **CLEANING**

- A. On completion of installation, vacuum dirt and debris from interiors; do not use compressed air to assist in cleaning.
- B. Inspect exposed surfaces and repair damaged finishes.

END OF SECTION

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SECTION 26 2913 - ENCLOSED CONTROLLERS

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes ac, enclosed controllers rated 600 V and less, of the following types:
 - 1. Across-the-line, manual and magnetic controllers.

1.03 SUBMITTALS

- A. Product Data: For each type of enclosed controller. Include dimensions and manufacturer's technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each enclosed controller.
 - 1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Each installed unit's type and details.
 - b. Nameplate legends.
 - c. Short-circuit current rating of integrated unit.
 - d. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices in combination controllers.
 - 2. Wiring Diagrams: Power, signal, and control wiring.
- C. Qualification Data: For manufacturer.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For enclosed controllers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Closeout Procedures," include the following:
 - 1. Routine maintenance requirements for enclosed controllers and all installed components.
- F. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

1.04 **REFERENCES**

- A. ANSI/NEMA ICS 6 - Enclosures for Industrial Controls and Systems.
- B. ANSI/UL 198C - High-Intensity Capacity Fuses; Current-Limiting Types.
- C. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service.
- D. FS W-F-870 - Fuseholders (For Plug and Enclosed Cartridge Fuses).
- E. FS W-S-865 - Switch, Box, (Enclosed), Surface-Mounted.
- F. NEMA AB 1 - Molded Case Circuit Breakers.
- G. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies.
- H. NEMA KS 1 - Enclosed Switches.
- I. ANSI/NFPA 70 - National Electrical Code.

1.05 **QUALITY ASSURANCE**

- A. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 100 miles of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.
- B. Source Limitations: Obtain enclosed controllers of a single type through one source from a single manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with NFPA 70.

1.06 **DELIVERY, STORAGE, AND HANDLING**

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle in accordance with manufacturer's written instructions. Lift large equipment only with lugs provided for the purpose. Handle carefully to avoid damage to motor control center components, enclosure, and finish.
- C. If stored in areas subject to weather, cover enclosed controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install electric heating of sufficient wattage to prevent condensation.

1.07 **PROJECT RECORD DOCUMENTS**

- A. Accurately record actual locations of each contactor and indicate circuits controlled. Submit under provisions of 26 0010.

1.08 **COORDINATION**

- A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7 Section "Roof Accessories."
- C. Coordinate features, accessories, and functions of each enclosed controller with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

1.09 **EXTRA MATERIALS**

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Spare Fuses: Furnish one spare for every five installed, but no fewer than one set of three of each type and rating.
 - 2. Indicating Lights: Two of each type installed.
 - 3. Keys: Furnish 2 of each to Owner.

PART 2 PRODUCTS

2.01 **MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. [ABB Power Distribution, Inc.](#); ABB Control, Inc. Subsidiary.
 - 2. [Danfoss Inc.](#); Danfoss Electronic Drives Div.
 - 3. [Eaton Corporation; Cutler-Hammer Products.](#)

4. [General Electrical Company; GE Industrial Systems.](#)
5. [Rockwell Automation; Allen-Bradley Co.; Industrial Control Group.](#)
6. [Siemens/Furnas Controls.](#)
7. [Square D.](#)

2.02 **ACROSS-THE-LINE ENCLOSED CONTROLLERS**

- A. Manual Controller: NEMA ICS 2, general purpose, Class A, with "quick-make, quick-break" toggle or pushbutton action, and marked to show whether unit is "OFF," "ON," or "TRIPPED."
 1. Overload Relay: Ambient-compensated type with inverse-time-current characteristics and NEMA ICS 2, Class 10 tripping characteristics. Relays shall have heaters and sensors in each phase, matched to nameplate, full-load current of specific motor to which they connect and shall have appropriate adjustment for duty cycle.
- B. Combination Magnetic Controller: Factory-assembled combination controller and disconnect switch.
 1. Fusible Disconnecting Means: NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 947-4-1, as certified by an NRTL.
 2. Nonfusible Disconnecting Means: NEMA KS 1, heavy-duty, nonfusible switch.
 3. Circuit-Breaker Disconnecting Means: NEMA AB 1, motor-circuit protector with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.

2.03 **ENCLOSURES**

- A. Description: Flush- or surface-mounting cabinets as indicated. NEMA 250, Type 1, unless otherwise indicated to comply with environmental conditions at installed location.
 1. Outdoor Locations: NEMA 250, Type 3R.
 2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
 3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
 4. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7C.

2.04 **ACCESSORIES**

- A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.
- B. Indicating Lights: Run (Red), off or ready (Green).
- C. Auxiliary Contacts: Provide two normally open (N.O.) and two normally closed (N.C.) contacts.
- D. Selector Switch: NEMA ISC 2, mounted in front cover to read "hand/off/auto," provide auxiliary contact for auto position monitoring.
- E. Control Relays: Auxiliary and adjustable time-delay relays.

2.05 **FACTORY FINISHES**

- A. Enclosure Finish: The enclosure shall be finished with gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1).

PART 3 EXECUTION

3.01 **EXAMINATION**

- A. Examine areas and surfaces to receive enclosed controllers for compliance with requirements, installation tolerances, and other conditions affecting performance.
 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 **APPLICATIONS**

- A. Select features of each enclosed controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, controller, and load; and configuration of pilot device and control circuit affecting controller functions.
- B. Select horsepower rating of controllers to suit motor controlled.

3.03 **INSTALLATION**

- A. For control equipment at walls, bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."
- B. Comply with mounting and anchoring requirements specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- C. Enclosed Controller Fuses: Install fuses in each fusible switch. Comply with requirements in Division 26 Section "Fuses."
- D. Install motor control equipment and contactors in accordance with manufacturer's instructions.

- E. Select and install heater elements in motor starters to match installed motor characteristics.
- F. Motor Data: Provide neatly typed label inside each motor starter enclosure door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.

3.04 **IDENTIFICATION**

- A. Identify enclosed controller, components, and control wiring according to Division 26 Section "Electrical Identification."

3.05 **CONTROL WIRING INSTALLATION**

- A. Install wiring between enclosed controllers according to Division 26 Section "Conductors and Cables."
- B. Bundle, train, and support wiring in enclosures.
- C. Connect hand-off-automatic switch and other automatic-control devices where applicable.
 - 1. Connect selector switches to bypass only manual- and automatic-control devices that have no safety functions when switch is in hand position.
 - 2. Connect selector switches with enclosed controller circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.06 **CONNECTIONS**

- A. Conduit installation requirements are specified in other Division 26 Sections. Drawings indicate general arrangement of conduit, fittings, and specialties.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding."

3.07 **FIELD QUALITY CONTROL**

- A. Prepare for acceptance tests as follows:
 - 1. Test insulation resistance for each enclosed controller element, bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.

3.08 **ADJUSTING**

- A. Set field-adjustable switches and circuit-breaker trip ranges.

3.09 **DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers. Refer to Division 1 Section "Closeout Procedures."

END OF SECTION

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SECTION 26 5119 - LED INTERIOR LIGHTING

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Interior solid-state luminaires that use LED technology.
 - 2. Lighting fixture supports.
- B. Related Requirements:
 - 1. Division 26 "Lighting Control Devices."

1.03 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. Lamp: LED and substrate as a replaceable assembly.
- F. LED: Light-emitting diode.
- G. Lumen: Measured output of lamp and luminaire, or both.
- H. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.04 SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Arrange in order of luminaire designation.
 - 2. Include data on features, accessories, and finishes.
 - 3. Include physical description and dimensions of luminaires.
 - 4. Include emergency lighting units, including batteries and chargers.
 - 5. Include life, output (lumens, CCT, and CRI), and energy efficiency data.

6. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing and Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps and accessories identical to those indicated for the lighting fixture as applied in this Project per IES LM-79 and IES LM-80.
 - a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products or certified by a qualified independent testing agency.
 - B. Shop Drawings: For nonstandard or custom luminaires.
 1. Include plans, elevations, sections, and mounting and attachment details.
 2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 3. Include diagrams for power, signal, and control wiring.
 - C. Qualification Data: For testing laboratory providing photometric data for luminaires.
 - D. Product Test Reports: For each luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency.
 - E. Sample warranty.
- 1.05 **CLOSEOUT SUBMITTALS**
- A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.
 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.
- 1.06 **MAINTENANCE MATERIAL SUBMITTALS**
- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Lamps: 5% attic stock of each type and rating installed. Furnish at least one of each type.
 2. LED Drivers 5% attic stock of each type and rating installed. Furnish at least one of each type.
 3. Diffusers and Lenses: 1% attic stock of each type and rating installed. Furnish at least one of each type.
 4. Globes and Guards: 5% attic stock of each type and rating installed. Furnish at least one of each type.
- 1.07 **QUALITY ASSURANCE**
- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
 - B. Provide luminaires from a single manufacturer for each luminaire type.
 - C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.
 - D. 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.
 - E. Comply with:
 1. NFPA 70 - National Electrical Code.
 2. NECA/IESNA 500-1998 – Recommended Practice for Installing Indoor Commercial Lighting Systems.
 3. NECA/IESNA 502-1999 – Recommended Practice for Installing Industrial Lighting Systems.
 4. Code of Federal Regulations (47 CFR 37342).
 5. Michigan Department of Community Industry Services requirements that all lamps shall be protected from breakage. Exposed lamps are not acceptable.
 - F. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.
- 1.08 **DELIVERY, STORAGE, AND HANDLING**
- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.09 **COORDINATION**

- A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.10 **WARRANTY**

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: Five year(s) or manufacturer's standard warranty length (whichever is longer) from date of Substantial Completion.

PART 2 PRODUCTS

2.01 **LUMINAIRES (LIGHTING FIXTURES)**

- A. Provide Luminaires as included in the luminaire schedule shown on drawings.
- B. Acceptable alternate manufacturers are indicated on the luminaire schedule. Alternate manufacturer products shall be equal in all respects including materials, finishes, photometric performance and energy performance and shall include all options, features, and accessories identified.

2.02 **LUMINAIRE 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. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
- C. Unless otherwise specified in Luminaire product data, provide products with a minimum CRI of 80.
- D. Unless otherwise specified in Luminaire product data, provide products with a CCT of 4000 K.
- E. Unless otherwise specified in Luminaire product data, provide products with an IES LM-80 rated lamp life of 70,000 hours.
- F. Driver
 - 1. Provided as an integrated component of the luminaire or as an external component of an assembly of luminaires.
 - 2. Nominal Input Voltage: All drivers shall be rated for use on either 120V or 277V systems.

2.03 **EXIT SIGNS**

- A. General: Comply with UL 924; for sign colors and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
 - 1. Lamps: Light-emitting diodes, 70,000 hours minimum of rated lamp life.
- C. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
 - 1. Battery: Sealed, maintenance-free, nickel-cadmium type with special warranty.
 - 2. Charger: Fully automatic, solid-state type with sealed transfer relay.
 - 3. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
- D. Provide edge lit signs with a mirror plaque background.

2.04 **MATERIALS**

- A. Metal Parts:
 - 1. Free of burrs and sharp corners and edges.
 - 2. Sheet metal components shall be steel unless otherwise indicated.
 - 3. Form and support to prevent warping and sagging.
- B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- C. Diffusers and Globes:
 - 1. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

2. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
- D. Factory-Applied Labels: Comply with UL 1598 Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
 1. Label shall include the following lamp characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. Lamp diameter, shape, size, wattage, and coating.
 - c. CCT and CRI for all luminaires.
- 2.05 **METAL FINISHES**
 - A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.
- 2.06 **LUMINAIRE FIXTURE SUPPORT COMPONENTS**
 - A. Comply with requirements in Section 26 0529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
 - B. Single-Stem Hangers: Unless otherwise specified in Luminaire product data, provide products with a minimum 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
 - C. Wires: Unless otherwise specified in Luminaire product data, provide products with a minimum ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage.
 - D. Rod Hangers: Unless otherwise specified in Luminaire product data, provide products with a minimum 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
 - E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 EXECUTION

- 3.01 **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 fixture installation. Proceed with installation only after unsatisfactory conditions have been corrected.
- 3.02 **TEMPORARY LIGHTING**
 - A. Do not use permanent luminaires for temporary lighting.
- 3.03 **INSTALLATION**
 - A. Install in accordance with manufacturer's instructions and N.E.C.A./I.E.S.N.A. 500-2006 and 502-2006.
 - B. Locate ceiling luminaires as indicated on reflected ceiling plan.
 - C. Support luminaires independent of ceiling framing. Support recessed grid luminaires from two opposite corners directly to structure. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.
 - D. Install recessed luminaires to permit removal from below.
 - E. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
 - F. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
 - G. Install fixture with no gaps between adjacent fixtures or between fixtures and surrounding surfaces. Trims of fixtures shall be properly and uniformly aligned.
 - H. Supports:
 1. Sized and rated for luminaire weight.
 2. Able to maintain luminaire position after cleaning and relamping.
 3. Provide support for luminaire without causing deflection of ceiling or wall.
 4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.
 - I. Flush-Mounted Luminaire Support:
 1. Secured to outlet box.
 2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.

- 3. Trim ring flush with finished surface.
 - J. Suspended Luminaire Support:
 - 1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
 - K. Comply with requirements in Section 26 0519 "Conductors and Cables" for wiring connections.
 - L. Fixtures shall have their exterior labels removed and shall be thoroughly cleaned.
 - M. Locate the remote test/monitor modules identically so that they are visible and they form a straight line when viewed from the end of the corridor or room. Where a suspended ceiling exists, center the modules in adjacent ceiling tiles.
- 3.04 **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.
 - B. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
 - C. Bond products and metal accessories to branch circuit equipment grounding conductor.
 - D. Connect luminaires to branch circuit outlet boxes provided under Division 26 Section "Raceways and Boxes" using 1/2" flexible conduit.
- 3.05 **IDENTIFICATION**
- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 0553 "Identification for Electrical Systems."
- 3.06 **FIELD QUALITY CONTROL**
- A. Perform the following tests and inspections:
 - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
 - 2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
 - B. Luminaire will be considered defective if it does not pass operation tests and inspections.
 - C. Prepare test and inspection reports.
 - D. A visual inspection shall be performed to verify cleanliness and alignment of the fixtures, misalignment and light leaks shall be corrected, and rattles due to ventilation system vibration shall be eliminated.
- 3.07 **ADJUSTING**
- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
 - 1. During adjustment visits, inspect all luminaires. Replace lamps, drivers, or luminaires that are defective.
 - 2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 - 3. Adjust the aim of luminaires in the presence of the Architect.
 - B. Adjust exit sign directional arrows as indicated on Drawings.
 - C. Adjust and calibrate all dimming system controls until the system works as designed. Contact the Architect/Engineer when dimming is complete and demonstrate operation to owner's representative and Architect/Engineer.
- 3.08 **CLEANING**
- A. Clean electrical parts to remove conductive and deleterious materials.
 - B. Remove dirt and debris from enclosures and lenses.
 - C. Clean photometric control surfaces as recommended by manufacturer.
 - D. Clean finishes and touch up damage.

END OF SECTION

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SECTION 26 5600 - EXTERIOR LIGHTING

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Exterior luminaires with lamps and ballasts.
 - 2. Luminaire-mounted photoelectric relays.
- B. Related Sections include the following:
 - 1. Division 26 Section "LED Interior Lighting" for exterior luminaires normally mounted on exterior surfaces of buildings.

1.03 DEFINITIONS

- A. CRI: Color-rendering index.
- B. HID: High-intensity discharge.
- C. Luminaire: Complete lighting fixture, including ballast housing if provided.

1.04 SUBMITTALS

- A. Product Data: For each luminaire, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:
 - 1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.
 - 2. Details of installation and construction.
 - 3. Luminaire materials.
 - 4. Photometric data based on laboratory tests of each luminaire type, complete with indicated lamps, ballasts, and accessories.
 - a. Photometric data shall be certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
 - 5. Photoelectric relays.
 - 6. Ballasts, including energy-efficiency data.
 - 7. Lamps, including life, output, and energy-efficiency data.
 - 8. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.
- B. Shop Drawings:
 - 1. Wiring Diagrams: Power wiring.
- C. Qualification Data: For agencies providing photometric data for lighting fixtures.
- D. Field quality-control test reports.

- E. Operation and Maintenance Data: For luminaires to include in operation, and maintenance manuals.
- F. Warranty: Special warranty specified in this Section.
- 1.05 **QUALITY ASSURANCE**
 - A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
 - B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - C. Comply with IEEE C2, "National Electrical Safety Code."
 - D. Comply with NFPA 70.
- 1.06 **WARRANTY**
 - A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period.
 - 1. Warranty Period for Luminaires: Five years from date of Substantial Completion.
 - 2. Warranty Period for Lamps: Replace lamps and fuses that fail within 12 months from date of Substantial Completion; furnish replacement lamps and fuses that fail within the second 12 months from date of Substantial Completion.
- 1.07 **EXTRA MATERIALS**
 - A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
 - 2. Glass and Plastic Lenses, Covers, and Other Optical Parts: 10 for every 100 of each type and rating installed. Furnish at least one of each type.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
 - 2. Basis of Design Product: The design of each item of exterior luminaire and its support is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.

2.02 LUMINAIRES, GENERAL REQUIREMENTS

- A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.
- B. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.
- C. Metal Parts: Free of burrs and sharp corners and edges.
- D. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.
- E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.
- F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.
- G. Exposed Hardware Material: Stainless steel.
- H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
- I. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:

1. White Surfaces: 85 percent.
 2. Specular Surfaces: 83 percent.
 3. Diffusing Specular Surfaces: 75 percent.
- J. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- K. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

PART 3 EXECUTION

3.01 LUMINAIRE INSTALLATION

- A. Install exterior lighting system per N.E.C.A./I.E.S.N.A. 501-2006.
- B. Install lamps in each luminaire.
- C. Fasten luminaire to indicated structural supports.
- D. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources.
- E. "Cast-in-Place Concrete."

3.02 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.
- B. Steel Conduits: Comply with Division 26 Section "Raceways and Boxes." In concrete foundations, wrap conduit with 0.010-inch- thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.03 GROUNDING

- A. Ground support structures according to Division 26 Section "Grounding and Bonding."

3.04 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.
 1. Verify operation of photoelectric controls.

3.05 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain luminaire lowering devices. Refer to Division 1 Section "Demonstration and Training."

END OF SECTION

SECTION 27 5119 – FIELD UTILITY BOXES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This section includes the following:
 - 1. Furnish all labor, materials, and equipment necessary to install synthetic turf field utility boxes.
- B. Related Sections include the following:
 - 1. Specification Section 32 1815 Synthetic Turf
 - 2. Division 26 – Electrical
 - 3. Division 27 - Communications

1.3 QUALITY ASSURANCE

- A. Warranty Guarantee:
 - 1. The completed system shall be guaranteed to be free from all defects for a period of one (1) year from the date of final acceptance, or the manufacturer's specific warranty related to the product or service, whichever is greater. Any defects or system malfunctions identified shall be immediately corrected at no cost to the Owner for the warranty/guarantee period.

1.4 SUBMITTALS

- A. Manufacturer's Product Data:
 - 1. Provide manufacturers product data prior to actual field installation work.
- B. Shop Drawings:
 - 1. Provide shop drawings of the manufacturer's recommended installation and foundation requirements (if required) prior to actual field installation work. Shop drawings shall include a utility box layout drawing if required.

1.5 PRODUCT DELIVERY AND STORAGE

- A. Materials delivered to the site shall be examined for damage or defects in shipping. Any defects shall be noted and reported to the Owner's representative. Replacements, if necessary, shall be immediately re-ordered. Sound materials shall be stored above ground under protective cover or indoors for proper protection.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Furnish and install synthetic turf utility boxes as detailed.
- B. Synthetic Turf Surface Utility boxes shall be from one of the following (or approved equal)
 - 1. Sportsfield Specialties: Model GPAFITC (1'-10" x 1'-10", 8" box ht.)

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install equipment in accordance with manufacturer's written instructions and as indicated on the drawings.
 - 1. For a Synthetic Turf Installation, the utility access box shall abut the concrete curb unless noted otherwise on the drawings.
- B. Contractor is responsible to confirm the exact locations of the proposed boxes with Architect or Electrical Engineer prior to installation.
- C. Field install synthetic turf surfacing.

END OF SECTION

SECTION 31 1000 – SITE PREPARATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section is a part of the entire set of Contract Documents and shall be coordinated with the applicable provisions of the other parts.
- B. The work under this Division consists of furnishing all labor, materials and equipment required for:
 - 1. Construction of synthetic turf baseball and softball fields.
 - 2. Construction of natural grass baseball and softball fields.
 - 3. Construction of synthetic turf practice fields.
 - 4. Construction of natural grass practice fields.
 - 5. Construction of batting cages, bullpens, and dugouts.
 - 6. Construction of post-tensioned concrete tennis courts.
 - 7. Fencing and netting.
 - 8. Bleacher installation.
 - 9. Scoreboard installation.
 - 10. Pavement and walkways.
- C. Bidders shall visit the site before submitting proposals and fully inform themselves as to the job and site conditions and other conditions under which the work of this section must be conducted. Verify themselves with the soil conditions at the site and familiarize themselves with the existing conditions that may be adjusted for this project. Submission of proposals implies that the Bidder has visited the site and is fully aware of these conditions.
- D. A pre-construction conference shall be held on the job site with all intended Contractors and Sub-contractors prior to the start of any work.

PART 2 - PRODUCTS

N/A

PART 3 - EXECUTION

3.1 SURVEY REQUIREMENTS

- A. The Contractor shall provide all survey work required to locate lines and grades for the construction of this project as herein specified and shown on drawings. The Contractor shall employ a registered engineer or surveyor for this layout.
- B. The Contractor upon entering the site and before any other work is underway, shall establish and set control points as indicated on the drawings and verify all finish grades.
- C. Existing survey as shown on the drawings is based on information provided for the generating of the enclosed construction drawings and accurate at time taken. Contractor shall verify field conditions and notify the Landscape Architect or Owner before bid date of any discrepancies found in the survey or site conditions.
- D. The Contractor shall provide a complete "as built" survey of the site within the site limits, noting all grades, locations, etc. if final constructed project should vary from bid documents.
- E. All work under this section shall be coordinated with the Landscape Architect so as to verify their understanding of the plans and intended layout.

END OF SECTION

SECTION 31 2010 – EARTHWORK – ATHLETICS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section is a part of the entire set of Contract Documents and shall be coordinated with the provisions of the other parts.
- B. Related Sections:
 - 1. Section 32 9223 Lawns - Sod
 - 2. Section 32 9227 General Lawn Restoration
 - 3. Section 33 4605 Subdrainage Systems – Sand
 - 4. Section 33 4615 Subdrainage Systems - Turf
- C. Section Includes:
 - 1. Excavation and backfill for site balance, utility trenches, footings, etc.
 - 2. Preparing subgrades for pavements, slabs-on-grade, synthetic turf, lawns, and plantings.
 - 3. Base course for asphalt or concrete paving.

1.2 SCOPE

- A. Furnish approved labor, materials, equipment, transportation, and services required to complete all earthwork as indicated on the drawings and specified herein. The Base Bid includes all earthwork and grading to provide a subgrade for other improvements. Adjustment of grades will be permitted, providing the overall grading concept and the positive drainage swales are maintained.

1.3 QUALITY ASSURANCE

- A. Excavation team shall be established and experienced with a minimum of 5 years experience constructing athletic fields.
- B. Testing Agency Service
 - 1. The Owner shall secure and pay for the services of a qualified, independent geotechnical engineer to classify existing soil materials, to recommend and to classify proposed borrow materials, when necessary, to verify compliance of materials with specified requirements, and to perform required field and laboratory testing. Geotechnical engineer shall be acceptable to the Architect and the Owner and shall be licensed to practice in the State in which the project is located.

1.4 DEFINITIONS

- A. Backfill: Soil materials used to fill an excavation
- B. Base Course: Layer placed between the subbase course and asphalt paving.
- C. Bedding Course: Layer placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow: Satisfactory soil imported from off-site for use as fill or backfill.
- E. Drainage Course: Layer supporting slab-on-grade or subbase for synthetic turf surfacing, used to minimize capillary flow of pore water.
- F. Engineered Fill: Material placed and compacted to densities specified, in a controlled manner, using lift thickness limited herein, monitored and tested by the Testing Agency or Independent Geotechnical Engineer.
- G. Excavation: Removal of material encountered above subgrade elevations.
- H. Fill: Soil materials used to raise existing grades.
- I. Structures: Buildings, footings, foundations, retaining walls, curbs, slabs, utility components, or other man-made features above grade.
- J. Subbase Course: Layer placed between the subgrade and base course for asphalt paving or concrete pavement.
- K. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.
- L. Undercutting: Necessary excavation or poor quality soils which occur below the existing topsoil and any uncontrolled fill soils as described in the Geotechnical Report.
- M. Utilities: Includes underground pipes, conduits, ducts, and cables, irrigation lines, data and fiber optic, and underground services within buildings.

1.5 EXAMINATION OF SITE

- A. The contractor is expected to visit the site to determine all conditions to be encountered, protect improvements on adjoining properties, as well as those on the owner's property, and to restore any improvements damaged by his work to their original condition, as acceptable to the owner or other parties or authorities having jurisdiction.
- B. Existing Utilities: Contractor shall not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Architect or owner and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Architect and Owner not less than three (3) calendar days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Architect's or Owner's written permission.
 - 3. Contact both public and private utility locator services for area where is Project is located before excavating.
- C. Demolish and completely remove from site, all existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

1.6 SAFETY CODES AND STANDARDS

- A. Perform excavation work in compliance with applicable requirements of governing authorities having jurisdiction.

1.7 DEWATERING

- A. The contractor shall perform all work so as to permit the site to be free draining at all times and to prevent ponding. Contractor shall provide positive drainage for the entire site during the course of construction to eliminate standing water in excavated areas.

1.8 PROTECTION

- A. Protect newly graded areas from traffic: pedestrian or construction, freezing, and erosion. Keep free of trash and debris.
- B. Protect all existing trees, bushes, etc. indicated to remain during construction activities.
- C. Repair and/or reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, or settled due to subsequent construction activities or weather conditions.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide soil materials without additional costs to Owner, when sufficient satisfactory soil materials are not available from excavations. Contractor is responsible for doing performing an independent earthwork calculation and including any import of appropriate fill material required to bring the site to the proposed elevations.

2.2 BACKFILL AND FILL MATERIALS

- A. General: Backfill shall be excavated soil material, free of rock or gravel larger than 2" in any dimension, debris, waste, frozen materials, vegetable matter, organic matter, and other deleterious matter. Existing materials may be used for backfill, provided no silt is mixed with material. Backfill consists of placement of acceptable soil material in layers, in excavations, to required subgrade elevation, for each area classification listed below.
- B. Subbase: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural/crushed sand. Generally, either MDOT Class II Sand or 21AA gravel will meet this requirement. Refer to plans and/or Geotechnical Engineer's recommendation as to whether the use of 21AA crushed concrete is an acceptable material.
- C. Base: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural/crushed sand. Generally, either MDOT Class II Sand or 21AA gravel will meet this requirement. Refer to plans and/or Geotechnical Engineer's recommendation as to whether the use of 21AA crushed concrete is an acceptable material.
- D. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural/crushed sand. Generally, either MDOT Class II Sand or 21AA gravel will meet this requirement. Refer to plans and/or Geotechnical Engineer's recommendation as to whether the use of 21AA crushed concrete is an acceptable material.

1. All materials shall meet MDOT Class II requirements and shall be clean granular fill.
 2. The use of on-site materials as engineered fill shall be approved by the Geotechnical Engineer prior to excavation and placement. Coordinate excavation protocols with Geotechnical Engineer to manage existing clay deposits.
 3. Import all fill materials as required to achieve volumes necessary to meet proposed elevations.
- E. Bedding: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural/crushed sand. Generally, either MDOT 3G or 6A will meet this requirement. Bedding materials used for utility installation shall meet the requirements of the local municipal jurisdiction.

PART 3 - EXECUTION

3.1 SITE PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, washout, or undermining caused by earthwork operations.
- B. Provide erosion-control measures to prevent erosion or contamination of soils and discharge of water runoff or airborne dust to adjacent properties, walkways, or bodies of water.

3.2 EXCAVATION GENERAL

- A. Unnecessary Excavation: the expense of excavation of materials outside the limits indicated or administered in writing by the Architect shall be the responsibility of the contractor.
 1. Unnecessary excavation under footings: either deepen footings to bear on actual subgrade elevation without changing top elevations or place concrete fill up to required elevation.
 2. Unnecessary excavation other than under footings: place either compacted fill or otherwise correct conditions, as required by the Architect.
- B. Subgrade Approval:
 1. Notify the Testing Agency when required elevations have been reached.
 2. Should the presence of unforeseen or unsatisfactory materials or factors exist, perform additional excavation and replace with approved compacted fill material in accordance with Geotechnical Engineer or Architect's instructions.
 3. Compensation for unforeseen additional work will be made in accordance with established unit prices or, if none, in accordance with provisions for changes in the work. No payment will be made for correction of subgrades improperly protected against damage from contractor neglect, freeze-thaw or accumulation of water, or for correction of otherwise defective subgrades.
- C. Coordinate excavations with Dewatering operations as required to allow for construction during dry/workable conditions.
- D. Stability: Slope sides of excavations over five feet (5') deep to angle of repose of material excavated; otherwise shore and brace where sloping is not possible either because of space restrictions or stability of material excavated. Maintain sides and slopes of excavations in a safe condition until completion of backfill by scaling, benching, shelving, or bracing. Take precautions to prevent slides or cave-ins when excavations are made in locations adjacent to backfill excavations, and when sides of excavations are subjected to vibrations from vehicular traffic or the operation of machinery or any other source. Remove soft or unstable soil below finish grade elevations and backfill such voids with compacted fill material.
- E. Excavation consists of removal of material encountered to obtain required subgrade elevations.
 1. Excavation for Trench: Cut trench to cross-sections and grades as shown. Deposit excavated materials a sufficient distance from the edge of trench to prevent cave-ins or material from sliding into ditch. Keep trench free of leaves, sticks, and other debris until final acceptance of work.
 - a. Excavate trenches to provide a uniform working clearance width of each side of pipe or conduit.
 - b. Trench walls shall be excavated vertically from top to bottom to 12 inches higher than top of pipe or conduit, unless noted otherwise.
 2. Trench Bottoms:
 - a. Excavate and shape trench bottoms in accordance with details. Excavate trenches a minimum 4 inches deeper than bottom of pipe to allow for bedding course. Remove all

projecting objects or foreign debris along trench subgrade.

- b. Place backfill materials and to compacted densities as noted herein.

3.3 SUBGRADE PREPARATION

- A. Perform mass earthwork operations to remove all existing topsoil and other organic materials in their entirety within the footprint of the proposed pavement and athletic field areas. Refer to Geotechnical Report for additional recommendations for site excavations. Buried objects should be removed in their entirety and backfilled.
- B. Contractor shall notify Testing Agency or Landscape Architect when excavations have reached the required subgrade elevations.
- C. Proof-roll subgrade in the presence of the Testing Agency and Landscape Architect to identify any areas of excessive yielding or soft conditions. Do not perform proof-roll on wet or saturated surfaces.
1. Perform proof roll of subgrade with heavy pneumatic-tired equipment or loaded 10-wheel tandem axle truck weighing not less than 15 tons.
 2. Completely perform proof-roll of subgrade in one direction, repeating in a direction perpendicular to the first direction. Perform any additional proof roll operations deemed necessary by the Testing Agency in order to identify unsatisfactory ground conditions.
 3. As determined by and at the direction of the Testing Agency, excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting. Replace material with engineered fill as directed.
- D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or improper construction activities.

3.4 MATERIAL STORAGE

- A. Export and dispose of all excavated materials classified as deemed unsatisfactory by the Testing Agency.
- B. Stockpile any imported materials and satisfactory excavated soil materials. Do not intermix new with excavated materials unless deemed allowable by the Testing Agency. Place, grade, and shape stockpiles to drain surface water and keep away from edge of excavations. Cover materials as necessary to prevent water or wind erosion of materials.

3.5 BACKFILL GENERAL

- A. Contractor shall ensure the following items have been completed prior to placement and compaction of backfill materials:
1. Survey locations of underground utilities for record documents.
 2. Inspect and test underground utilities as necessary.
 3. Remove concrete form work.
 4. Remove trash and debris.

3.6 SITE PREPARATION

- A. Remove vegetation, debris, unsatisfactory soil materials, obstruction and deleterious materials from ground surface prior to placement of fills.
- B. Plow, scarify, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- C. Place and compact fill materials in layers to required elevations as follows:
1. Under grass, planted, and landscape areas: use satisfactory soil material.
 2. Under walks and pavements: use satisfactory soil material as long as the Geotechnical Engineer deems material to be suitable and compactions requirements can be achieved.
 3. Under steps and ramps: use engineered fill
 4. Behind retaining walls: use engineered fill
 5. Under footings and foundations: use engineered fill
 6. Over excavated areas: use engineered fill

3.7 MOISTURE CONTROL

- A. Do not place backfill or fill material on surfaces that are muddy, or frozen, or contain frost or ice.
- B. Uniformly moisten or aerate subgrade and each subsequent fill or backfill later before compaction to within two (2) percent of optimum moisture content.

3.8 COMPACTION

- A. Place backfill materials in layers not more than eight inches (8") in 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. Thoroughly compact all fill and backfill by rolling each layer, following spreading, as closely as possible. Roll the areas in equal amounts in two directions. Provide compaction equipment or type best suited to achieve the desired results with the type of soil. In general, use sheeps foot and/or tamping type rollers on soils of a cohesive type; pneumatic wheeled or vibrating rollers on granular fill material, all as approved by the Landscape Architect. Operate compacting equipment on each layer until the entire area has been thoroughly and uniformly compacted to the required density.
- C. Compact soil to not less than the following percentages of maximum dry density weight according to ASTM D1557 and ASTM D698
 - 1. Under lawn or unpaved areas, scarify and recompact top six (6) inches below subgrade and compact each layer at eighty-five percent (85%).
 - 2. Under walkways, scarify and recompact top six (6) inches below subgrade and compact each layer at ninety-five percent (95%).
 - 3. Under structures, building slabs, steps, and pavements, scarify and recompact top twelve (12) inches of existing subgrade and compact each layer at ninety-five percent (95%).

3.9 GRADING

- A. General: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with all compaction requirements and grade to cross-section, lines, not more than 0.10 feet above or below a subgrade elevation.
 - 1. Provide a smooth transition between existing grades and new grades.
 - 2. Fine grade sub-soil systematically to eliminate uneven areas and low spots and trim high spots. Remove debris, roots, branches, stones, etc., in excess of two inches (2") in size.
 - 3. Contractor shall confirm that the proposed grades shown on the plans will not create a ponding water condition (i.e. an unintended low spot of less than 1%).

3.10 LINES AND DRAINAGE SWALES

- A. Synthetic Turf: the plans indicate lines, grades and elevations of the finish work. In general, areas to be turfed shall be excavated, filled, and graded to the bottom elevations of drainage aggregate.

3.11 FIELD QUALITY CONTROL

- A. Testing Agency: The Owner shall engage a qualified independent Geotechnical Engineering Testing Agency to perform quality-control testing as identified.
- B. Allow Testing Agency to inspect and to test subgrades and each fill or backfill layer. Contractor may proceed with subsequent earthwork only after test results for previously completed work has been have authorized to allow to proceed.
- C. When Testing Agency reports that subgrades, fills, or backfills have not achieved required compaction, scarify and moisten or aerate and remove/replace soil to depth required. Recompact and retest until specified compaction has been achieved.

3.12 DEBRIS

- A. Unless noted otherwise, all debris is to be disposed off Owner's property. This includes surplus satisfactory soil or waste materials and unsatisfactory trash or debris. Burning of materials on the Owner's property is strictly prohibited.

END OF SECTION

SECTION 31 3219 – GEOTEXTILE FABRIC

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section is a part of the entire set of Contract Documents and shall be coordinated with the applicable provisions of the other parts.

1.2 SCOPE

- A. The work under this section shall consist of furnishing all labor, materials and equipment for the installation of the geotextile fabric.

1.3 SUBMITTALS

- A. Manufacturer's Literature: Furnish to Landscape Architect, when required, copies of manufacturer's specifications, and installation instructions for geotextile fabric. Include photographs, catalogue cuts, samples as may be required to show compliance with these specifications.

PART 2 - PRODUCT

2.1 GEOTEXTILE FABRIC

- A. The product shall be AMOCO CEF2006, Mirafi - 600x, LINQ Industrial Fabrics - GTF-300, CSI Geoturf - W315 or an approved equivalent.
- B. The geotextile shall be of woven construction and consist of long-chain polymeric yarns. The yarns must be composed of at least 95% propylene or ester polymers. The fibers shall be produced in a manner which achieves a stable network. The geotextile shall conform to the mechanical and hydraulic property requirements listed below:

MINIMUM AVERAGE

<u>PROPERTY</u>	<u>VALUE</u>	<u>UNIT</u>	<u>TEST PROCEDURE</u>
Grab Tensile Strength	315	lbs.	ASTM D-4632
Grab Tensile Elongation	15	%	ASTM D4632
Wide Width Tensile	175/175	lbs/in	ASTM D4595
Wide Width Elongation	15/8	%	ASTM D4595
Mullen Burst	600	Psi	ASTM D3786
Puncture	145	lbs	ASTM D4833
Trapezoidal Tear	120	lbs	ASTM D4533
UV Resistance	70	% @ 500 hr	ASTM D4355
Apparent Opening Size (max)	40	AOS	ASTM D4751
Permitivity	.055	1/sec	ASTM D4491
Flow Rate	4.0	gpm/ft2	ASTM D4491

PART 3 – EXECUTION

3.1 INSTALLATION

- A. The geotextile fabric shall be furnished and stored in a wrap which will protect the geotextile fabric from ultraviolet radiation and abrasion. The geotextile fabric shall be covered with the appropriate soil cover within two weeks of its placement.
- B. Should the geotextile fabric be damaged during construction, the torn or punctured section shall be repaired by placing a piece of fabric that is sufficiently large enough to cover the damaged area plus two feet (2') of adjacent undamaged geotextile fabric in all directions.
- C. Fabric shall be installed on dry soil as per manufacturer.
- D. Overlap the fabric as recommended by the manufacturer.
- E. Installation and Unit Price shall include overlap quantities.

END OF SECTION

SECTION 32 1123 – AGGREGATE DRAINAGE LAYER

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section is a part of the entire set of Contract Documents and shall be coordinated with the applicable provisions of the other parts.
- B. Related Sections:
 - 1. Section 31 2010 Earthwork – Turf

1.2 SCOPE

- A. The work under this section of the specification shall consist of furnishing all labor, materials and equipment to produce, place, spread, compact and finish to proper grade and cross section all aggregate base courses according to the drawings and specifications.

1.3 QUALITY ASSURANCE

- A. Reference Standards: American Society for Testing and Materials (ASTM):
 - C117 Method for Materials Finer than 75-m (No. 200) Sieve in Mineral Aggregates by Washing
 - C136 Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
 - F1551 Comprehensive Characterization of Synthetic Turf Playing Surfaces and Materials
 - F2898-11 Standard Test Method for Permeability of Synthetic Turf Sports Field Base Stone and Surface System by Non-confined Area Flood Test Method
- B. Contractor shall have previously installed ten (10) artificial infill turf bases for turf fields larger than 80,000 square feet in the last three (3) years.
 - 1. The contractor is responsible for fine grading, installation of the perimeter nailing system (as necessary), and installation of the dynamic stone base.
- C. Firms must have been in business under the same ownership for at least five (5) years and shall have been installing similar sports fields for that entire period.
- D. Contractor shall provide a sieve analysis prior to placement for every 150 ton of stone delivered to site. Material should be tested by a third-party construction testing firm administered through the project.
- E. Contractor will be required to provide product pit tickets to designated Owner's Representative for each load of material brought to and intended for job to ensure conformance to the approved Sieve Analysis. Material non-compliant with approved submittal shall be rejected.
- E. The synthetic turf manufacturer/installer shall perform an inspection of the field base onto which the synthetic turf system is to be installed to examine the finished surface for required compaction, permeability and grade tolerances. Earthwork contractor is responsible for correcting deficient items noted by the turf manufacturer/installer prior to acceptance. The turf installer will accept the aggregate stone base in writing when the Owner's representative provides test results for compaction, permeability and planarity that are in compliance with the project plans and specifications. After any discrepancies between the required materials, application and tolerance requirements noted have been corrected, the synthetic turf installer should submit a written certification of acceptance of the base for installation of synthetic turf system.

1.4 SUBMITTALS

- A. Submit to the Landscape Architect a sieve analysis of the proposed stone to be installed. Sieve analysis shall be dated within 14 days of submission.

1.5 ACCEPTABILITY OF THE WORK

- A. Grade: Grade conformance tests shall be conducted on the entire surface. The surface shall have positive drainage of 0.50% inclination.
- B. Planarity: After completion of the compacting operations, the compacted aggregate base shall be tested with a 10' straightedge. Measurements shall be made perpendicular to and across the field at a distance not to exceed 25' feet. The grade will not vary by 1/8" from proposed grades, elevations and slopes provided.
- C. The grade of the aggregate base shall be evaluated with a "string test". The contractor shall identify, with paint, every 5 yd line, in-bound lines, side line, touch line and end lines.

- D. Aggregate shall be tested as per ASTM F1551-09 or ASTM 2898-11 at a minimum of 8 locations after final grade as been achieved and accepted.
- E. Foresite Design commits to being onsite for a maximum 3 hours during string check. Any additional time required will be billed as an Additional Service to be compensated by the Base Contractor or Construction Manager. Hourly rates are between \$125 - \$150 depending on which personnel are present.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aggregate base material shall conform to specifications for 100% crushed 100% limestone and shall be placed and compacted to the minimum depth shown on plans. Crushed concrete, slag, etc. shall not be allowed. DOT standard classifications do not conform. Modifications of standard DOT aggregate classification maybe required to meet specification. On-site mixing will not be an acceptable method for providing this material.

<u>Aggregate Sieve Analysis</u>	<u>Percent Passing</u>	
	Base Material	Finishing Stone (Not to exceed 1" compacted depth)
1 1/2"	90-100	
1"	75-100	
3/4"	65-95	100
3/8"	40-75	85-100
1/4"	25-65	75-100
No. 4	15-60	60-90
No. 8	0-40	35-75
No. 16	0-20	10-55
No. 30	0-7	0-40
No. 60	0-5	0-15
No. 100	0-3	0-8
No. 200	0-2.0	0-2.0
LBW	Maximum 2.5	Maximum 2

- B. The hydraulic conductivity of the aggregate shall be such that is capable of draining the entire synthetic surface at a minimum of 10"/hr for the carpet and 14"/hr including aggregate drainage stone with perforated under drain system acting as the main water displacement conductor. The aggregate shall maintain its finished grade elevations. Migration of fines and subsequent loss of finished tolerances will not be accepted.
- C. Material shall be tested by a testing agency selected by the Owner to ensure compliance with the submitted documentation (ASTM D422 particle size analysis and ASTM 2898 or F1551-09/DIN 18-035:6, permeability to water). A minimum of 8 tests shall be performed at random locations selected by Owner's representative.

PART 3 - EXECUTION

3.1 SUB-GRADE CONSTRUCTION

- A. The sub-grade shall be so constructed as to have uniform stability for a width at least equal to that of the proposed improvements plus of the proposed anchoring system. It shall be brought to an elevation and cross section such that, after being rolled, the surface will be at the required elevation. At the time

the sub-grade is prepared, the fill area shall have been constructed to the full width and to at least the elevation of the finished sub-grade.

- B. The material present in the next six (6) inches below the elevation of the sub-grade shall be scarified, mixed and recompact, or otherwise treated to produce a uniform condition. Stones over four (4) inches in size shall be removed from the loosened portion of the sub-grade and disposed as directed by the project representative.
- C. Depressions that develop during the following shall be filled with suitable material, and the rolling shall continue until the sub-grade is uniformly firm, properly shaped and substantially true to grade and cross section. It shall be so maintained until the pavement is place.
- D. Material, other than sand, which will not compact readily under roller shall be removed and replaced with material which will compact readily and that portion of the sub-grade shall be rolled again.
- E. The rolling of the sub-grade shall extend for at least twelve (12) inches outside of each edge of the proposed turf boundaries when possible. Piles or ridges of earth or material that would seriously interfere with the operations of finishing the pavement shall not be left on the shoulders.
- F. During the process of construction sub-grade, the soil shall be maintained in a condition sufficiently moist to facilitate compaction and produce a firm, compact surface.
- G. If, in the preparation of the sub-grade, it becomes necessary to excavate below the elevation of the earth shoulders, ditches or drains shall be provided at frequent intervals to permit ready drainage of surface water from sub-grade to side ditches.
- H. If ruts or other objectionable irregularities form in the sub-grade during construction, the Contractor shall reshape and re-roll the sub-grade before the drainage course is laid. The material used for filling ruts or other depressions shall be of such character as to make it equally desirable for sub-grade purposes as the material presented in the sub-grade.
- I. When the sub-grade is being prepared for placement as an aggregate base course, the elevation of the most finished surface, at the time the next layer is placed, shall not vary by more than 0.02 foot above or below the prescribed elevation at any point where measurement is made.

3.2 AGGREGATE DRAINAGE COURSE

- A. Base course construction shall proceed as follows only after the qualified testing firm has approved the sub-grade construction and the gravel tests.
- B. The base shall be constructed in layers of not more than three (3) inches (75mm) compacted thickness when conventional rolling equipment is used.
- C. If vibratory or other approved special equipment is used, the thickness of every compacted layer may be increased to a maximum of eight (8) inches (200mm).
- D. The finished surface of any aggregate drainage layer shall not vary more than 1/8" from the elevations, grades and cross sections on the drawings.
- E. Compacted full profile aggregate drainage stone base dimensions shall be a minimum of 8". The thickness of the finishing stone shall not exceed one (1) inch of compacted depth.
- F. It shall be the contractor's responsibility to maintain a uniform consistent stone base gradation during the installation process. This shall include but not limited to keeping aggregate base at optimum moisture content (5%, \pm 1%) and/ or providing, placing, and compacting a 1/2 " layer of stone chips.
- G. Installation shall be accomplished using automated laser grade control, equipment, with dual-slope capabilities.
- H. Prior to calling for grade verification from Landscape Architect, the contractor shall have a registered land surveyor establish and set PK nails at the following locations:
 - 1. Back of end zone.
 - 2. Goal line.
 - 3. Every 5 yard line.
 - 4. Football side line
 - 5. Soccer touch line
- I. PK nails, or equivalent, shall be placed on turf nailer system. Do not set flush into nailer. Allow enough to loop grade line onto nail for grade verification. String Check.
- J. Contractor shall have on-site, prior to Landscape Architect arrival, the following equipment:
 - 1. One (1) ton steel drum rover – rubber tired equipment not acceptable.
 - 2. 50 ton 3/8" stone chips.

3. Topdresser – to distribute 3/8" stone chips.
 4. Two (2) 48"/38" aluminum landscape rakes.
 5. 24" wide broom.
 6. There must be enough personnel to operate all equipment simultaneously.
- K. It will be the contractor's obligation and responsibility to have all of the above items in place prior to grade verification by Landscape Architect.

3.3 COMPACTION REQUIREMENTS

- A. Sub-grade shall be compacted to not less than ninety-two percent (92%) of maximum density at not less than seventy-five percent (75%) of optimum moisture content.
- B. Aggregate drainage layer shall be compacted to not less than eighty-five percent (85%) of maximum density. Using conventional rolling equipment, moisture content shall not be less than ninety percent (90%) nor more than one hundred-ten percent (110%) of optimum moisture content. Using vibrating equipment, moisture content shall not be less than seventy-five (75%) of optimum moisture content.
- C. Maximum density shall be determined in accordance with AASHTO Modified Method of Test for the Compaction and Density of Soil, Designation T-180, and the optimum moisture content shall be that corresponding to the maximum density in the above test.
- D. Contractor shall maintain optimum moisture content during the installation, (placement, grading, compacting, etc.) of the aggregate base materials.

3.4 ROLLERS

- A. Smooth steel-wheeled rollers shall be self-propelled and have a total weight not less than 8 tons. The compression (driving) roller shall exert a pressure of not less than 250 lbs. per inch width of the roller.
- B. Pneumatic-tire rollers shall have a compacting width of sixty (60) inches (1.5m) or more and shall be capable of varying the weight from 100 to 250 lbs. per inch of rolling width.

END OF SECTION

SECTION 32 1809 – SYNTHETIC TURF – BATTING CAGE & BULLPEN

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section is a part of the entire set of Contract Documents, including General and Supplementary Conditions. Drawings shall be coordinated with the applicable provisions of the other parts.
- B. Related Sections:
 - 1. Section 03 3000 Cast in Place Concrete - Athletics

1.2 SYSTEM DESCRIPTION

- A. Provide all labor, materials, equipment, and tools necessary for the complete installation of non-infilled synthetic grass as shown on plans. The system shall consist of, but not necessarily be limited to, the following:
 - 1. A complete synthetic turf system consisting of 8,400 denier monofilament nylon fibers along with an extruded nylon root zone. Pile height shall be nominal 1.25". Fibers shall be tufted to a primary backing and a mechanically applied 8 mm thick adhesive secondary backing.
- B. Performance Requirements:
 - 1. Shock Attenuation (ASTM F1292):
 - a. Gmax: Less than 200
 - b. Flammability (ASTM D2859): Pass
 - c. Water Permeability: >20"/hr.
 - d. Accessibility: Comply with requirements of ASTM F1951

1.3 QUALITY ASSURANCE AND REFERENCE STANDARDS

- A. Following acceptance of bids and evaluation of all product related information submitted with bid and requested additionally, the Owner reserves the right to award to the Contractor based on factors other than low bid.
- B. Passes the Federal Flammability Standard DOC FF 1-70
- C. All finished installations shall conform to all applicable current ASTM guidelines.
- D. Qualifications: Utilize an installer approved and trained by the manufacturer of the surfacing system, having experience with other projects of the scope and scale of the work described in this section.
- E. Certifications: Certification by manufacturer that installer is an approved applicator of the surfacing system.

1.4 SUBMITTALS

- A. All submittals shall be provided within 14 days after Notice to Proceed.
- B. General: Submit listed submittals in accordance with Conditions of the Contract and Submittal Procedures Section.
- C. Product Data: Submit manufacturer's product data and installation instructions.
- D. Verification Samples: Submit manufacturer's standard verification samples of 6" x 9" minimum.
- E. Quality Assurance/Control Submittals: Submit the following:
 - 1. Certificate of qualifications of the playground surfacing installer.
- F. Closeout Submittals: Submit the following:
 - 1. Warranty documents specified herein.

1.5 DELIVERY, STORAGE & HANDLING

- A. General: Comply with Product Requirement Section.
- B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at a minimum temperature of 40 degrees F (4 degrees C) and a maximum temperature of 90 degrees F (32 degrees C).

1.6 PROJECT/SITE CONDITIONS

- A. Environmental Requirements: Install surfacing system when minimum ambient temperature is 40 degrees F (1 degree C) and maximum ambient temperature is 90 degrees F (32 degrees C). Do not install in steady or heavy rain.

1.7 WARRANTY

- A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.

B. Manufacturer's Warranty: Refer to PART 4 - WARRANTY

PART 2 - PRODUCTS

2.1 MATERIALS - SYNTHETIC GRASS

- A. Basis of Design Synthetic Turf Material: Monofilament nylon fibers with nylon root zone and attached cushion.
1. A complete synthetic turf system consisting of monofilament polypropylene fibers with a texturized polypropylene secondary fiber. Pile height shall be nominal 0.5625". Fibers shall be tufted to a primary backing and a mechanically applied 5 mm thick adhesive secondary foam backing.
 2. The tufted primary fiber shall not weigh less than 36 oz/yd² and the secondary (texturized) fiber shall not weigh less than 36 oz/yd². The total fiber weight shall not be less than 71 oz/yd² and the total product weight, including foam pad, shall not be less than 118 oz/yd². The tufted rows of fiber are to be spaced no more than 1/2" apart. ASTM tests proving the fiber meets these qualifications must be provided with the bid.
 3. The carpet's primary backing shall be comprised of three layers (18 pic polypropylene, 13 pic polypropylene, reinforced by a non-woven PET cap fiber layer). This backing is to have a minimum weight of 7 oz per square yard. The carpet shall then be coated with a secondary backing of synthetic coating and foam material with a minimum application rate of 78 oz/yd².
 4. The pile surface shall provide good traction in all types of weather with the use of conventional sneaker type shoes, composition mold sole athletic shoes, baseball spikes and screw-on football spikes.
 5. The pile surface shall be suitable for both temporary and permanent line markings using acrylic paint, as per the turf provider's recommendations.
 6. All adhesives used in bonding the seams shall be resistant to moisture, freeze/thaw, bacteria and fungus attacks, and resistant to ultraviolet radiation. The adhesive shall be made especially for the adhesion of synthetic turf seams.
 7. The adhesive system shall have been utilized on at least 25 full installations. It shall consist of a factory-made adhesive bed applied to a non-woven fabric seaming tape. The adhesive bed shall be a metered amount suitable for the application. It shall be heat and pressure activated. A special heat application machine and pressure application using weighted rollers is mandatory.

PART 3 - EXECUTION

3.1 CERTIFICATION OF BASE CONSTRUCTION

- A. GENERAL: A written "Certification of Acceptance of the Base Construction" is required from the artificial turf/surfacing system prior to proceeding with any installation work under this section of the specifications.
- B. All discrepancies between the required materials, application and tolerance requirements noted by the installer shall be brought immediately to the attention of the Contractor and Landscape Architect. Failure to immediately inform the contractor and Landscape Architect of any prior work which does not meet the required specifications for installation of the artificial turf surfacing system shall be considered an acceptance by the installer of the non-conforming work. Any additional work later required to bring the base to acceptable conditions shall be preformed by this installer at no additional cost to the Owner. Any discrepancies in the prior work which does not meet the specifications and noted in writing to the Owner and Landscape Architect shall be preformed immediately at no additional cost to the Owner.

3.2 INSTALLATION OF THE TURF

- A. GENERAL: All installation shall be done in strict accordance with the manufacturer's current printed installation instructions approved by the Landscape Architect.
- B. REPLACEMENT: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Landscape Architect and at no additional cost to the Owner.
- C. SYNTHETIC GRASS: Place turf and cut to fit configuration as shown on Drawings. Splice seams. All seams must be attached with splicing film/fabric and adhesive as approved by the manufacturer for this type of installation of their product.

- D. ANCHORING/EDGING: Edges of turf will be secured to ground with adhesive, mechanical fasteners, stakes or edging.
- E. BONDING OF MATERIAL SURFACES: The adhesive bonding of all system material components shall provide a permanent, tight, secure and hazard free playing surface.
- F. WORK QUALITY: All seams shall be flat and tight, with no separation or fraying. Submit seaming procedures to Architect for review, prior to installation. Any deviations to the plans shall be brought to the attention of the Architect prior to installation, Seams that appear separated shall be corrected immediately.

3.3 CLEANING

- A. Contractor shall be responsible for clean up on a daily basis of all materials utilized. Upon completion of installation, all surrounding areas, including turf area, shall be clean and in "play" condition.
- B. Contractor shall utilize magnetic bar to remove any metal objects within the field prior to infill and after infill, before final acceptance.
- C. All turf remnants of desirable size shall become property of the Owner. Contractor will be responsible to neatly place attic stock on pallets and deliver to a suitable location as directed by Owner.

PART 4 – WARRANTY

4.1 WARRANTY

- A. Manufacturer 10 year limited product warranty on turf from the date of purchase. The product shall be free from defects in material and workmanship resulting in premature wear or color loss.
- B. Supplier's warranty excludes: any Product defect, damage or failure that is the direct result of Product abuse, misuse or negligent maintenance; and Product damage caused directly or indirectly by acts of third parties, including, without limitation, negligence of owner/operator, vandalism, machinery, animals, flood, chemical reaction, improper sub- surface preparation and/or installation, improper cleaning methods, and acts of God.

END OF SECTION

SECTION 32 1811 – SYNTHETIC TURF – LANDSCAPE

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section is a part of the entire set of Contract Documents, including General and Supplementary Conditions. Drawings shall be coordinated with the applicable provisions of the other parts.
- B. Related Sections:
 - 1. Section 32 1123 Aggregate Drainage Layer

1.2 SYSTEM DESCRIPTION

- A. Provide all labor, materials, equipment, and tools necessary for the complete installation of landscape synthetic grass as shown on plans. The system shall consist of, but not necessarily be limited to, the following:
 - 1. Synthetic grass consisting of fibers that are nominal 1-5/8". Turf fiber construction consisting of polyethylene monofilament and texturized thatch fibers tufted to a 2- layer stabilized woven polypropylene fabric (primary backing), with a secondary backing (stitch binder) of urethane.
 - 2. Silica sand may be provided as a ballast layer per manufacturer's recommendations.
- B. Performance Requirements:
 - 1. Shock Attenuation (ASTM F1292):
 - a. Gmax: Less than 200
 - b. Head Injury Criteria: Less than 1000
 - c. Flammability (ASTM D2859): Pass
 - d. Water Permeability: >45"/hr.
 - e. Accessibility: Comply with requirements of ASTM F1951
- C. Work included in this Section includes grading necessary to shape and drain the area and base preparation and installation of the synthetic grass in areas shown on Drawings.

1.3 QUALITY ASSURANCE AND REFERENCE STANDARDS

- A. Bidders shall submit a color roll of standard manufacturer colors with their bid.
- B. Following acceptance of bids and evaluation of all product related information submitted with bid and requested additionally, the Owner reserves the right to award to the Contractor based on factors other than low bid.
- C. ASTM F1292 Standard Specification for Impact Attenuation of Surface Systems Under and Around Playground Equipment
- D. ASTM F1492 Standard Consumer Safety Performance Specification for Playground Equipment for Public Use
- E. ASTM F1951 Standard Specification for Determination of Accessibility of Surface Systems Under and Around Playground Equipment.
- F. ASTM F2223 Standard Guide for ASTM Standards on Playground Surfacing
- G. Passes the Federal Flammability Standard DOC FF 1-70
- H. All finished installations shall conform to all applicable current ASTM guidelines.
- I. Qualifications: Utilize an installer approved and trained by the manufacturer of the playground surfacing system, having experience with other projects of the scope and scale of the work described in this section.
- J. Certifications: Certification by manufacturer that installer is an approved applicator of the playground surfacing system.

1.4 SUBMITTALS

- A. All submittals shall be provided within 14 days after Notice to Proceed.
- B. General: Submit listed submittals in accordance with Conditions of the Contract and Submittal Procedures Section.
- C. Product Data: Submit manufacturer's product data and installation instructions.
- D. Verification Samples: Submit manufacturer's standard verification samples of 6" x 9" minimum.
- E. Quality Assurance/Control Submittals: Submit the following:
 - 1. Certificate of qualifications of the playground surfacing installer.
- F. Closeout Submittals: Submit the following:
 - 1. Warranty documents specified herein.

1.5 DELIVERY, STORAGE & HANDLING

- A. General: Comply with Product Requirement Section.

- B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at a minimum temperature of 40 degrees F (4 degrees C) and a maximum temperature of 90 degrees F (32 degrees C).

1.6 PROJECT/SITE CONDITIONS

- A. Environmental Requirements: Install surfacing system when minimum ambient temperature is 40 degrees F (1 degree C) and maximum ambient temperature is 90 degrees F (32 degrees C). Do not install in steady or heavy rain.

1.7 WARRANTY

- A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.
- B. Manufacturer's Warranty: Refer to PART 4 - WARRANTY

PART 2 - PRODUCTS

2.1 MATERIALS - SYNTHETIC GRASS LANDSCAPE SURFACE

- A. Basis of Design: SynLawn 648, or approved equal.
- B. Synthetic grass minimum requirements:
 - 1. Face Weight: 65 oz/sy
 - 2. Face Yarn Type: Polyethylene
 - 3. Grass Zone Denier: 12000/6
 - 4. Grass Zone Color: Field/Clover
 - 5. Thatch Zone Denier: 5040/12
 - 6. Thatch Zone Color: Light Beige
 - 7. Pile Height: 1 5/8 inches
 - 8. Tufting Gauge: 1/2"
 - 9. Primary Backing: 2-part 13/18 6 oz. Polypropylene
 - 10. Secondary Backing: Enviroloc™ 20 oz.
 - 11. Total Product Weight: 91 oz/sy
 - 12. Finished Roll Width 15 feet
- C. Silica Sand:
 - 1. Round, uniformly-sized pure silica sand
 - 2. Sized between US Sieve 20 to 40

PART 3 - EXECUTION

3.1 CERTIFICATION OF BASE CONSTRUCTION

- A. GENERAL: A written "Certification of Acceptance of the Base Construction" is required from the artificial turf/surfacing system prior to proceeding with any installation work under this section of the specifications.
- B. SCOPE: This certification shall include but not be limited to the acceptance of:
 - 1. The base construction finish surface is completely acceptable for the application of work specified under this section.
 - 2. The materials and method of installation for the aggregate stone base construction is in conformance with the manufacturer's current recommendations for the application of the turf to be installed under this section.
 - 3. The aggregate stone base construction is totally suitable for work to proceed with the assurance that the final installation of the work under this section will result in a high quality athletic sub-base. In order to provide these assurances and the Certificate of Acceptance, the turf system installer shall cooperate and communicate fully, at all times, with the construction manager. This contractor shall inspect the base construction work and verify that conditions and tolerances required for application of the artificial turf system are being met and that the Owner's representative has provided test results for compaction, porosity and planarity.
 - 4. All discrepancies between the required materials, application and tolerance requirements noted by the installer shall be brought immediately to the attention of the Contractor and Landscape Architect. Failure to immediately inform the contractor and Landscape Architect of any prior work which does not meet the required specifications for installation of the artificial turf surfacing system shall be considered an acceptance by the installer of the non-conforming work. Any additional work later required to bring the base to acceptable conditions shall be performed by this installer at no additional cost to the Owner. Any

discrepancies in the prior work which does not meet the specifications and noted in writing to the Owner and Landscape Architect shall be preformed immediately at no additional cost to the Owner.

3.2 INSTALLATION OF THE TURF

- A. GENERAL: All installation shall be done in strict accordance with the manufacturer's current printed installation instructions approved by the Landscape Architect.
- B. REPLACEMENT: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Landscape Architect and at no additional cost to the Owner.
- C. SYNTHETIC GRASS: Place turf and cut to fit configuration as shown on Drawings. Splice seams. All seams must be attached with splicing film/fabric and adhesive as approved by the manufacturer for this type of installation of their product.
- D. INFILL: Apply layers of synthetic grass infill evenly with a spreader and broom the turf fibers with stiff bristle broom to stand fibers up and allow infill to settle into the bottom. Broom in infill approximately 3 1/2 pounds per square foot.
- E. Anchoring/Edging: Edges of turf will be secured to ground with mechanical fasteners, stakes or edging.
- F. BONDING OF MATERIAL SURFACES
 - 1. The adhesive bonding of all system material components shall provide a permanent, tight, secure and hazard free playing surface.
- G. WORK QUALITY: All seams shall be flat and tight, with no separation or fraying. Submit seaming procedures to Architect for review, prior to installation. Any deviations to the plans shall be brought to the attention of the Architect prior to installation, Seams that appear separated shall be corrected immediately.

3.3 CLEANING

- A. Contractor shall be responsible for clean up on a daily basis of all materials utilized. Upon completion of installation, all surrounding areas, including turf area, shall be clean and in "play" condition.
- B. Contractor shall utilize magnetic bar to remove any metal objects within the field prior to infill and after infill, before final acceptance.
- C. All turf remnants of desirable size shall become property of the Owner. Contractor will be responsible to neatly place attic stock on pallets and deliver to a suitable location as directed by Owner.

PART 4 – WARRANTY

4.1 WARRANTY

- A. Manufacturer 10 year limited product warranty on turf from the date of purchase. The product shall be free from defects in material and workmanship resulting in premature wear or color loss.
- B. Supplier's warranty excludes: any Product defect, damage or failure that is the direct result of Product abuse, misuse or negligent maintenance; and Product damage caused directly or indirectly by acts of third parties, including, without limitation, negligence of owner/operator, vandalism, machinery, animals, flood, chemical reaction, improper sub- surface preparation and/or installation, improper cleaning methods, and acts of God.

END OF SECTION

SECTION 32 1815 – SYNTHETIC TURF – MULTI-PURPOSE

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section is a part of the entire set of Contract Documents, including General and Supplementary Conditions. Drawings shall be coordinated with the applicable provisions of the other parts.
- B. Related Sections:
 - 1. Section 32 1123 Aggregate Drainage Layer

1.2 SCOPE OF WORK

- A. The work under this section includes the following:
 - 1. Furnish all labor, materials and equipment, necessary for the complete installation of a multi-purpose synthetic turf system.
 - 2. Procure and install infill material
 - 3. Pre and Post Installation Testing
 - 4. Warranty Guarantees
 - 5. Maintenance Equipment
 - 6. Installation of synthetic grass surfacing system shall include all incidental work required to complete the work described herein, as shown on the Drawings, and included in related Specifications.

1.3 REFERENCES

- A. Reference herein to any technical society, organization, group, or regulation are made in accordance with the following abbreviations, and unless noted or specified otherwise, all work under this Section shall conform to the latest edition as applicable.
- B. American Society for Testing and Materials (ASTM):

D418	Standard Test Method for Testing Pile Yarn Floor Covering Construction
D789	Yarn Melting Point
D1335	Standard Test Method for Tuft Bind of Pile Yarn Floor Coverings
D1577	Standard Test Method for Linear Density of Textile Fiber
D1682	Standard Method of Test for Breaking Load and Elongation of Textile Fabrics
D2256	Standard Test Method for Tensile Properties of Yarns by the Single-Strand Method (breaking Strength and Elongation)
D2859	Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials
D3218	Standard Test for Fiber Thickness (Microns)
D4491	Water Permeability of Geotextiles by Permittivity
D5034	Standard Test Method of Breaking Strength and Elongation of Textile Fabrics (Grab Test)
D5035	Standard Test Method for Breaking Force and Elongation of Textile Fabrics (Strip Method)
D5848	Standard Test Method for Mass Per Unit Area of Pile Yarn Floor Covering
F355	Standard Test Method for Impact Attenuation of Playing Surface Systems and Materials
F1015	Standard Test Method for Relative Abrasiveness of Synthetic Turf Playing Surfaces
F1551	Comprehensive Characterization of Synthetic Turf Playing Surfaces and Materials
F1936	Standard Specification for Impact Attenuation of Turf Playing Systems as Measured in the Field
F2117	Standard Test Method for Vertical Rebound Characteristics of Sports Surface/Ball Systems; Acoustical Measurement
F2765	Standard Specification for Total Lead Content in Synthetic Grass Fibers

- C. Federation Internationale de Football Association (FIFA)

FIFA 09/EN 13672	Simulated Wear/Abrasion Resistance
EN ISO 20105-A02	Artificial Weathering (3,000 hours UVA)
EN 13864	Artificial Weathering (3,000 hours UVA) Pile Yarn Tensile Strength

- D. National Collegiate Athletic Association (NCAA)
- E. National Federation of State High School Associations (NFHS)
- F. Michigan High School Athletic Association (MHSAA)
- G. Synthetic Turf Council (STC)
- H. American Sports Builders Association (ASBA)

1.4 **QUALITY ASSURANCE**

- A. In the event conflicts exist between information contained in this Specification and in other parts of the Contract documents, Bidder shall assume that the more stringent and highest performing solution is required.
- B. Following acceptance of bids and evaluation of all product related information submitted with bid and requested additionally, the Owner reserves the right to award based on factors other than low bid.
- C. Manufacturer Qualifications:
 - 1. Have not had a Surety or Bonding Company finish work on any contract within the last five (5) years.
 - 2. Have not been disqualified or barred from performing work for any public Owner or contracting entity.
 - 3. Shall have documented financial strength to fully service and warrant the systems installed. An audited financial statement for the past fiscal year shall be provided upon the request of the Owner or Landscape Architect.
 - 4. Must be a member in good standing of the Synthetic Turf Council (STC) and/or American Sports Builders Association (ASBA). Prospective bidder shall employ one ASBA Synthetic Turf Certified Field Builder.
 - 5. All products and installation methods shall meet or exceed the current guidelines of the NFHS, NCAA, all applicable ASTM State and Federal Standards, and all current guidelines set forth by the Synthetic Turf Council.
 - 6. Prospective bidder must be experienced in the manufacturing of infilled synthetic turf systems. Turf Manufacturer/Installer shall have fifty (50) fields in the last (5) five years of the same synthetic turf system being proposed with the same manufacturer, product and infill proposed for this project. This includes the fiber, backing, the secondary backing and installation method.
 - 7. Product shall meet the following criteria:
 - a. Have a NCAA Division 1 football field installed with parallel slit or monofilament fiber product.
 - b. Have a football field of 85,000 sq. ft. or more of the exact specified material, including the infill material and fiber, in play for at least two years with the same turf manufacturer and company proposed for this field.
 - c. Verification that provider meets these requirements shall be included with Bid.
- D. Installer Qualifications:
 - 1. The Turf Contractor must provide competent workmen skilled in the installation of synthetic turf material, including, but not limited to, gluing or sewing seams, gluing inlays, proper installation of the infill material, and competency in installing performance shock pads (if required). The Installer shall have a representative onsite to certify the installation and warranty compliance.
 - 2. The assigned designated Supervisory Personnel on the project must be certified, in writing by the Turf Manufacturer, as competent in the installation of the proposed material. Should there be a change in the assigned designated Supervisory Personnel, the Owner and/or Landscape Architect shall be notified in writing within 48 hours of change.

3. Supervisory Personnel shall remain onsite at all times during the installation.
4. The installer shall provide documentation for the following: Fifteen (15) reference projects consisting of Synthetic Multi-Sport Grass Fields of 75,000 square-feet or larger within the past three (3) years which details the following criteria:
 - a. Project Name and Location
 - b. Project Scope
 - c. Construction timeline
 - d. Construction Cost
 - e. Reference name, title, affiliation, and contact information
- E. Pre-Installation Field Verification:
 1. Base Acceptance:
 - a. The synthetic turf manufacturer and/or installation contractor shall perform an inspection of the field base onto which the synthetic turf system is to be installed and to examine the finished surface for required compaction, permeability and grade tolerances.
 - b. Upon correction of any discrepancies between the required materials, application and tolerance, the Owner's representative shall provide test results for compaction, permeability and planarity that are in compliance with the project plans and specifications. The turf installer shall accept the aggregate stone base via a written certification of acceptance of the base for installation of subsequent layers of the synthetic turf system.
 - c. The acceptance of the base construction should be included in the certification for warranty validation.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Properly store all materials in accordance with manufacturer's recommendations.
 1. Deliver products in original, unopened packaging with manufacturer's identification clearly legible. All products shall be received by Contractor.
 2. All materials shall be stored in a location directed by the Owner and acceptable to the Contractor.
 3. Protect materials from puncture, dirt, grease, water, moisture, mechanical abrasion, excessive heat or cold, or other damaging circumstances.
- B. Upon delivery and prior to installation of synthetic turf system and materials, Contractor shall inspect the materials as follows:
 1. For damaged or defective items.
 2. Measure synthetic turf roll lengths, perforations, and uniformity of product and color.
 3. Adhesives and seaming tape shall arrive in sealed dry containers or packaging and shall be kept in adequate temperatures per manufacturers written requirements.
 4. Rubber infill shall arrive in sacks or bags without any tears or loose material. Rubber shall arrive dry and loose: no rubber will be accepted that is bulked or solid.
 5. Sand Infill:
 - a. Bagged Material: shall arrive without any tears and shall be free from contamination of site materials.
 - b. Bulk Material: deliver materials in clean, washed and covered trucks to eliminate contamination during transportation. Onsite stockpiling locations shall be coordinated with the Owner. Stockpile only in areas free of debris and away from drainage routes and structures. Cover all materials with plastic or geotextile if materials are to be stockpiled more than 48 hours.
 6. Any material(s) that does not meet minimum specified criteria is grounds for rejection.
- C. At time of delivery, lot numbers for each carpet roll shall be provided to Construction Manager or Owner's Representative to validate carpet supplied. Lot numbers shall be provided as part of close-out documentation.

1.6 SUBMITTALS

- A. Bid Submittals
 1. Proposal package shall include the following information to assist in the preliminary review process:

- a. Manufacturer qualifications/references as noted herein.
 - b. Installer qualifications/references as noted herein.
 - c. Samples of non-infilled turf product for all colors required, minimum 8"x8" in size. Bidders may elect to submit a color roll of standard manufacturer colors with their bid in lieu of individual samples.
 - d. Fiber manufacturer's name, type of fiber and composition of fiber.
 - e. Product being bid meets or exceeds pre-manufacturer testing
 - f. Sample Manufacturer's Warranty and Third-Party Insured Warranty
 - g. Sample insurance policy for the Third-Party Insured Warranty
 2. The following letters, on the submitting company's letterhead and signed by a company officer, shall be submitted with the Bid:
 - a. A letter confirming that the Bid Documents have been completely reviewed by qualified representatives of the submitting company acknowledging that the materials and system proposed are adequate for the applications shown and will not impact the system warranty.
 - b. The Bidder shall provide written documentation that system for which they are bidding, does not violate any known or pending patents for specified products.
- B. Post-Award Submittals**
1. Shop Drawings – Submit the following for approval:
 - a. Complete scaled and dimensional drawing, in full color, showing all field lines, markings, inlays, and boundaries in specified colors required for project. All markings shall be tufted in the factory or field inlaid, unless noted otherwise. Custom logos can be provided by Landscape Architect in AutoCad format to expedite shop drawing process.
 - b. Roll/seaming layout Plan
 - c. Details on field construction, noting any details that may deviate from the Drawings or Specifications including, but not limited to: edge detail, goal post detail, covers for access to subsurface structures, etc.
 2. Provide certified copies of independent (third-party) laboratory testing reports per section 1.7 Quality Control Testing.
 3. Fiber manufacturer's name, type of fiber and composition of fiber.
 4. Proposed infill composition, including pounds of sand and pounds of rubber per square foot. Provide (3) one-pound samples of sand and rubber (in separate bags).
 5. Rubber, with certification of availability, from supplier guaranteeing product supply reserved for the Troy School District. Certification shall include:
 - a. Type and origin of raw material (certify that it comes from tires)
 - b. Production facility
 - c. Production method (cryo or ambient)
 - d. Fiber content (%)
 - e. CRI sieve/gradation analysis
 - f. The provider of the of CRI shall provide in writing that they maintain an ongoing Quality Control program meeting all the standards of the STC Guidelines for CRI Used in Synthetic Turf Fields and capable of meeting all the specifications described herein.
 6. Maintenance Equipment: Submittals shall include: product data specifications, operational instructions, etc.
- 1.7 QUALITY CONTROL TESTING**
- A. All testing services shall be the responsibility of and paid for by the submitting or awarded Contractor, unless noted otherwise. All testing noted herein shall be performed by a third-party testing agency that is ISO 17025 certified and approved by the Landscape Architect.
 - B. Testing by independent laboratory must be for current materials and testing not older than twelve (12) months from project Bid Date.
 - C. Any material tested and found non-compliant with the specifications may be rejected. The Contractor shall be required to submit material that is compliant with the specifications.
 - D. The Owner, or the Landscape Architect on the Owner's behalf, reserves the right to independently test any material. Any testing performed by the Owner will be at the Owner's expense. The

Contractor is responsible to bear the cost of any testing of product found to be non-compliant.
 Contractor will bear the cost of all retesting as required by the Owner.

- E. Pre-Manufacturing Testing: Contractor shall submit to Landscape Architect a copy of the test results certified by the independent Testing Laboratory prior to manufacturing of the synthetic turf for the project. Testing data required is as follows:

SYNTHETIC GRASS YARN		
PROPERTY	TEST METHOD	REQUIREMENT
Pile Height	ASTM D 5823	± 1/8" of specification
Pile Weight	ASTM D 5848	± 5% of specification
Total Weight	ASTM D 5848	± 5% of specification
Tuft Bind (w/o infill)	ASTM D 1335	> 8 lbs
Melting Point	ASTM D 789	> 235 degrees F
Denier	ASTM D 1907	± 10% of specifications
Pill Burn Test	ASTM D2859	8 Passed / 0 Failed
Microns	ASTM D3218	± 10% of specifications
Breaking Strength (length)	ASTM D 5034	> 283 lbs./ft
Breaking Strength (width)	ASTM D 5034	> 200 lbs./ft
Fiber Abrasiveness Index	ASTM F 1015	< 35
Lead Content	ASTM F 2765-09	< 50 ppm
Artificial Wearing (3,000 hours UVA) Turf Color Change	EN ISO 20105-A02	> Gray Scale 3
Artificial Wearing (3,000 hours UVA) Pile Yarn Tensile Strength	EN 13864	< 50% reduction

SYNTHETIC GRASS BACKING MATERIALS		
PROPERTY	TEST METHOD	REQUIREMENT
Primary Backing Weight	ASTM D 5848	± 2 oz./yd ² of specification
Secondary Backing Weight	ASTM D 5848	± 2 oz./yd ² of specification

SYNTHETIC GRASS INFILL MATERIALS		
PROPERTY	TEST METHOD	REQUIREMENT
Safety of Toys Part 3	EN 71-3	Pass
Safety of Synthetic Turf Infill	ASTM F 3188	Pass
Infill Size Gradation	EN 933	
Infill Bulk Density	EN 1097	
Artificial Weathering (3,000 hours UVA) Infill Color Change	EN ISO 20105-A02	> Gray Scale 3

SYNTHETIC GRASS SYSTEM		
PROPERTY	TEST METHOD	REQUIREMENT
Lisport Simulated Wear	EN 13672	> 50,000 passes without splitting

- F. Post Manufacturing/Pre-Shipment Testing: Contractor shall submit to Landscape Architect a copy of the test results certified by the Independent Testing Laboratory prior to shipping of the

synthetic turf product. Any test result not meeting specifications is grounds for rejection of product, in whole or in part. Testing requirements are as follows:

1. Test sample shall be from five random rolls manufactured for this project. Proof of documentation must be provided upon delivery of the carpet to the job site.
2. Test results to identify manufacturer, date of test(s), lab technician, project, lot number, etc.

SYNTHETIC GRASS SURFACING CARPET		
PROPERTY	TEST METHOD	REQUIREMENT
Tuft Bind (w/o infill)	ASTM D 1335	> 8 lbs
Stitch Gauge	ASTM D 5793	< 1/2"
Pile Height	ASTM D 5823	± 1/8" of specification
Pile Weight	ASTM D 5848	± 5% of specification
Total Weight	ASTM D 5848	± 5% of specification
Perforations	Visual	> 3/16" dia., spaced 4" o.c.
Denier	ASTM D 418 or 1907	± 10% of specification
Primary Backing Weight	ASTM D 5848	± 2 oz./yd ² of specification
Secondary Backing Weight	ASTM D 5848	± 2 oz./yd ² of specification
Breaking Strength (length)	ASTM D 5034	> 283 lbs./ft
Breaking Strength (width)	ASTM D 5034	> 200 lbs./ft
Pill Burn Test	ASTM D2859	8 Passed / 0 Failed
Lead Content	ASTM F 2765-09	< 50 ppm

SYNTHETIC GRASS SURFACING SYSTEM (carpet, infill)		
PROPERTY	TEST METHOD	REQUIREMENT
Water Infiltration Rate	ASTM F 1551	> 16 in./hr.
Infill Depth Measurement	EN 1969	± 10% of specification (1/2" exposed fiber)
Impact Attenuation	ASTM F 1936	< 165 G's

- G. Post Installation Testing: Upon substantial completion, the Contractor shall perform a one-time test of the items listed below. Contractor shall submit to Landscape Architect, a copy of these test results, certified by the independent Testing Agency.
1. Testing shall be completed on-site within five (5) days upon completion of the installation.
 2. Following field testing, it shall be the Contractor's responsibility to correct any part of the system deemed non-compliant with the specifications.

SYNTHETIC GRASS SURFACING SYSTEM (carpet, infill)		
PROPERTY	TEST METHOD	REQUIREMENT
Infill Depth Measurement	EN 1969	± 10% of specification (1/2" exposed fiber)
Impact Attenuation (min. 10 locations)	ASTM F 1936	< 165 G's (individual, not average results)

3. Any testing desired after the initial testing shall be the responsibility and obligation of the Owner.

1.8 WARRANTY GUARANTEE

- A. Warranty Testing
1. Upon substantial completion, the Contractor shall perform a one-time test of the five items listed below. Contractor shall submit to Landscape Architect, a copy of these test results, certified by the independent Testing Agency.
 2. Any testing desired after the initial testing shall be the responsibility and obligation of the Owner.

B. Synthetic Turf System Warranty:

1. The Contractor shall be responsible to provide a Pre-Paid and non-prorated Manufacturer/Installer Warranty Guarantee (referred to herein as "Warranty") for the synthetic grass system for a minimum non-prorated period of eight (8) years from the date of Certificate of Substantial Completion. Synthetic grass system refers to synthetic turf materials, infill materials, installation materials and installation workmanship.
2. \$5,000,000.00 per each insured warranty and \$15 Million dollar annual aggregate for all warranties issued during each 12-month period of the 8-Year warranty.
3. Infill material shall be warranted against breakdown of material outside of project specifications and failure to adhere to EN 71-3 and ASTM F3188 Testing Requirements.
4. The Turf Manufacturer's Warranty must be underwritten by a third-party Best "A" Rated (or better) Insurance Carrier listed in the A.M. Best Key Rating Guide. Warranty shall be guaranteed to cover the items set forth in this Specification for the full eight (8) year period.
5. Insured Warranty coverage must be provided in the form of one (1) single policy.
6. Policies that include self-insurance or self-retention clauses shall not be considered.
7. Policy cannot include any form of deductible amount nor should the Owner be responsible for any deductible.
8. A sample policy shall be provided at the time of Bid to prove that policy is in force. A letter from an agent of sample Certificate of Insurance will not be acceptable.
9. The artificial grass field turf must maintain an ASTM 1936 G-max between 110-165 for the life of the Warranty.

C. Warranty Requirements:

1. The materials utilized in the synthetic turf system shall be guaranteed for the designated usage:
 - a. Football, Rugby, Soccer, Baseball, Softball, Lacrosse, Field Hockey
 - b. Marching Band
 - c. Physical Education and Intramural Sports Programs
 - d. Physical Education exercises and other similar uses
 - e. Pedestrian traffic
 - f. Pneumatic rubber-tired maintenance and service equipment, designated for use on athletic fields and golf courses
 - g. Shot put and discus throwing events compliant with manufacturer recommendations
 - h. Graduations and Ceremonies compliant with manufacturer recommended floor protection
2. Warranty Coverage on Materials:
 - a. General wear and damage caused from UV degradation
 - b. Excessive fiber wear weathering
 - c. Wrinkling, panel movement, or panel shrinkage
 - d. Seam integrity
 - e. Drainage (of Carpet and Infill only)
 - f. Flammability
3. Warranty Coverage on Workmanship:
 - a. Warranty shall cover defects in the installation workmanship for full warranty period. Workmanship includes, but not limited to, seam installation (glued and sewn), inlay installation, proper installation of infill materials, and securing of turf system to nailer board.
 - b. The Turf Manufacturer shall verify that Supervisory Personnel have inspected the installation and that the work conforms to the manufacturer's requirements.
4. Warranty Replacement:
 - a. The warranty shall specifically exclude acts of vandalism and acts of God beyond the control of the Owner or the Manufacturer.
 - b. All items covered by the Warranty are to be replaced or repaired with new materials, including installation at the sole expense of the warranting manufacturer for the life of the warranty period. Replacement or repair of affected areas shall include all necessary

- materials, labor, and transportation costs to complete repairs.
- c. Must have a provision to either make a cash refund or repair/replace such portions of the installed materials that are no longer serviceable to maintain a playable surface.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. All components and their installation method shall be designed and manufactured for use on outdoor athletic fields. The finished surface shall resist abrasion and cutting from normal use.
- B. The materials and turf system should be able to withstand full climatic exposure and shall be resistant to insects, rot, fungus, mildew, ultraviolet light degradation, heat degradation, and shall be non-allergenic and non-toxic.
- C. The turf system shall consist of an artificial grass-like surface pile, which shall be tufted into a primary backing and coated with a secondary backing to lock in the tufted fibers. The turf system shall be constructed to maximize dimensional stability and to resist damage and normal wear and tear from its designated uses.
- D. The entire turf system shall have the basic characteristics of flow-through drainage, allowing free movement of surface runoff through the turf system where such water may flow to the sub-base and field drainage system. The Turf System shall remain free-draining at all times before, during, and after the infill materials are installed.
- E. Turf fibers shall be a proven athletic caliber yarn designed specifically for outdoor use and shall resemble natural grass appearance, texture and color. Streaks, discoloration, or different dye lots shall not be accepted and may be grounds for product rejection. The turf fiber shall provide good traction in all types of weather with the use of conventional sneakers type shoes, composition mold sole athletic shoes, baseball spikes, and screw-on football cleats.
- F. In addition to the tufted lines, inlaid lines and logos, the pile surface shall be suitable for both temporary and permanent line markings using paint specifically developed for this use and as recommended by the turf manufacturer.
- G. The Turf Fabric surface shall be constructed and installed in minimum roll widths of 15 feet with no longitudinal or transverse seams, except for inlaid lines with finished roll assembly.
- H. All adhesives used in bonding the inlaid markings to the adjacent carpet shall be resistant to moisture, bacteria and fungus attacks, and resistant to ultraviolet radiation. Adhesives used shall be as recommended by the Turf Manufacturer.

2.2 PRODUCTS

- A. Synthetic Turf Products:
 - 1. The synthetic turf material and resilient infill shall be in accordance with the following:

Physical Properties	Minimum Specification Requirements
Pile Height	2.25
Fiber Composition	Polyethylene, Parallel-Slit
Pile Ribbon Weight	46 oz./sy
Primary Backing Weight	8 oz./sy
Secondary Backing Weight	24 oz./sy
Total Product Weight	78 oz./sy
Denier	8,000
Fiber Thickness	>100 microns
Primary Backing Material	Polypropylene
Secondary Backing Material	Polyurethane
Turf Bind	> 8 lbs w/o infill
Approved Yarn Suppliers	Tencate XP Blade Plus Polytex (Duramax Minimum) *Proprietary fiber may only be used if it has been pre-approved by Architect within 6 months' time from date of Project Bid
Grab Tear Strength – Width	300 lbs/force

Grab Tear Strength – Length	180 lbs/force
Stitch Gauge	< 1/2"

**Note: Exceptions to Specifications shall be outlined within Proposal

B. Carpet Backing:

1. The primary backing shall consist of a one part, three component polyester/polypropylene backing and treated with UV inhibitors.
2. The secondary backing shall consist of an application of porous polyurethane, heat activated to permanently lock fibers in place . Products using latex based secondary backings will not be acceptable.
3. Perforations:
 - a. Synthetic turf surfacing shall be perforated to provide vertical drainage or the secondary backing can be applied to the tufted fiber rows. Complete synthetic grass system shall drain in excess of 10" per hour.
 - b. Perforations shall be uniformly spaced at 4 inches, in both directions.
 - c. Perorations shall be tested by passing a 3/8" drill bit through the holes with no more than 7 lbs. pressure.

C. Turf Panels, Markings and Logos

1. The carpet shall be delivered in 15-foot wide rolls with the four 4 inch white, 5-yard lines tufted into the ends of each roll.
2. The rolls shall be of sufficient length to go from sideline to sideline. The perimeter white line shall be tufted into the individual sideline rolls. Head seams between the sidelines of the football field will not be acceptable.
3. All field lining, marking, field boundary system with the team area limits, logos, etc. shall be the same material (yarn, infill, and backing) as the playing field system.
4. Lines, logos, and graphics to be installed per the design documents and approved shop drawings are to be tufted in the factory to the maximum extent practical. Those not tufted in the factory shall be inlaid in the field.
5. Logos and inlays shall be true and shall not vary more than 1/2" from specified width and location.
6. The primary fiber color of the playing field shall be Field Green.
7. Primary Field Markings and Lines:
 - a. Football: 4" White
 - b. Soccer: 4" Yellow
 - c. Men's Lacrosse: 4" Royal Blue
 - d. Women's Lacrosse: 4" Red

D. Infill Materials:

1. Infill Materials shall be uniformly filled to a depth which leaves no more than 1/2" of exposed pile after settlement.
 - a. Infill materials shall be new material and consist of a homogeneous non-compacting mixture of uniformly sized ambient and/or cryogenic SBR crumb rubber and silica sand.
 - b. For installations over aggregate stone base (no shock pad), the crumb rubber content shall be approximately 60-70% by weight and the sand content shall be 30-40% by weight. Manufacturer shall provide proposed infill ratios based on pre-installation testing.
2. Crumb Rubber:
 - a. The CRI used in artificial turf fields shall be derived from used whole vulcanized automobile, SUV, and truck tires (DOT tires for over the road). Buffing's, bladders and tubes shall not be used as feedstock for CRI. No factory tires rejects are allowed.
 - b. The Crumb Rubber shall have a specific gravity range from 1.1 minimum to 1.2 maximum as determined by ASTM D 297.
 - c. Shall be free of all metal and produced with 100% recycled automobile or truck tires. The material shall have a size not to exceed 10 mesh nor smaller than 20 mesh.
 - d. The fine particles shall not exceed 10% and shall have no visible evidence of steel particles present in the final synthetic turf surfacing.

- e. Crumb rubber shall be UV stable and resistant to heat degradation.
- f. Rubber Mesh

*Mesh (ASTM E-11)	
Sieve Size	Percent Retained
8	
12	1.3%
16	58.8%
20	38.2%
30	1.0%
40	0.0%
50	0.0%
PAN	Not-to-exceed 0.004%

3. Silica Sand:

- a. Round, uniformly-sized pure silica sand
 - b. Sized between US Sieve 20 to 40
- E. Maintenance Equipment: Turf Contractor/Manufacturer shall provide the following equipment as part of the Base Bid.
- a. Groomer/Sweeper combined unit shall be:
 - i. "Turfcare TCA1400 with magnet" by SMG (attn: Kevin Dorney- (425) 687-1560)
 - b. Maintenance equipment proprietary to Turf Manufacturer may be submitted as a Voluntary Alternate to the project.

PART 3 - EXECUTION

3.1 GENERAL

- A. The Contractor shall perform all work in strict accordance to the Contract Drawings, Approved Shop Drawings and manufacturer's written specifications and instructions.
- B. The Contractor shall be responsible for the inspecting, verifying, and completing all installed work of this section.
- C. Environmental Conditions: The Contractor shall not perform any work if the conditions for working are:
 - 1. Ambient air temperatures are below 45 degrees F.
 - 2. Material temperatures are below 45 degrees F.
 - 3. Surfaces are wet or damp.
 - 4. Rain is imminent or falling.
 - 5. Conditions exist or are imminent, which will be unsuitable to installation requirements of the systems specified herein. Humidity levels will be inside the limits recommended by the adhesive manufacturer to obtain optimum bonding characteristics of the surfaces.

3.2 EXAMINATION

- A. Acceptance of Base Construction: Upon completion of the base and drainage work, a written "Certification of Acceptance of the Base Construction" is required from the synthetic turf manufacturer and/or installation contractor (referred to herein as "Surfacing Contractor") prior to proceeding with any installation work under this section of the specifications.
- B. The Certification shall include but not be limited to the acceptance of the following:
 - 1. Surfacing Contractor has reviewed the base construction finish surface and is accepting the construction is acceptable for application of work under this Section.
 - 2. Surfacing Contractor has been provided testing results of water permeability and accepts the results to place the synthetic turf material.
 - 3. The materials and method of installation for the aggregate stone base construction is in conformance with the manufacturer's current recommendations for the application of the turf to be installed under this section.

4. Surfacing Contractor has reviewed the base construction with representatives of the Site Contractor and Landscape Architect and all parties are satisfied with the compaction and planarity of the surface.
 5. The base construction finish surface is clean and free of contaminants.
 6. Continuing with the installation of the synthetic turf materials without issuance of a Certification of Acceptance Letter shall be considered as an approval of the base by the Turf Contractor.
- C. All discrepancies between the required materials, application and tolerance requirements noted by the installer shall be brought immediately to the attention of the Contractor and Landscape Architect. Failure to immediately inform the Site Contractor and Landscape Architect of any prior work which does not meet the required specifications for installation of the artificial turf surfacing system shall be considered an acceptance by the installer of the non-conforming work.

3.3 INSTALLATION OF TURF AND COMPONENTS

A. GENERAL:

1. All installation shall be done in strict accordance with the manufacturer's current written installation instructions approved by the Landscape Architect.
2. The synthetic turf shall be staged and unrolled as necessary for a daily installation. No material shall be allowed to remain unrolled for a period of 24 hours prior to installation.
3. In the event of damage during delivery, staging, or installation, immediately make all repairs and replacements necessary to the approval of the Landscape Architect and at no additional cost to the Owner.
4. The pile lay of the turf shall be installed facing the home bleacher side of the field, unless noted otherwise. During the turf panel installation process, the Contractor shall continuously check the field layout dimensions in all directions.

B. SEAMS

1. All panel seam spacing shall be held to a minimum of 15 feet in width unless prior approval of seaming diagram indicates a lesser panel width.
 - a. For fields with football yardlines, all seams shall be adjacent to 4" white yardline. Yardlines placed in the middle of the carpet roll will not be permitted. See Section 2.2, C. #1, this Specification.
2. The mechanical or adhesive bonding of all system material components shall provide a permanent, tight, secure and hazard free athletic playing surface.
3. All panel seams are to be held to the absolute minimum and as approved by Landscape Architect. Ridges or tenting of seams is not acceptable. Gaps greater than 1/8" are not acceptable.
4. Seams within the body of the field shall be sewn with a high strength polyester fiber cord.
 - a. Sewn seams shall be butt-sewn with a double loop lock stitch.
 - b. Hand-bagger type seam stitching is not permitted.
 - c. Seams shall lay flat after infill installation.
5. Traverse panel seams shall be securely sewn or glued and lay flat. A minimum of 5" of seaming tape and glue shall extend on either side of the seam

C. LINES, MARKINGS, AND INLAYS

1. Lines and markings shall be tufted in the factory to the greatest extent possible during manufacturing.
2. Lines and markings not tufted in the factory are to be field cut, inlaid and glued with manufacturer approved adhesive or hot-melt. Shaving and gluing of inlays is not a permitted method of installation.
3. All lines and markings shall be installed and verified prior to installation of infill material.
4. All inlays shall have a 12" wide manufacturer approved seaming tape, which is fully coated with adhesive.
 - a. Bonding surfaces shall be clean, dry and free from grease, oil, wax, or other contaminants.
5. All seams and inlays shall be thoroughly brushed or picked before infill materials are installed.
6. All seams and inlays shall be fully fastened with no loose areas. At no time should pulling of section allow for separation of the turf from the seaming tape. Gaps greater than 1/8" are not acceptable.

7. Install turf as required to boxes/lids as shown on plans.

D. TURF EDGES AND TERMINATION

1. The perimeter of the field shall be firmly secured to the wood nailer edge, for the life of the warranty and as detailed, using stainless steel or hot dipped galvanized fasteners, minimum 1" in length. Fastener spacing shall not exceed 12 inches on-center.
2. Final infill level shall be flush with adjacent anchor curb.

E. INFILL INSTALLTION

1. No infill materials shall be installed until the synthetic turf system is fully installed with all lines, markings, and logos. Infill level on box covers/lids shall be flush with adjacent turf infill.
2. The infilling operation shall only take place with dry material, dry field conditions, and no forecasted threat of rain or snow.
3. Open utility grates and drains shall be covered by turf installer prior to placing infill.
4. The synthetic turf surface shall be thoroughly brushed prior to installation of infill materials to remove any wrinkles.
5. The infill shall be installed at a rate determined by the manufacturer. Infill material shall be thoroughly raked and brushed into the turf fibers during each pass of the broadcasting unit.
6. The infill shall not leave more than 1/2" exposed fiber after settlement.

2.4 CLEANING

- A. Contractor shall be responsible for clean up of all materials utilized on a daily basis. Upon completion of installation, all surrounding areas, including turf area, shall be clean and in "game" condition.
- B. Contractor shall utilize magnetic bar to remove any metal objects within the field prior to infill and after infill, before final acceptance.
- C. Contractor shall be responsible to neatly place attic stock on pallets and deliver to a suitable location as directed by Owner.
- D. All excess infill outside of the playing surface shall be properly removed and disposed of and deemed acceptable to Owner and Landscape Architect.

2.5 ACCEPTANCE, MAINTENANCE, AND PROJECT CLOSE-OUT

A. ACCEPTANCE

1. Should any imperfections develop in the surface areas prior to the final acceptance of the work and deemed to not have been vandalism or an Act of God, they shall be removed and replaced with new materials. All such repair work shall be done at no additional cost to the Owner.
2. Final acceptance will be issued to the Contractor as described and issued with a formal "Certificate of Substantial Completion". The Owner or Landscape Architect will not be responsible for any additional acceptance requirements by the Contractor or their subcontractors.

B. MAINTENANCE

1. Following turf system installation, the Turf Contractor shall be responsible for training the Owner's personnel in necessary maintenance of the turf system. Prior to conducting training, Contractor shall assemble and test all maintenance equipment. Equipment should be fully functional and ready to use at the time of training.
2. Owner Training shall include review and demonstration of the following items:
 - a. Daily / Weekly fiber, infill and seam inspections
 - b. Hand grooming low infill and techniques for placing infill
 - c. Emergency seam repair
 - d. Proper methods for field sweeping and grooming: including demonstration of hook-up, detachment, transporting, and use of all equipment.
 - e. Field Snow Plowing (as applicable)
 - f. Protection of surface for events
 - g. Procedure for Warranty Claims
3. Maintenance training shall take place no later than fourteen (14) days after "Quality Control/Post-Installation Testing" is completed.

C. PROJECT CLOSE-OUT

1. Contractor shall furnish three (3) copies of Maintenance Manuals, which shall include all necessary instructions for the proper care and preventative maintenance of the turf system, including painting, markings, small repair procedures, and cleaning.
2. Maintenance Manual shall include list of procedures required to maintain surface condition and activities to be avoided, including static and dynamic load limits, snow clearing, etc.
3. Provide Project Record Documents: Record actual locations of seams and other pertinent information.
4. Provide sample Maintenance Log Book and proposed Testing Schedule for all required testing during Warranty Period.

D. ATTIC STOCK

1. The Contractor shall supply and deliver an additional 50 lineal feet of full width material (± 750 sf), plus 100 lineal feet of each 4" line color installed.
2. The Contractor shall supply and deliver (1) bag of additional rubber infill material to the Owner. The rubber infill shall be placed in RubberMaid 50 gallon containers with covers and wheels.

END OF SECTION

SAMPLE SYNTHETIC TURF WARRANTY

1.1 Warranty

- A. System Installer/Manufacturer (“_____”) hereby warrants to Troy School District subject to the limitations and conditions set forth below, that its entire synthetic turf installation described as _____, is free from defects in material workmanship, meets or exceeds the specifications, and shall (for a period of EIGHT (8) YEARS from the date of final acceptance) remain acceptable for multiple sports activities.
- B. System Installer/Manufacturer warrants to Troy School District that its synthetic turf system shall not unevenly fade, shall not fail, shrink, expand, flood, tear, bubble and shall not reflect unusual excessive wear and shall meet specified Gmax values, for a period of EIGHT (8) YEARS from the date of Certificate of Substantial Completion. In the event that the synthetic turf shall unevenly fade, fail, shrink, expand, flood, tear, bubble or reflect excessive water, System Installer/Manufacturer shall repair and/or replace such areas of the synthetic turf that are affected.
- C. System Installer/Manufacturer warrants to Troy School District that the installation of the entire synthetic turf and all associated turf components (i.e. Inlays and seams) shall be performed in a professional manner under the supervision of highly-trained employees familiar in the installation of their tufted synthetic turf system. The supervisor and key installers shall have installed synthetic turf systems for at least three (10) previous system installations.
- D. System Installer/Manufacturer warrants that the finished synthetic turf system shall have an initial G-max (shock attenuation) value of approximately 110 G’s and shall not become harder than 165 G’s over the life of the system at any point on the field of play. The manufacturer shall make only the necessary repairs if, at any time during the warranty period, the G-max force at any point exceeds the specified 165 G’s.
- E. The term “not fade” in the context of this warranty shall mean that the synthetic grass material remain a uniform shade of green or the other colors installed with no significant loss of color as defined by not greater than 20% loss or shade reduction.
- F. The term “not fail” or “excessive wear” as used in the context of this warranty shall mean that the length and weight of the face yarn or pile material in the synthetic grass surface shall not have been decreased by more than 6% per year according to ASTM D418, nor exceed 20% during the warranty period.
- G. System Installer/Manufacturer shall warrant seams against separation, puncturing, bubbling, etc., for any reason.
- H. This warranty does not cover any defect, failure, damage or undue wear in or to the synthetic turf system caused by or connected with abuse, neglect, deliberate act, Act of God, casualty, static or dynamic loads exceeding recommended levels, footwear having metal cleats, spikes, or similar projections (other than conventional football, baseball, soccer or rugby shoes having cleats of not more than ½” in length).

- I. System Installer/Manufacturer shall be allowed to examine the synthetic turf system regarding any claim which Troy School District makes, to be present at and to analyze the results of all tests conducted by Troy School District or others, and to conduct such tests incurred by Troy School District or others with respect to such tests.
- J. All claims made by Troy School District under this warranty must be made in writing to System Installer/Manufacturer.
- K. This warranty, when signed and notarized by all parties, shall constitute a contract made in the State of Michigan and shall be governed by the laws thereof.
- L. Contractor shall provide an independent 3rd party insurance policy to cover all items identified above.

OWNER: Troy School District

DATE: _____

BY: _____

CONTRACTOR:

DATE: _____

BY: _____

MANUFACTURER:

DATE: _____

BY: _____

SECTION 32 1819 – SYNTHETIC TURF – BASEBALL & SOFTBALL

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section is a part of the entire set of Contract Documents, including General and Supplementary Conditions, Drawings and shall be coordinated with the applicable provisions of the other parts.
- B. Related Work:
 - 1. Section 32 1123 Aggregate Drainage Layer – Turf

1.2 SCOPE OF WORK

- A. The work under this section includes the following:
 - 1. Furnish all labor, materials and equipment, necessary for the complete installation of a baseball/softball synthetic turf system.
 - 2. Procure and install infill material
 - 3. Pre and Post Installation Testing
 - 4. Inlaid lines, logos and markings
 - 5. Removable batters and catchers box panels. One installed on field and four (4) additional sets of panels (per field) shall be included with Base Bid.
 - 6. Review and Certification of previous work performed by other Contractors, relating to the grade work of Section 32 1123 Aggregate Drainage Layer.
 - 7. Warranty Guarantees
 - 8. Installation of synthetic grass surfacing system shall include all incidental work required to complete the work described herein, as shown on the Drawings, and included in related Specifications.
 - 9. Attic Stock
- B. Contractors are encouraged to submit Voluntary Alternates for additional or proprietary turf systems. Voluntary Alternates may serve as the basis for Contract Award.

1.3 REFERENCES

- A. Reference herein to any technical society, organization, group, or regulation are made in accordance with the following abbreviations, and unless noted or specified otherwise, all work under this Section shall conform to the latest edition as applicable.
- B. American Society for Testing and Materials (ASTM):
 - D418 Standard Test Method for Testing Pile Yarn Floor Covering Construction
 - D789 Yarn Melting Point
 - D1335 Standard Test Method for Tuft Bind of Pile Yarn Floor Coverings
 - D1577 Standard Test Method for Linear Density of Textile Fiber
 - D1682 Standard Method of Test for Breaking Load and Elongation of Textile Fabrics
 - D2256 Standard Test Method for Tensile Properties of Yarns by the Single-Strand Method (breaking Strength and Elongation)
 - D2859 Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials
 - D3218 Standard Test for Fiber Thickness (Microns)
 - D4491 Water Permeability of Geotextiles by Permittivity
 - D5034 Standard Test Method of Breaking Strength and Elongation of Textile Fabrics (Grab Test)
 - D5035 Standard Test Method for Breaking Force and Elongation of Textile Fabrics (Strip Method)
 - D5848 Standard Test Method for Mass Per Unit Area of Pile Yarn Floor Covering
 - F355 Standard Test Method for Impact Attenuation of Playing Surface Systems and Materials
 - F1015 Standard Test Method for Relative Abrasiveness of Synthetic Turf Playing Surfaces
 - F1551 Comprehensive Characterization of Synthetic Turf Playing Surfaces and Materials
 - F1936 Standard Specification for Impact Attenuation of Turf Playing Systems as Measured in the Field

- F2117 Standard Test Method for Vertical Rebound Characteristics of Sports Surface/Ball Systems; Acoustical Measurement
- F2765 Standard Specification for Total Lead Content in Synthetic Grass Fibers

- C. National Collegiate Athletic Association (NCAA)
- D. National Federation of State High School Associations (NFHS)
- E. Michigan High School Athletic Association (MHSAA)
- F. Synthetic Turf Council (STC)
- G. American Sports Builders Association (ASBA)
- H. Manufacturer Qualifications:
 - 1. Have not had a Surety or Bonding Company finish work on any contract within the last five (5) years.
 - 2. Have not been disqualified or barred from performing work for any public Owner or contracting entity.
 - 3. Shall have documented financial strength to fully service and warrant the systems installed. An audited financial statement for the past fiscal year shall be provided upon the request of the Owner or Landscape Architect.
 - 4. Must be a member in good standing of the Synthetic Turf Council (STC) and/or American Sports Builders Association (ASBA). Prospective bidder shall employ one ASBA Synthetic Turf Certified Field Builder.
 - 5. All products and installation methods shall meet or exceed the current guidelines of the NFHS, NCAA, all applicable ASTM State and Federal Standards, and all current guidelines set forth by the Synthetic Turf Council. Products shall meet or exceed applicable FIFA standards as identified in the Reference section of this specification
 - 6. Prospective bidder must be experienced in the manufacturing of infilled synthetic turf systems. Turf Manufacturer/Installer shall have fifty (50) fields in the last (5) five years of the same synthetic turf system being proposed with the same manufacturer, product and infill proposed for this project. This includes the fiber, backing, the secondary backing and installation method.
- I. Installer Qualifications:
 - 1. The Turf Contractor must provide competent workmen skilled in the installation of synthetic turf material, including, but not limited to, gluing or sewing seams, gluing inlays, proper installation of the infill material, and competency in installing performance shock pads (if required). The Installer shall have a representative onsite to certify the installation and warranty compliance.
 - 2. The assigned designated Supervisory Personnel on the project must be certified, in writing by the Turf Manufacturer, as competent in the installation of the proposed material. Should there be a change in the assigned designated Supervisory Personnel, the Owner and/or Landscape Architect shall be notified in writing within 48 hours of change.
 - 3. Supervisory Personnel shall remain onsite at all times during the installation.
 - 4. The installer shall provide documentation for the following: Fifteen (15) reference projects consisting of Synthetic Multi-Sport Grass Fields of 75,000 square-feet or larger within the past three (3) years which details the following criteria:
 - a. Project Name and Location
 - b. Project Scope
 - c. Construction timeline
 - d. Construction Cost
 - e. Reference name, title, affiliation, and contact information
- J. Pre-Installation Field Verification:
 - 1. Base Acceptance:
 - a. The synthetic turf manufacturer and/or installation contractor shall perform an inspection of the field base onto which the synthetic turf system is to be installed and to examine the finished surface for required compaction, permeability and grade tolerances.
 - b. Upon correction of any discrepancies between the required materials, application and

tolerance, the Owner's representative shall provide test results for compaction, permeability and planarity that are in compliance with the project plans and specifications. The turf installer shall accept the aggregate stone base via a written certification of acceptance of the base for installation of subsequent layers of the synthetic turf system.

- c. The acceptance of the base construction should be included in the certification for warranty validation.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Properly store all materials in accordance with manufacturer's recommendations.
 1. Deliver products in original, unopened packaging with manufacturer's identification clearly legible. All products shall be received by Contractor.
 2. All materials shall be stored in a location directed by the Owner and acceptable to the Contractor.
 3. Protect materials from puncture, dirt, grease, water, moisture, mechanical abrasion, excessive heat or cold, or other damaging circumstances.
- B. Upon delivery and prior to installation of synthetic turf system and materials, Contractor shall inspect the materials as follows:
 1. For damaged or defective items.
 2. Measure synthetic turf roll lengths, perforations, and uniformity of product and color.
 3. Adhesives and seaming tape shall arrive in sealed dry containers or packaging and shall be kept in adequate temperatures per manufacturer's written requirements.
 4. Rubber infill shall arrive in sacks or bags without any tears or loose material. Rubber shall arrive dry and loose: no rubber will be accepted that is bulked or solid.
 5. Sand Infill:
 - a. Bagged Material: shall arrive without any tears and shall be free from contamination of site materials.
 - b. Bulk Material: deliver materials in clean, washed and covered trucks to eliminate contamination during transportation. Onsite stockpiling locations shall be coordinated with the Owner. Stockpile only in areas free of debris and away from drainage routes and structures. Cover all materials with plastic or geotextile if materials are to be stockpiled more than 48 hours.
 6. Any material(s) that does not meet minimum specified criteria is grounds for rejection.
- C. At time of delivery, lot numbers for each carpet roll shall be provided to Construction Manager or Owner's Representative to validate carpet supplied. Lot numbers shall be provided as part of close-out documentation.

1.6 SUBMITTALS

- A. Bid Submittals
 1. Proposal package shall include the following information to assist in the preliminary review process:
 - a. Manufacturer qualifications/references as noted herein.
 - b. Installer qualifications/references as noted herein.
 - c. Samples of non-infilled turf product for all colors required, minimum 8"x8" in size. Bidders may elect to submit a color roll of standard manufacturer colors with their bid in lieu of individual samples.
 - d. Fiber manufacturer's name, type of fiber and composition of fiber.
 - e. Product being bid meets or exceeds pre-manufacturer testing
 - f. Sample Manufacturer's Warranty and Third-Party Insured Warranty
 - g. Sample insurance policy for the Third-Party Insured Warranty
 2. The following letters, on the submitting company's letterhead and signed by a company officer, shall be submitted with the Bid:
 - a. A letter confirming that the Bid Documents have been completely reviewed by qualified representatives of the submitting company acknowledging that the materials and system proposed are adequate for the applications shown and will not impact the system warranty.
 - b. The Bidder shall provide written documentation that system for which they are bidding,

does not violate any known or pending patents for specified products.

B. Post-Award Submittals

1. Shop Drawings – Submit the following for approval:
 - a. Complete scaled and dimensional drawing, in full color, showing all field lines, markings, inlays, and boundaries in specified colors required for project. All markings shall be tufted in the factory or field inlaid, unless noted otherwise. Custom logos can be provided by Landscape Architect in AutoCad format to expedite shop drawing process.
 - b. Roll/seaming layout Plan
 - c. Details on field construction, noting any details that may deviate from the Drawings or Specifications including, but not limited to: edge detail, goal post detail, covers for access to subsurface structures, etc.
2. Provide certified copies of independent (third-party) laboratory testing reports per section 1.7 Quality Control Testing.
3. Fiber manufacturer’s name, type of fiber and composition of fiber.
4. Proposed infill composition, including pounds of sand and pounds of rubber per square foot. Provide (3) one-pound samples of sand and rubber (in separate bags).
5. Rubber, with certification of availability, from supplier guaranteeing product supply reserved for the Troy School District. Certification shall include:
 - a. Type and origin of raw material (certify that it comes from tires)
 - b. Production facility
 - c. Production method (cryo or ambient)
 - d. Fiber content (%)
 - e. CRI sieve/gradation analysis
 - f. The provider the of CRI shall provide in writing that they maintain an ongoing Quality Control program meeting all the standards of the STC Guidelines for CRI Used in Synthetic Turf Fields and capable of meeting all the specifications described herein.
6. Maintenance Equipment: Submittals shall include: product data specifications, operational instructions, etc.

1.7 QUALITY CONTROL TESTING

- A. All testing services shall be the responsibility of and paid for by the submitting or awarded Contractor, unless noted otherwise. All testing noted herein shall be performed by a third-party testing agency that is ISO 17025 certified and approved by the Landscape Architect.
- B. Testing by independent laboratory must be for current materials and testing not older than twelve (12) months from project Bid Date.
- C. Any material tested and found non-compliant with the specifications may be rejected. The Contractor shall be required to submit material that is compliant with the specifications.
- D. The Owner, or the Landscape Architect on the Owner’s behalf, reserves the right to independently test any material. Any testing performed by the Owner will be at the Owner’s expense. The Contractor is responsible to bear the cost of any testing of product found to be non-compliant. Contractor will bear the cost of all retesting as required by the Owner.
- E. Pre-Manufacturing Testing: Contractor shall submit to Landscape Architect a copy of the test results certified by the independent Testing Laboratory prior to manufacturing of the synthetic turf for the project. Testing data required is as follows:

SYNTHETIC GRASS YARN		
PROPERTY	TEST METHOD	REQUIREMENT
Pile Height	ASTM D 5823	± 1/8” of specification
Pile Weight	ASTM D 5848	± 5% of specification
Total Weight	ASTM D 5848	± 5% of specification
Tuft Bind (w/o infill)	ASTM D 1335	> 8 lbs
Melting Point	ASTM D 789	> 235 degrees F
Denier	ASTM D 1907	± 10% of specifications
Pill Burn Test	ASTM D2859	8 Passed / 0 Failed
Microns	ASTM D3218	± 10% of specifications

Breaking Strength (length)	ASTM D 5034	> 283 lbs./ft
Breaking Strength (width)	ASTM D 5034	> 200 lbs./ft
Fiber Abrasiveness Index	ASTM F 1015	< 35
Lead Content	ASTM F 2765-09	< 50 ppm
Artificial Wearing (3,000 hours UVA) Turf Color Change	EN ISO 20105-A02	> Gray Scale 3
Artificial Wearing (3,000 hours UVA) Pile Yarn Tensile Strength	EN 13864	< 50% reduction

SYNTHETIC GRASS BACKING MATERIALS		
PROPERTY	TEST METHOD	REQUIREMENT
Primary Backing Weight	ASTM D 5848	± 2 oz./yd ² of specification
Secondary Backing Weight	ASTM D 5848	± 2 oz./yd ² of specification

SYNTHETIC GRASS INFILL MATERIALS		
PROPERTY	TEST METHOD	REQUIREMENT
Safety of Toys Part 3	EN 71-3	Pass
Safety of Synthetic Turf Infill	ASTM F 3188	Pass
Infill Size Gradation	EN 933	
Infill Bulk Density	EN 1097	
Artificial Weathering (3,000 hours UVA) Infill Color Change	EN ISO 20105-A02	> Gray Scale 3

SYNTHETIC GRASS SYSTEM		
PROPERTY	TEST METHOD	REQUIREMENT
Lisport Simulated Wear	EN 13672	> 50,000 passes without splitting

- F. Post Manufacturing/Pre-Shipment Testing: Contractor shall submit to Landscape Architect a copy of the test results certified by the Independent Testing Laboratory prior to shipping of the synthetic turf product. Any test result not meeting specifications is grounds for rejection of product, in whole or in part. Testing requirements are as follows:
1. Test sample shall be from five random rolls manufactured for this project. Proof of documentation must be provided upon delivery of the carpet to the job site.
 2. Test results to identify manufacturer, date of test(s), lab technician, project, lot number, etc.

SYNTHETIC GRASS SURFACING CARPET		
PROPERTY	TEST METHOD	REQUIREMENT
Tuft Bind (w/o infill)	ASTM D 1335	> 8 lbs
Stitch Gauge	ASTM D 5793	< 1/2"
Pile Height	ASTM D 5823	± 1/8" of specification
Pile Weight	ASTM D 5848	± 5% of specification
Total Weight	ASTM D 5848	± 5% of specification
Perforations	Visual	> 3/16" dia., spaced 4" o.c.
Denier	ASTM D 418 or 1907	± 10% of specification
Primary Backing Weight	ASTM D 5848	± 2 oz./yd ² of specification
Secondary Backing Weight	ASTM D 5848	± 2 oz./yd ² of specification
Breaking Strength (length)	ASTM D 5034	> 283 lbs./ft
Breaking Strength (width)	ASTM D 5034	> 200 lbs./ft
Pill Burn Test	ASTM D2859	8 Passed / 0 Failed

Lead Content	ASTM F 2765-09	< 50 ppm
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SYNTHETIC GRASS SURFACING SYSTEM (carpet and infill)		
PROPERTY	TEST METHOD	REQUIREMENT
Water Infiltration Rate	ASTM F 1551	> 16 in./hr.
Infill Depth Measurement	EN 1969	± 10% of specification (1/2" exposed fiber)
Impact Attenuation	ASTM F 1936	< 165 G's w/o pad

- G. Post Installation Testing: Upon substantial completion, the Owner will secure an Independent Third-Party Testing Agency to perform a one-time test of the items listed below.
1. Testing shall be completed on-site within five (5) days upon completion of the installation.
 2. Upon completion of testing, the Contractor will be furnished a copy of the test results. Any material tested and found not in compliance with the contract and Warranty provided by the manufacturer may be rejected and Contractor shall rectify the issue to be acceptable. Any area/item not within conformance shall be retested at the Contractors expense after remedy is implemented until satisfactory results are achieved.
 3. Any testing desired after the initial testing shall be the responsibility and obligation of the Owner.

SYNTHETIC GRASS SURFACING SYSTEM (carpet and infill)		
PROPERTY	TEST METHOD	REQUIREMENT
Infill Depth Measurement	EN 1969	± 10% of specification (1/2" exposed fiber)
Impact Attenuation (min. 10 locations)	ASTM F 1936	< 165 G's w/o pad (individual, not average)

1.8 WARRANTY GUARANTEE

- A. Synthetic Turf System Warranty:
1. The Contractor shall be responsible to provide a Pre-Paid and non-prorated Manufacturer/Installer Warranty Guarantee (referred to herein as "Warranty") for the synthetic grass system for a minimum non-prorated period of eight (8) years from the date of Certificate of Substantial Completion. Synthetic grass system refers to synthetic turf materials, infill materials, installation materials and installation workmanship.
 2. \$5,000,000.00 per each insured warranty and \$15Million dollar annual aggregate for all warranties issued during each 12-month period of the 8-Year warranty.
 3. Infill material shall be warranted against breakdown of material outside of project specifications and failure to adhere to EN 71-3 and ASTM F3188 Testing Requirements.
 4. The Turf Manufacturer's Warranty must be underwritten by a third-party Best "A" Rated (or better) Insurance Carrier listed in the A.M. Best Key Rating Guide. Warranty shall be guaranteed to cover the items set forth in this Specification for the full eight (8) year period.
 5. Insured Warranty coverage must be provided in the form of one (1) single policy.
 6. Policies that include self-insurance or self-retention clauses shall not be considered.
 7. Policy cannot include any form of deductible amount nor should the Owner be responsible for any deductible.
 8. A sample policy shall be provided at the time of Bid to prove that policy is in force. A letter from an agent of sample Certificate of Insurance will not be acceptable.
 9. The artificial grass field turf must maintain an ASTM 1936 G-max between 110-165 for the life of the Warranty.
- B. Warranty Requirements:
1. The materials utilized in the synthetic turf system shall be guaranteed for the designated usage:
 - a. Primary Usage: Baseball and Softball
 - b. Alternate Use: Football, Rugby, Soccer, Lacrosse, Field Hockey, Marching Band
 - c. Physical Education and Intramural Sports Programs

- d. Physical Education exercises and other similar uses
- e. Pedestrian traffic
- f. Pneumatic rubber-tired maintenance and service equipment, designated for use on athletic fields and golf courses
2. Warranty Coverage on Materials:
 - a. General wear and damage caused from UV degradation
 - b. Excessive fiber wear weathering
 - c. Wrinkling, panel movement, or panel shrinkage
 - d. Seam integrity
 - e. Drainage (of Carpet and Infill only)
 - f. Flammability
3. Warranty Coverage on Workmanship:
 - a. Warranty shall cover defects in the installation workmanship for full warranty period. Workmanship includes, but not limited to, seam installation (glued and sewn), inlay installation, proper installation of infill materials, and securing of turf system to nailer board.
 - b. The Turf Manufacturer shall verify that Supervisory Personnel have inspected the installation and that the work conforms to the manufacturer's requirements.
4. Warranty Replacement:
 - a. The warranty shall specifically exclude acts of vandalism and acts of God beyond the control of the Owner or the Manufacturer.
 - b. All items covered by the Warranty are to be replaced or repaired with new materials, including installation at the sole expense of the warranting manufacturer for the life of the warranty period. Replacement or repair of affected areas shall include all necessary materials, labor, and transportation costs to complete repairs.
 - c. Must have a provision to either make a cash refund or repair/replace such portions of the installed materials that are no longer serviceable to maintain a playable surface.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. All components and their installation method shall be designed and manufactured for use on outdoor athletic fields. The finished surface shall resist abrasion and cutting from normal use.
- B. The materials and turf system should be able to withstand full climatic exposure and shall be resistant to insects, rot, fungus, mildew, ultraviolet light degradation, heat degradation, and shall be non-allergenic and non-toxic.
- C. The turf system shall consist of an artificial grass-like surface pile, which shall be tufted into a primary backing and coated with a secondary backing to lock in the tufted fibers. The turf system shall be constructed to maximize dimensional stability and to resist damage and normal wear and tear from its designated uses.
- D. The entire turf system shall have the basic characteristics of flow-through drainage, allowing free movement of surface runoff through the turf system where such water may flow to the sub-base and field drainage system. The Turf System shall remain free-draining at all times before, during, and after the infill materials are installed.
- E. Turf fibers shall be a proven athletic caliber yarn designed specifically for outdoor use and shall resemble natural grass appearance, texture and color. Streaks, discoloration, or different dye lots shall not be accepted and may be grounds for product rejection. The turf fiber shall provide good traction in all types of weather with the use of conventional sneakers type shoes, composition mold sole athletic shoes, baseball spikes, and screw-on football cleats.
- F. In addition to the tufted lines, inlaid lines and logos, the pile surface shall be suitable for both temporary and permanent line markings using paint specifically developed for this use and as recommended by the turf manufacturer.
- G. The Turf Fabric surface shall be constructed and installed in minimum roll widths of 15 feet with no longitudinal or transverse seams, except for inlaid lines with finished roll assembly.
- H. All adhesives used in bonding the inlaid markings to the adjacent carpet shall be resistant to moisture, bacteria and fungus attacks, and resistant to ultraviolet radiation. Adhesives used shall be as

recommended by the Turf Manufacturer.

2.2 PRODUCTS

A. Synthetic Turf Products:

1. The synthetic turf material and resilient infill shall be in accordance with the following:

Physical Properties	Minimum Specification Requirements (GREEN AREAS)
Pile Height	1.75 inches
Fiber Composition	Polyethylene, Parallel-Slit and monofilament (50 / 50)
Pile Ribbon Weight	42 oz./sy
Primary Backing Weight	8 oz./sy
Secondary Backing Weight	24 oz./sy
Total Product Weight	74 oz./sy
Denier	8,000
Fiber Thickness	>100 microns
Primary Backing Material	Polypropylene
Secondary Backing Material	Polyurethane
Turf Bind	> 8 lbs w/o infill
Approved Yarn Suppliers	Tencate XP Blade Plus Polytex (Duramax Minimum) *Proprietary fiber may only be used if it has been pre-approved by Architect within 6 months' time from date of Project Bid
Grab Tear Strength – Width	300 lbs/force
Grab Tear Strength – Length	180 lbs/force
Stitch Gauge	< 1/2"

**Note: Exceptions to Specifications shall be outlined within Proposal

Physical Properties	Minimum Specification Requirements (INFIELD/WARNING TRACK AREAS)
Pile Height	1.50 inches
Fiber Composition	Slit-Film: Polyethylene, Thatch Zone: Nylon
Pile Ribbon Weight	48 oz./sy
Primary Backing Weight	8 oz./sy
Secondary Backing Weight	24 oz./sy
Total Product Weight	80 oz./sy
Denier	Slit Film: 10,000 Thatch: 750
Fiber Thickness	Slit Film: 110 Micron Thatch: 100 Microns
Primary Backing Material	Polypropylene
Secondary Backing Material	Polyurethane
Turf Bind	> 8 lbs w/o infill
Approved Yarn Suppliers	Tencate XP Blade Plus Polytex (Duramax Minimum) *Proprietary fiber may only be used if it has been pre-approved by Architect within 6 months' time from date of Project Bid
Grab Tear Strength – Width	300 lbs/force

Grab Tear Strength – Length	180 lbs/force
Stitch Gauge	< 1/2"

**Note: Exceptions to Specifications shall be outlined within Proposal

B. Carpet Backing:

1. The primary backing shall consist of a one part, three component polyester/polypropylene backing and treated with UV inhibitors.
2. The secondary backing shall consist of an application of porous polyurethane, heat activated to permanently lock fibers in place . Products using latex based secondary backings will not be acceptable.
3. Perforations:
 - a. Synthetic turf surfacing shall be perforated to provide vertical drainage or the secondary backing can be applied to the tufted fiber rows. Complete synthetic grass system shall drain in excess of 10" per hour.
 - b. Perforations shall be uniformly spaced at 4 inches, in both directions.
 - c. Perforations shall be tested by passing a 3/8" drill bit through the holes with no more than 7 lbs. pressure.

C. Turf Panels, Markings and Logos

1. The carpet shall be delivered in 15-foot wide rolls and shall be of sufficient length to go from side to side of field extents.
2. Lines, logos, and graphics to be installed per the design documents and approved shop drawings are to be tufted in the factory to the maximum extent practical. Those not tufted in the factory shall be inlaid in the field.
3. Logos and inlays shall be true and shall not vary more than 1/2" from specified width and location.
4. The primary fiber color of the playing field shall be as follows:
 - a. Primary Field Color: Alternating panels of Field Green and Field/Lime Green (50/50 A/B by row).
 - b. Foul Area: Field Green
 - c. Infield: Brown
 - d. Warning Track: Black
 - e. Baseball: White (size as noted on drawings)

D. Infill Materials:

1. Infill Materials shall be uniformly filled to a depth which leaves no more than 1/2" of exposed pile after settlement.
 - a. Infill materials shall be new material and consist of a homogeneous non-compacting mixture of uniformly sized ambient and/or cryogenic SBR crumb rubber and silica sand.
 - b. For installations over aggregate stone base (no shock pad), the infill ratios shall be as follows:
 - i. Green Areas: Minimum infill ratio to be 40% sand and 60% rubber by weight
 - ii. Infield/Warning Track Areas: Minimum infill ratio to be 60% sand and 40% rubber by weight.
 - iii. Manufacturer shall provide proposed infill ratios based on pre-installation testing.
2. Crumb Rubber:
 - a. The CRI used in artificial turf fields shall be derived from used whole vulcanized automobile, SUV, and truck tires (DOT tires for over the road). Buffing's, bladders and tubes shall not be used as feedstock for CRI. No factory tires rejects are allowed.
 - b. The Crumb Rubber shall have a specific gravity range from 1.1 minimum to 1.2 maximum as determined by ASTM D 297.

- c. Shall be free of all metal and produced with 100% recycled automobile or truck tires. The material shall have a size not to exceed 10 mesh nor smaller than 20 mesh.
- d. The fine particles shall not exceed 10% and shall have no visible evidence of steel particles present in the final synthetic turf surfacing.
- e. Crumb rubber shall be UV stable and resistant to heat degradation.
- f. Rubber Mesh

Sieve Size	*Mesh (ASTM E-11) Percent Retained
8	
12	1.3%
16	58.8%
20	38.2%
30	1.0%
40	0.0%
50	0.0%
PAN	Not-to-exceed 0.004%

- 3. Silica Sand:
 - a. Round, uniformly-sized pure silica sand
 - b. Sized between US Sieve 20 to 40

PART 3 - EXECUTION

3.1 GENERAL

- A. The Contractor shall perform all work in strict accordance to the Contract Drawings, Approved Shop Drawings and manufacturer's written specifications and instructions.
- B. The Contractor shall be responsible for the inspecting, verifying, and completing all installed work of this section.
- C. Environmental Conditions: The Contractor shall not perform any work if the conditions for working are:
 - 1. Ambient air temperatures are below 45 degrees F.
 - 2. Material temperatures are below 45 degrees F.
 - 3. Surfaces are wet or damp.
 - 4. Rain is imminent or falling.
 - 5. Conditions exist or are imminent, which will be unsuitable to installation requirements of the systems specified herein. Humidity levels will be inside the limits recommended by the adhesive manufacturer to obtain optimum bonding characteristics of the surfaces.

3.2 EXAMINATION

- A. Acceptance of Base Construction: Upon completion of the base and drainage work, a written "Certification of Acceptance of the Base Construction" is required from the synthetic turf manufacturer and/or installation contractor (referred to herein as "Surfacing Contractor") prior to proceeding with any installation work under this section of the specifications.
- B. The Certification shall include but not be limited to the acceptance of the following:
 - 1. Surfacing Contractor has reviewed the base construction finish surface and is accepting the construction is acceptable for application of work under this Section.
 - 2. Surfacing Contractor has been provided testing results of water permeability and accepts the results to place the synthetic turf material.
 - 3. The materials and method of installation for the aggregate stone base construction is in conformance with the manufacturer's current recommendations for the application of the turf to be installed under this section.
 - 4. Surfacing Contractor has reviewed the base construction with representatives of the Site Contractor and Landscape Architect and all parties are satisfied with the compaction and planarity of the surface.

5. The base construction finish surface is clean and free of contaminants.
 6. Continuing with the installation of the synthetic turf materials without issuance of a Certification of Acceptance Letter shall be considered as an approval of the base by the Turf Contractor.
- C. All discrepancies between the required materials, application and tolerance requirements noted by the installer shall be brought immediately to the attention of the Contractor and Landscape Architect. Failure to immediately inform the Site Contractor and Landscape Architect of any prior work which does not meet the required specifications for installation of the artificial turf surfacing system shall be considered an acceptance by the installer of the non-conforming work.

3.3 INSTALLATION OF TURF AND COMPONENTS

A. GENERAL:

1. All installation shall be done in strict accordance with the manufacturer's current written installation instructions approved by the Landscape Architect.
2. The synthetic turf shall be staged and unrolled as necessary for a daily installation. No material shall be allowed to remain unrolled for a period of 24 hours prior to installation.
3. In the event of damage during delivery, staging, or installation, immediately make all repairs and replacements necessary to the approval of the Landscape Architect and at no additional cost to the Owner.
4. The pile lay of the turf shall be installed facing the home bleacher side of the field, unless noted otherwise. During the turf panel installation process, the Contractor shall continuously check the field layout dimensions in all directions.

B. SEAMS

1. All panel seam spacing shall be held to a minimum of 15 feet in width unless prior approval of seaming diagram indicates a lesser panel width.
2. The mechanical or adhesive bonding of all system material components shall provide a permanent, tight, secure and hazard free athletic playing surface.
3. All panel seams are to be held to the absolute minimum and as approved by Landscape Architect. Ridges or tenting of seams is not acceptable. Gaps greater than 1/8" are not acceptable.
4. Seams within the body of the field shall be sewn with a high strength polyester fiber cord.
 - a. Sewn seams shall be butt-sewn with a double loop lock stitch.
 - b. Hand-bagger type seam stitching is not permitted.
 - c. Seams shall lay flat after infill installation.
5. Traverse panel seams shall be securely sewn or glued and lay flat. A minimum of 5" of seaming tape and glue shall extend on either side of the seam

C. LINES, MARKINGS, AND INLAYS

1. Lines and markings shall be tufted in the factory to the greatest extent possible during manufacturing.
2. Lines and markings not tufted in the factory are to be field cut, inlaid and glued with manufacturer approved adhesive or hot-melt. Shaving and gluing of inlays is not a permitted method of installation.
3. All lines and markings shall be installed and verified prior to installation of infill material.
4. All inlays shall have a 12" wide manufacturer approved seaming tape, which is fully coated with adhesive.
 - a. Bonding surfaces shall be clean, dry and free from grease, oil, wax, or other contaminants.
5. All seams and inlays shall be thoroughly brushed or picked before infill materials are installed.
6. All seams and inlays shall be fully fastened with no loose areas. At no time should pulling of section allow for separation of the turf from the seaming tape. Gaps greater than 1/8" are not acceptable.
7. Install turf as required to boxes/lids as shown on plans.

D. TURF EDGES AND TERMINATION

1. The perimeter of the field shall be firmly secured to the wood nailer edge, for the life of the warranty and as detailed, using stainless steel or hot dipped galvanized fasteners, minimum 1" in length. Fastener spacing shall not exceed 12 inches on-center.

2. Final infill level shall be flush with adjacent anchor curb or track surfacing.

E. INFILL INSTALLTION

1. No infill materials shall be installed until the synthetic turf system is fully installed with all lines, markings, and logos. Infill level on box covers/lids shall be flush with adjacent turf infill.
2. The infilling operation shall only take place with dry material, dry field conditions, and no forecasted threat of rain or snow.
3. Open utility grates and drains shall be covered by turf installer prior to placing infill.
4. The synthetic turf surface shall be thoroughly brushed prior to installation of infill materials to remove any wrinkles.
5. The infill shall be installed at a rate determined by the manufacturer. Infill material shall be thoroughly raked and brushed into the turf fibers during each pass of the broadcasting unit.
6. The infill shall not leave more than 1/2" exposed fiber after settlement.

2.4 CLEANING

- A. Contractor shall be responsible for clean up of all materials utilized on a daily basis. Upon completion of installation, all surrounding areas, including turf area, shall be clean and in "game" condition.
- B. Contractor shall utilize magnetic bar to remove any metal objects within the field prior to infill and after infill, before final acceptance.
- C. Contractor shall be responsible to neatly place attic stock on pallets and deliver to a suitable location as directed by Owner.
- D. All excess infill outside of the playing surface shall be properly removed and disposed of and deemed acceptable to Owner and Landscape Architect.

2.5 ACCEPTANCE, MAINTENANCE, AND PROJECT CLOSE-OUT

A. ACCEPTANCE

1. Should any imperfections develop in the surface areas prior to the final acceptance of the work and deemed to not have been vandalism or an Act of God, they shall be removed and replaced with new materials. All such repair work shall be done at no additional cost to the Owner.
2. Final acceptance will be issued to the Contractor as described and issued with a formal "Certificate of Substantial Completion". The Owner or Landscape Architect will not be responsible for any additional acceptance requirements by the Contractor or their subcontractors.

B. MAINTENANCE

1. Following turf system installation, the Turf Contractor shall be responsible for training the Owner's personnel in necessary maintenance of the turf system. Prior to conducting training, Contractor shall assemble and test all maintenance equipment. Equipment should be fully functional and ready to use at the time of training.
2. Owner Training shall include review and demonstration of the following items:
 - a. Daily / Weekly fiber, infill and seam inspections
 - b. Hand grooming low infill and techniques for placing infill
 - c. Emergency seam repair
 - d. Proper methods for field sweeping and grooming: including demonstration of hook-up, detachment, transporting, and use of all equipment.
 - e. Field Snow Plowing (as applicable)
 - f. Protection of surface for events
 - g. Procedure for Warranty Claims
3. Maintenance training shall take place no later than fourteen (14) days after "Quality Control/Post-Installation Testing" is completed.

C. PROJECT CLOSE-OUT

1. Contractor shall furnish three (3) copies of Maintenance Manuals, which shall include all necessary instructions for the proper care and preventative maintenance of the turf system, including painting, markings, small repair procedures, and cleaning.

2. Maintenance Manual shall include list of procedures required to maintain surface condition and activities to be avoided, including static and dynamic load limits, snow clearing, etc.
 3. Provide Project Record Documents: Record actual locations of seams and other pertinent information.
 4. Provide sample Maintenance Log Book and proposed Testing Schedule for all required testing during Warranty Period.
- D. ATTIC STOCK
1. The Contractor shall supply and deliver an additional 50 lineal feet of full width material (± 750 sf), plus 100 lineal feet of each 4" line color installed.
 2. The Contractor shall supply and deliver (1) bag of additional rubber infill material to the Owner. The rubber infill shall be placed in RubberMaid 50 gallon containers with covers and wheels.

END OF SECTION

SAMPLE SYNTHETIC TURF WARRANTY

1.1 Warranty

- A. System Installer/Manufacturer (“_____”) hereby warrants to Troy School District subject to the limitations and conditions set forth below, that its entire synthetic turf installation described as _____, is free from defects in material workmanship, meets or exceeds the specifications, and shall (for a period of EIGHT (8) YEARS from the date of final acceptance) remain acceptable for multiple sports activities.
- B. System Installer/Manufacturer warrants to Troy School District that its synthetic turf system shall not unevenly fade, shall not fail, shrink, expand, flood, tear, bubble and shall not reflect unusual excessive wear and shall meet specified Gmax values, for a period of EIGHT (8) YEARS from the date of Certificate of Substantial Completion. In the event that the synthetic turf shall unevenly fade, fail, shrink, expand, flood, tear, bubble or reflect excessive water, System Installer/Manufacturer shall repair and/or replace such areas of the synthetic turf that are affected.
- C. System Installer/Manufacturer warrants to Troy School District that the installation of the entire synthetic turf and all associated turf components (i.e. Inlays and seams) shall be performed in a professional manner under the supervision of highly-trained employees familiar in the installation of their tufted synthetic turf system. The supervisor and key installers shall have installed synthetic turf systems for at least three (10) previous system installations.
- D. System Installer/Manufacturer warrants that the finished synthetic turf system shall have an initial G-max (shock attenuation) value of approximately 110 G’s and shall not become harder than 165 G’s over the life of the system at any point on the field of play. The manufacturer shall make only the necessary repairs if, at any time during the warranty period, the G-max force at any point exceeds the specified 165 G’s.
- E. The term “not fade” in the context of this warranty shall mean that the synthetic grass material remain a uniform shade of green or the other colors installed with no significant loss of color as defined by not greater than 20% loss or shade reduction.
- F. The term “not fail” or “excessive wear” as used in the context of this warranty shall mean that the length and weight of the face yarn or pile material in the synthetic grass surface shall not have been decreased by more than 6% per year according to ASTM D418, nor exceed 20% during the warranty period.
- G. System Installer/Manufacturer shall warrant seams against separation, puncturing, bubbling, etc., for any reason.
- H. This warranty does not cover any defect, failure, damage or undue wear in or to the synthetic turf system caused by or connected with abuse, neglect, deliberate act, Act of God, casualty, static or dynamic loads exceeding recommended levels, footwear having metal cleats, spikes, or similar projections (other than conventional football, baseball, soccer or rugby shoes having cleats of not more than ½” in length).
- I. System Installer/Manufacturer shall be allowed to examine the synthetic turf system regarding any claim which Troy School District makes, to be present at and to analyze the results of all tests conducted by Troy School District or others, and to conduct such tests incurred by Troy School District or others with respect to such tests.
- J. All claims made by Troy School District under this warranty must be made in writing to System Installer/Manufacturer.

- K. This warranty, when signed and notarized by all parties, shall constitute a contract made in the State of Michigan and shall be governed by the laws thereof.
- L. Contractor shall provide an independent 3rd party insurance policy to cover all items identified above.

OWNER: Troy School District

DATE: _____

BY: _____

CONTRACTOR:

DATE: _____

BY: _____

MANUFACTURER:

DATE: _____

BY: _____

SECTION 32 1822 – INFIELD MIX – RED CLAY

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section is a part of the entire set of Construction Documents and shall be coordinated with the applicable provisions of the other parts.
- B. Related Sections:
 - 1. Section 31 2000 Earthwork - Athletics

1.2 SCOPE

- A. This section of the specifications shall consist of providing and placing of red-clay athletic surface materials and clay bricks for infield areas as indicated on the plans.

1.3 QUALITY ASSURANCE

- A. Upon installation of infield, warning track and clay brick material, Contractor shall arrange for material supplier representative to conduct a training session with Owner's maintenance staff on proper field maintenance and general grounds keeping practices.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Infield Mix: The material shall consist of an engineered blend of sand, baked clay and virgin clay with a uniform and consistent medium which provide s a safe playing surface, dependable bounce, is easily maintained and ability to drain well. Particle size analysis shall be 75-85% Sand, 10-15% Silt and 5-8% Clay.
 - 1. Washington Ball Mix as supplied by Mar-Co Clay Products (800) 950-2555, or approved equal.
 - 2. Classic Infield Mix as supplied by Dura-Edge Natural Sand Co. (866) 867-0052, or approved equal.

<u>Sieve Analysis</u>	<u>Percent Passing</u>
4	100
7	85-95
20	65-75
60	50-60
140	30-35
200	25-30

- B. Mound Clay: Material shall be virgin raw clay crushed and screened to less than 1/8". Mound clay shall be used as packing clay to build, form and shape pitching mound and batters box. Particle size analysis shall be 25-35% Sand, 35-45% Silt and 35-45% Clay.
 - 1. "Mound Clay" as supplied by Mar-Co Clay Products (800) 950-2555, or approved equal.
 - 2. "Dura-Pitch" as supplied by Dura-Edge Natural Sand Co. (866) 867-0052, or approved equal.

<u>Sieve Analysis</u>	<u>Percent Passing</u>
4	100
7	90-100
20	80-90
60	70-80
140	65-75
200	60-70

- C. Base Material Sand: The material shall be a 3/16" sand blend
 - 1. "Sport Sand" as supplied by Mar-Co Clay Products (800) 950-2555, or approved equal.
- D. Clay Bricks: The material shall be virgin raw clay, crushed, screened, moisturized and pressed into a block, measuring 4"w x 8"l x 2 1/2"h.

1. Pitchers Mound & Batter's Box Clay Bricks – "Field Bricks" as supplied by Mar-Co Clay Products. Telephone: (800) 950-2555.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Infield Mix Material
 1. Spread base material sand evenly over existing subgrade for a firm depth of 5".
 2. Using a topdresser at the manufacturer's recommended application rates, spread Washington Ball Mix evenly over the sand base to a compacted depth of 4".
 3. Allow materials to settle naturally through rainfall or heavy watering. Contractor shall re-evaluate after saturation to ensure 4" compacted depth has been achieved.
- B. Pitchers Mounds and Batters Boxes
 1. Prior to finish grade on infields, install batter's boxes and pitcher's mounds as indicated on drawings.
 2. Spread mound clay and compact to required elevations. Dampen area with water to assist bonding of mound clay and clay bricks.
 3. At the batter's box, the base elevation prior to installation of the field bricks should be +/- 3-1/2" below top of home plate.
 4. Install clay bricks in a tightly laid pattern as indicated on the drawings. Using mechanical means, tamp evenly making several passes over the bricks. Spread a thin layer (+/- 1-1/2") of mound clay over bricks to fill voids and firmly hand tamp.
 5. Spread mound clay inside pitching mound radius and grade slopes as indicated on drawings. Compact pitcher's mound and continue to spread mound clay until required elevations are achieved.
 6. Once required elevations have been achieved, apply a generous amount of water to clay areas and tarp to cure for minimum 72 hours.

END OF SECTION

SECTION 32 1831 – SHOT PUT MATERIAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. This Section is a part of the entire set of Construction Documents and shall be coordinated with the applicable provisions of the other parts.
- B. Related Sections
 - 1. Section 31 2010 Earthwork - Athletics

1.2 SCOPE

- A. The work under this section of the specification shall consist of furnishing all labor, materials and equipment to produce, place, spread, compact and finish shot put landing material to proper grade and cross section.

1.3 SUBMITTALS

- A. Submit to the Landscape Architect a sieve analysis of the proposed shot put material to be installed.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. The materials shall meet the following requirements:
 - 1. Shot Put Landing Areas shall be crushed limestone athletic meal as supplied by Stoneco (phone (734-241-8996), or approved equal. Gradation values are as follows:

<u>Screen Size</u>	<u>Percent Retained</u>
3/8"	0.0
#4	0.3
#8	1.5
#16	21.8
#30	48.2
#50	69.7
#100	83.5
#200	<u>90.5</u>

TOTAL: 100%

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Place a minimum 6" depth of material on new shot put area. For location and dimensions, please refer to drawings.
- B. Material shall be compacted to 90% Modified Proctor

END OF SECTION

SECTION 32 1836 – ACRYLIC TENNIS COURT SURFACE - CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section is a part of the entire set of Contract Documents and shall be coordinated with the applicable provisions of the other parts.
- B. Related Sections:
 - 1. Section 03 3800 Post-Tensioned Concrete

1.2 SCOPE

- A. The work under this section of the specifications shall consist of furnishing all labor, materials and equipment necessary for acrylic tennis court surfacing and line markings.

1.3 QUALITY ASSURANCE

- A. Reference Standards:
 - 1. American Sports Builders Association (ASBA)
- B. The installation contractor must be able to supply the Owner, upon request, a list of twenty (20) outdoor tennis courts surfaces with the material accepted over the last five (5) years and have required no maintenance.

1.4 SUBMITTALS

- A. COLOR SAMPLES MUST BE PROVIDED WITH BID.
- B. Contractor shall submit manufacturer's data sheets and color samples for all materials.
- C. Contractor must submit copies of the Material Data Safety Sheets (MSDS) for all products to be used, before materials are delivered to the site.

PART 2 - PRODUCTS

2.1 TENNIS COURT SURFACE MATERIAL

- A. This material shall be a fully pigmented system in-depth color. The material shall be from one of the following approved manufacturers:
 - 1. NOVACOURT, by Novasport USA, Framingham, MA (800) 872-6682
 - 2. PLEXI-PAVE, by California Products, Cambridge, MA (800) 225-1141
 - 3. LAYKOLD, by Advanced Polymer Technology, Harmony, PA (888) 266-4221
 - 4. SportMaster Sport Surfaces by Seal Master, Sandusky, Ohio 800-326-1994
- B. Acrylic Coloring of Courts for inner (playing court) and outer (non-playing court) shall be selected from manufacturer's standard colors.
- C. Asphalt or tar in any form will not be permitted in any coating. The color shall be pure acrylic-type containing no asphalt or tar emulsions and no vinyls, alkyds or non-acrylic resins. The color finish system shall contain factory-mixed compositions requiring only the addition of water on the job site. The material shall be delivered to the site in sealed containers with the manufacturer's label affixed.

2.2 CONCRETE PRIMER

- A. Manufacturer-specific concrete primer
 - 1. Novacrylic WB100 Water Based Epoxy, by Novasport USA
 - 2. Ti-Coat (PLEXI-PAVE), by California Products
 - 3. Polyprimer (LAYKOLD), or Qualipur 152 2 part by Advanced Polymer Technology
 - 4. Acrylic Adhesion Promoter (SportMaster) by Seal Master

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Concrete shall cure for a minimum of 30 days prior to application of surfacing materials. Concrete shall have a medium broom finish. No curing compounds/agents are to be used.
- B. Acid-etch surface with phosphoric or muriatic acid and rinse thoroughly with water before installation of any finish surface coatings.
- C. The concrete surface shall be flooded by concrete paver/site contractor (if different), and any ponding water that remains after 1 hour and is deep enough to cover the thickness of a five cent piece shall be corrected using a patch mix by the approved surfacing manufacturer. Ambient air

temperature to be +/- 70 degrees. Application of patch-mix material shall be performed by the surfacing contractor unless noted otherwise.

- D. Application of the system shall be in strict accordance with the printed instructions of the manufacturer. If the system is installed by someone other than the manufacturer, an experienced manufacturer's representative shall supervise the installation of the material.
- E. The surface to receive the tennis surface system as specified shall be checked to be free from grease, oil and other foreign materials before starting the work. The Contractor shall remove by brush, vacuum or blower all dust, dirt, imbedded soil, etc. and shall mechanically wash areas, if required.
- F. Holes, cracks and spalled areas shall be clean of dirt, water and deleterious materials before any coating operations are started. After cleaning and treating these areas with the proper filler materials, the application shall proceed only if the surfaces are dry and clean and the surface temperature is at least fifty degrees Fahrenheit (50°F) and rising, with overnight temperature not less than 45 °F, and the surface temperature is not in excess of one hundred forty degrees Fahrenheit (140°F).
- G. After all leveling and patching, the tennis court area shall receive one (1) coat of manufacturer-specific concrete primer.
- H. One (1) coat of sand filled acrylic resurfacer material shall be applied at the rate specified by the surface manufacturer.
- I. Apply two (2) filler coats and one (1) finish coat. Application shall be in strict accordance with manufacturer's specifications. The material shall have in-depth color in the color combinations as indicated for the final surface.
- J. The filler coat shall be applied at a rate of .05 gallons (concentrated material prior to dilution) per square yard for each coat. The final surface shall be applied at a rate of .04 gallons (concentrated material prior to dilution) per square yard for each coat. Only small amounts of water shall be added if too rapid drying is occurring during application. The Contractor shall be accountable at all times for the amount of materials of each color used. Permission of the Landscape Architect shall be obtained before adding any additional water.
- K. Care shall be taken to protect adjacent areas and structures (fences, posts, sidewalks, buildings, etc.) which are not to be coated. If coated, remove immediately before drying occurs.
- L. Contractors must notify the Landscape Architect of all applications, 48 hours prior to installation.
- M. Acceptability of work: The finished surface shall be constant in color and texture, free from voids, depressions, joint marks, ridges, wheel marks or other imperfections. If any of these become apparent during the installation of the system, the contractor will correct prior to the final coat application, or the surface shall be rejected.

3.2 LINE MARKINGS

- A. Upon completion and acceptance of the tennis surface, this Contractor shall prepare and paint lines for tennis. Unless otherwise noted, tennis lines shall be white.
- B. The lines shall be masked on both sides with an acceptable tape. Each measurement shall be accurately set to within 1/8" tolerance in accordance with the American Sports Builders Association (ASBA). Each court area shall be marked for doubles play.
- C. All areas that have overlapped in color shall be corrected and non-appearing. All overspray in excess shall be corrected and non-appearing. No spraying shall be done with the wind factor above seven (7) mph.

END OF SECTION

SECTION 32 3100 – CHAINLINK FENCE

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section is a part of the entire set of Contract Documents and shall be coordinated with the applicable provisions of the other parts.
- B. Related Sections:
 - 1. Section 03 3000 Cast In Place Concrete – Athletics
 - 2. Section 03 3800 Post Tension Concrete
 - 3. Section 31 2010 Earthwork – Athletics

1.2 SCOPE

- A. The work under this section of the specifications shall consist of furnishing all labor, materials and equipment necessary for a new chainlink fence system as indicated herein and on Contract Documents. Work shall include but not limited to footings, posts, fabric, rails, gates and all related hardware.

1.3 QUALITY ASSURANCE

- A. Reference Standards:
 - 1. American Society for Testing and Materials (ASTM):
 - a. ASTM C94 – Standard Specification for Ready-Mixed Concrete
 - b. ASTM A116 – Standard Specification for Metallic-Coated, Steel Woven Wire Fence Fabric
 - c. ASTM A120 – Standard Specification for Black and Hot-Dipped Zinc Coated (Galvanized) Welded Seamless Pipe
 - d. ASTM A491 – Standard Specification for Aluminum Coated Steel Chain Link Fence Fabric
 - e. ASTM F567 – Standard Practice for Installation of Chainlink Fence
 - f. ASTM F900 – Standard Specification for Industrial and Commercial Swing Gates
 - g. ASTM 1083 – Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures
 - h. ASTM F1184 – Standard Specification for Industrial and Commercial Horizontal Slide Gates
- B. Weights and tolerances to conform to Federal Specification RR-F-191/1D, dated May 14, 1990. Mill certificates shall be made available at the request of the Landscape Architect or Owner.
- C. All material installed under this specification shall be subject to testing by the Owner. Any material so inspected and found to be not in strict conformance with this specification shall be promptly removed and replaced by the Contractor at his expense.

1.4 WARRANTY GUARANTEE

- A. The Contractor and any Sub-contractors hereunder guarantee their respective work against defective materials or workmanship for a period of one (1) year from the date of filing Certificate of Substantial Completion and as accepted by the Owner.

1.5 PROJECT CONDITIONS

- A. Field Measurements: Verify layout information for chainlink fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in the manufacturing of products specified in this section with a minimum of ten (10) years experience
- B. Installer: Company specializing in performing work of this section with a minimum of five (5) years experience of comparable projects. Must have a minimum of two in-house fence installation crews.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver fence fabric and accessories in packed cartons or firmly tied rolls.
- B. Identify each package with manufacturer's name.
- C. Store fence fabric and accessories in a secure and dry place.

1.8 SUBMITTALS

- A. Shop drawings showing plan layout, spacing of components, post foundation dimensions, hardware, gates and schedule of components.
- B. Product Data: Submit product data on fabric pattern, posts, accessories, fittings, and hardware.

- C. At the request of the Architect, provide Material Certificates confirming product provided is Domestic pipe.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Framing Steel: ASTM F1083 domestic Schedule 40 galvanized steel pipe weighing three and sixty-five one-hundredths (3.65) lbs. per lineal foot or domestic SS-40 galvanized steel pipe weighing three and sixty-five one-hundredths (3.65) lbs. per lineal foot with hot dip galvanized zinc exterior and interior. Pipe shall utilize flow coat or inline galvanization process.
- B. Fabric Wire: ASTM A392 Class 1 zinc coated steel wire or aluminized steel wire.
- C. Concrete: ASTM C94; Portland Cement 3,500 psi strength at 28 days.
- D. All hardware and caps shall be made in the USA.

2.2 COMPONENTS

- A. Chain Link Fabric: The chain link fabric shall be 2" mesh, 9 gauge. Top and bottom selvage shall have knuckle finish. Fabric shall be free from barbs, icicles or other projections resulting from the aluminizing process, and any fabric not free thereof will be rejected even though erected. Bottom of fence fabric shall be 3/4", ±1/4" above grade.
- B. Line Posts: Line posts shall not be splice welded in such a manner that the weld appears above the grade line. All line posts shall have an outside diameter of 2 1/2", except the Varsity Baseball outfield fence which shall have any outside diameter of 3". The chain link fabric shall be tied to the line posts with No. 9 gauge annealed galvanized steel tie wire. Aluminum wire ties will not be accepted. Fence fabric shall be secured to line posts no more than 18" O.C., with excess wire cut off and turned down.
- C. Terminal and Gate Post: Terminal and gate posts shall not be splice welded in such a manner that the weld appears above the grade line. End, corner and gate posts shall have an outside diameter of 3" and weight of not less than five and seventy-nine one-hundredths (5.79) lbs. per lineal foot. Post caps at terminal posts shall be securely fastened to prevent removal.
- D. Terminal and Gate Post Fittings: Terminal and gate post fittings including tension bands, brace connections and top rail connections shall be No. 11 gauge. Hot-dipped iron or pot metal fittings will be accepted as equals or substitutes. Top rail, brace and truss bands shall not be less than one inch (1") wide, secured by five-sixteenths inch (5/16") diameter carriage bolts and nuts.
- E. Top, Mid and Bottom Rails: Top, middle, and bottom rails shall meet the same specifications of quality as line and terminal posts. The rails shall have an outside diameter of one and five-eighths inches (1-5/8") and weigh two and twenty-seven one-hundredths (2.28) lbs. per lineal foot. An outside sleeve-type coupling measuring not less than 6" in length shall be provided at each interval of twenty feet (20'). The chain link fabric shall be tied to the top rail at intervals of twenty-four inches (24") with No. 9 gauge annealed galvanized steel tie wire. Rail(s) shall be securely fastened by means of suitable malleable iron or pressed steel connections. The terminal ends of all top, bottom, mid and bracing rails shall utilize fully closed rail end cups that prevents insects from gaining access into top rails.
- F. Braces and Terminal Gate and Gate Posts: Terminal and gate posts shall be strengthened and reinforced by braces meeting the same specifications of quality as line and terminal posts. Braces shall be installed midway between top rail and grade and extend from each terminal post to the first adjacent line posts. Braces shall be securely fastened to posts by heavy pressed steel connections and also be trussed from line posts back to terminal post with a three-eighths inch (3/8") round truss rod complete with tightened unit.
- G. Post Spacings and Settings:

1. Gate, terminal and end posts shall be set in concrete foundation not less than twelve inches (12") in diameter and not less than forty-two inches (42") in depth. Concrete shall attain a compressive strength of not less than three thousand five hundred (3,500) lbs. per square inch at the twenty-eighth (28th) day after pouring. Spacing of posts in the line of fence shall be uniform. See plans for dimensions.
2. Line posts can either be set in concrete foundations as noted above or pneumatically driven.
3. Refer to Chart in Section 3.2, A.

H. Gates:

1. Gates shall be not less than four feet (4') wide and constructed and hung as detailed on drawings.
2. Frames shall be constructed of pipe, having an outside diameter of 1.9" or alternately, being two inches (2") square and weighing two and seventy-two one-hundredths (2.72) lbs. per lineal foot. Gate frames shall be welded, or alternately, shall utilize corner fittings of heavy malleable iron or pressed steel securely riveted to the frame.
3. Fabric matching the system fence fabric shall be installed in the frame by means of tension bars and hook bolts.
4. Frames having corner fittings shall be equipped with adjustable truss rods having a diameter of three-eighths inches (3/8").
5. Hinges shall be of adequate strength to support the gate and have large bearing surfaces for clamping in position. Under no conditions of use or abuse shall the hinges twist or turn under action of the gate.
6. Gates shall be capable of being opened and closed quickly and easily by one (1) person. Gates shall be equipped with a positive strong arm latching device that will accommodate padlocking. A plunger rod, catch and semi-automatic outer catch shall be installed on drive gates so as to secure gates in an open position. Hinges, latches and catches shall be approved by the Landscape Architect.

I. Hardware

1. All hardware requiring nuts and bolts should have no more than 1/2" of the threaded bolt extending beyond the nut.
2. Standard gate hinges shall utilize Bulldog Hinges.
3. Gates 16' wide and larger shall utilize galvanized pressed-steel hinges.
4. Gate latches shall be commercial grade Strong Arm gate latches
 - a. Fork & collar not approved

J. Driven Post Caulk

1. Contractor is responsible to caulk around all driven fence posts.
2. Caulk shall be supplied from the following manufacturer:
 - a. Sportmaster "Courtflex Crack Sealant"
Phone: 800-395-7325
 - b. Color: Neutral

2.3 FENCE COMPONENTS – BACKSTOPS (JV Fields)

- A. Chain Link Fabric: The chain link fabric shall be 2" mesh, 6 gauge for the bottom six feet (6') of the backstop. The remaining vertical dimension shall have chain link fabric with 2" mesh 9 gauge. The canopy shall be 2" mesh, 11 gauge. Top and bottom sleeve shall have knuckle finish. Fabric shall be free from barbs, icicles or other projections resulting from the aluminizing process, and any fabric not free thereof will be rejected even though erected. Bottom of fence fabric shall be buried 6" into the ground and tied to the bottom rail.
- B. Line Posts: Line posts shall not be splice welded in such a manner that the weld appears above the grade line. Line posts shall have an outside diameter of 4" and weight of not less than six and fifty-six one-hundredths (6.56) lbs. per lineal foot.
- C. Terminal Posts: Terminal posts shall not be splice welded in such a manner that the weld appears above the grade line. End posts shall have an outside diameter of 6-5/8" and weight of not less than eighteen and ninety-nine one-hundredths (18.99) lbs. per lineal foot.

- D. Terminal Post Fittings: Terminal post fittings including tension bands, brace connections and top rail connections shall be No. 11 gauge. Hot-dipped iron or pot metal fittings will be accepted as equals or substitutes. Top rail, brace and truss bands shall not be less than one inch (1") wide, secured by five-sixteenths inch (5/16") diameter carriage bolts and nuts.
- E. Top, Intermediate and Bottom Rails: Top rail shall meet the same specifications of quality as line and terminal posts. The top rail shall have an outside diameter of one and five-eighths inches (1-5/8") and weigh two and twenty-seven one-hundredths (2.27) lbs. per lineal foot. An outside sleeve-type coupling measuring not less than 6" in length shall be provided at each interval of twenty feet (20'). The chain link fabric shall be tied to the top rail at intervals of twenty-four inches (24") with No. 9 gauge annealed galvanized steel tie wire. Rail(s) shall be securely fastened by means of suitable malleable iron or pressed steel connections. Intermediate rails shall be fastened between posts with vinyl clad boulevard type connectors or bands and rail end caps. The terminal ends of all top, bottom, mid and bracing rails shall utilize fully closed rail ends hardware that prevents insects from gaining access into top rails.
- F. Braces: Braces shall be installed midway between top rail and grade and extend from each terminal post to the first adjacent line posts. Braces shall be securely fastened to posts by heavy pressed steel connections and also be trussed from line posts back to terminal post with a three-eighths inch (3.8") round truss rod complete with tightened unit.
- G. Post Spacings and Settings: Line and terminal posts shall be set in concrete foundation not less than twelve inches (18") in diameter and not less than forty-eight inches (48") in depth. Concrete shall attain a compressive strength of not less than three thousand five hundred (3,500) lbs. per square inch at the twenty-eighth (28th) day after pouring. Spacing of posts in the line of fence shall be uniform. See plans for dimensions.

2.2 FENCE COMPONENTS - TENNIS COURTS

- A. Chain Link Fabric: The chain link fabric shall be 1-3/4" mesh, 9 gauge. Top and bottom selvage shall have knuckle finish. Fabric shall be free from barbs, icicles or other projections resulting from the aluminizing process, and any fabric not free thereof will be rejected even though erected. Bottom of fence fabric shall be 3/4" plus or minus 1/4" above court surface.
- B. Line Posts: Line posts shall not be splice welded in such a manner that the weld appears above the grade line. All line posts shall have an outside diameter of 2 1/2" The chain link fabric shall be tied to the line posts with No. 9 gauge annealed galvanized steel tie wire no more than 18" O.C. Excess wire shall be cut off and turned down.
- C. Terminal and Gate Post: Terminal and gate posts shall not be splice welded in such a manner that the weld appears above the grade line. End, corner and gate posts shall have an outside diameter of 3" and weight of not less than five and seventy-nine one-hundredths (5.79) lbs. per lineal foot.
- D. Terminal and Gate Post Fittings: Terminal and gate post fittings including tension bands, brace connections and top rail connections shall be No. 11 gauge. Hot-dipped iron or pot metal fittings will be accepted as equals or substitutes. Top rail, brace and truss bands shall not be less than one inch (1") wide, secured by five-sixteenths inch (5/16") diameter carriage bolts and nuts.
- E. Top, Middle and Bottom Rails: Rails shall meet the same specifications of quality as line and terminal posts. The rails shall have an outside diameter of one and five-eighths inches (1-5/8") and weigh two and twenty-seven one-hundredths (2.27) lbs. per lineal foot. An outside sleeve-type coupling measuring not less than 6" in length shall be provided at each interval of twenty feet (20'). The chain link fabric shall be tied to the top rail at intervals of twenty-four inches (24") with No. 9 gauge annealed galvanized steel tie wire. Rail(s) shall be securely fastened by means of suitable malleable iron or pressed steel connections. The terminal ends of all top, bottom, mid and bracing rails shall utilize fully closed rail end cups that prevents insects from gaining access into top rails.
- F. Braces and Terminal Gate and Gate Posts: Terminal and gate posts shall be strengthened and reinforced by braces meeting the same specifications of quality as line and terminal posts. Braces shall be installed midway between top rail and court surface and extend from each terminal post to the first adjacent line posts. Braces shall be securely fastened to posts by heavy pressed steel connections and also be trussed from line posts back to terminal post with a three-eighths inch (3.8") round truss rod complete with tightened unit. Post Spacing and Settings: Line and terminal posts shall be set in concrete foundation not less than twelve inches (12") in diameter and not less

than forty-two inches (42") in depth. Concrete shall attain a compressive strength of not less than three thousand five hundred (3,500) lbs. per square inch at the twenty-eighth (28th) day after pouring. Spacing of posts in the line of fence shall be uniform. See plans for spacing dimensions.

G. Gates:

1. Gates shall be not less than four feet (4') wide and constructed and hung as detailed on drawings.
2. Frames shall be constructed of pipe having an outside diameter of 1.9" or alternately, being two inches (2") square and weighing two and seventy-two one-hundredths (2.72) lbs. per lineal foot. Gate frames shall be welded, or alternately, shall utilize corner fittings of heavy malleable iron or pressed steel securely riveted to the frame. Fabric matching the fence fabric shall be installed in the frame.
3. Fabric matching the fence fabric shall be installed in the frame by means of tension bars and hook bolts.
4. Frames having corner fittings shall be equipped with adjustable truss rods having a diameter of three-eighths inches (3/8").
5. Hinges shall be of adequate strength to support the gate and have large bearing surfaces for clamping in position. Under no conditions of use or abuse shall the hinges twist or turn under action of the gate.
6. Gates shall be capable of being opened and closed quickly and easily by one (1) person. Gates shall be equipped with a positive latching devise that will accommodate padlocking. A plunger rod, catch and semi-automatic outer catch shall be installed on drive gates so as to secure gates in an open position. Hinges, latches and catches shall be one of the manufacturer's standard designs as selected and approved by the Landscape Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for a verified survey of property lines and legal boundaries, site clearing, earthwork, pavement work, and other conditions affecting performance of the Work.
 1. Do not begin installation before final grading is completed unless permitted by Architect.
 2. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Stake locations of fence lines, gates and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks and property monuments.

3.2 INSTALLATION

- A. All posts shall be set plumb and in accordance with the following table (unless specified otherwise):

1. Corner/Terminal and Bracing Post - General Fence

Fabric Height	Post Depth	Diameter of Foundation	Foundation Depth	Maximum Spacing
0' - 6'-0"	36"	12" min	42"	8'-0"
6'-1" - 10'-0"	36"	12" min	42"	8'-0"
12'-0"	36"	12" min	48"	6'-0"

2. Line Post - Backstop

Backstop Height	Post Depth	Diameter of Foundation	Foundation Depth	Maximum Spacing
24'	48"	18" min	60"	Varies
30'	48"	18" min	60"	8'-0"

3. Line posts shall be pneumatically driven into the ground using the following chart*:

Fabric Height	Pipe Below Grade	Total Length of Post
4'	4'	8'
6'	5'	11'

8'	6'	14'
10'	7'	17'
12'	8'	20'

- B. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil.
- C. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.
 - 1. Verify that posts are set plumb, aligned and at correct height and spacing, and hold position during setting with concrete or mechanical devices.
 - 2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.
- D. Fence posts shall be installed with maximum 6 inches clear opening from end posts to buildings, fences, property lines or other structures.
- E. Install gates level, plum and secure for full opening without interference. Attach hardware using tamper-resistant or concealed means. Adjust hardware for smooth operation and lubricate where necessary.
- F. The fabric shall be installed on the court/playing side of posts. Bottom of fence fabric shall be 3/4" (+/-1/4") above the finished court surface. Fabric shall be furnished with selvage knuckled on both ends.
- G. Top of concrete footing shall be left down and topped with surrounding pavings as detailed. Asphalt cold patch is not acceptable.

3.3 CLEAN UP AND DISPOSAL

- A. Remove dirt and concrete from rails and posts.
- B. Remove all tags.
- C. Remove from the site all equipment, materials, and debris resulting from construction work included in this section. Leave work area neat and clean and in a condition acceptable by the Landscape Architect and Owner. All work shall be complete, ready for use, at the time of final acceptance.

END OF SECTION

SECTION 32 8400 – UNDERGROUND IRRIGATION SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section is a part of the entire set of Contract Documents and shall be coordinated with the applicable provisions of the other parts.
- B. Related Sections/Work:
 - 1. Division 26 – Electrical
 - a. 115V Power for the controllers at locations indicated on drawing.
 - b. 115/230V or 208 V single phase power into the control panel for the booster pump
 - 2. Section 33 4413 Manholes, Catch Basins and Similar Structures
 - 3. Section 36 4600 Subdrainage Systems
 - 4. General:
 - a. Sleeving for the irrigation system (see general notes on drawing for size and type)
 - b. Cores through wall for irrigation entry and exit and conduit sleeves
 - c. Point of Connection: All plumbing up to irrigation contractor's point of connection as specified on the drawings.
 - d. Enclosures: See general notes on drawing for size and type specified.

1.2 SCOPE

- A. The work under this section of the specifications shall consist of furnishing all necessary labor, materials, equipment and tools to provide a fully automatic irrigation system as indicated on the irrigation drawings and described herein. Design shall incorporate head to head coverage for areas indicated on plans including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1.3 QUALITY ASSURANCE

- A. Reference Standards:
 - 1. American Society for Testing and Materials (ASTM):
 - a. ASTM D2235 – Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
 - b. ASTM D2241 – Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR)
 - c. ASTM D2282 – Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe (SDR-PR).
 - d. ASTM D2564 – Standard Specification for Solvent Cement for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings
- B. Manufacturer's Qualifications: Irrigation products (i.e.: sprinklers, valves, controllers) shall be by a single manufacturer. All irrigation system components shall be supplied by the regionally authorized distributors to provide single source responsibility for warranty service and operations to conform to specifications in all respects.
- C. Contractor's Qualifications: Irrigation contractor must meet the following criteria:
 - 1. Irrigation contractor to have established business for a minimum of 5 years.
 - 2. Irrigation contractor to be insured and capable of bonding.
 - 3. Irrigation contractor must have previous experience installing similar size and scope jobs.
- D. Regulatory Requirements:
 - 1. Conform to applicable code for piping and component requirements.
 - 2. Provide certificate of compliance from authority having jurisdiction indicating approval of products in system.

1.4 PROJECT CONDITIONS

- A. Specifications and Drawings
 - 1. Any items necessary; to the completion of the work shown which may not be indicated or included on the drawings or specifications, but which are necessary and usually employed in common practice shall be supplied in place as part of work.
 - 2. Discrepancies between drawings and specifications shall be brought to the attention of the

Landscape Architect who shall interpret the true intent and direct contractor as how to proceed.

3. Sprinkler lines, sprinkler heads and valve locations are schematic only. Locations of all components needed for a complete underground irrigation system shall be established by the contractor at the time of construction. Spacing of sprinkler heads and quick coupling valves are shown on the drawings.
 4. Unless otherwise indicated on drawings or specified, construction of the sprinkler system shall include furnishing, installing, final adjustments and testing of all irrigation materials and equipment.
- B. Site Conditions:
1. The Contractor shall coordinate his work with that of other trades wherever possible.
 - a. Existing Utilities and Conditions
 - i. Before excavation, the Contractor shall obtain location of all cables, conduits, sewers, septic tanks, and other utilities, and shall be cautious as not to damage them. If such obstacles conflict with the proposed work, the Contractor shall immediately notify the owner's representative for arrangements for relocation.
 - ii. In the event of damage, the contractor shall repair or replace the damaged utilities to the satisfaction of the Owner's Representative at no cost to the Owner.
 - iii. It is the Irrigation Contractor's responsibility to verify that all sleeving is installed under paving in locations as shown on drawings.
 - b. Coordinate system installation with size, location and installation of service utilities.
 - c. Coordinate the work with site backfilling, site grading and existing plants.

1.5 SUBMITTALS

- A. Shop Drawings: Indicate piping layout to water source, location of sleeves under pavement, location and coverage of sprinkler heads, components, plant and landscaping features, site structures and schedule of fittings to be used.
- B. Product Data: Provide component and control system, including wiring diagrams.
- C. Manufacturer's Installation Instructions: Include controller, heads, valves, and drainage.
- D. Record Documents: After completion of system and before final payment, contractor shall furnish to Owner a reproducible copy of the drawing of record of the entire system showing sprinkler heads, valves, drains, controllers and pipelines to scale with dimensions as required.
- E. Operation and Maintenance Data:
 1. Provide instructions for operation and maintenance of system and controls, seasonal activation and winterization and manufacturer's parts catalog. Maintenance sheets and operations manuals shall be bound into a folder and furnished to the Owner.
 2. Provide schedule indicating length of time each valve is required to be open to provide a determined amount of water.
 3. Contractor shall also provide all necessary specialty tools for maintaining the system.

1.6 EXTRA MATERIALS

- A. Provide the following extra components:
 1. Two sprinkler heads of each type and size.
 2. Two valve keys for manual valves.
 3. Two valve box keys.
 4. Two keys for valve markers.
 5. Two wrenches for each type head core and for removing and installing each type head.
 6. Contractor shall provide equal number of brass quick coupler keys for each quick coupling valve installed. Quick coupler keys shall also include fitting to allow for easy attachment to a standard garden hose.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. The basis of design for all sprinkler heads, valves, controllers and quick coupler valves shall be provided by Hunter. Bidders may elect to use approved equal products as manufactured by Toro or Rainbird.

2.2 MATERIALS

A. Pipe

1. PVC Pipe: All PVC pipe shall be pressure pipe as manufactured by J-M Manufacturing or Cresline Plastic Pipe Company. High-impact virgin polyvinyl-chloride (PVC-1120) conforming to NSF Standard 14 and ASTM D-2241 for thermoplastic pipe with minimum 160 PSI test strength. Pipe shall have standard thermoplastic pipe dimension ratio of SDR-26 and shall be marked or stamped every 5 feet to indicate brand, strength rating, size and standards.
2. Polyethylene Pipe: All polyethylene pipe specified on plan shall be high-density (HD) flexible, non-toxic polyethylene made from 100% virgin polyethylene material, and all sizes shall have a minimum 100 PSI working pressure rating (ASTM D2239) conforming to NSF standard for thermoplastic pipe dimension ratio of SDR-15. All polyethylene pipe shall be continuously and permanently marked with the manufacturer's name, materials, size and schedule. Pipe shall conform to the U.S. Department of Commerce Commercial Standard CS255-63-PE-3408 or latest revision thereof. Pipe shall be suitable for potable water and shall bear the "NSF" trademark. See drawing for sizes specified.

B. Pipe Sleeves

<u>Pipe Sleeve Size</u>	<u>Sleeve Size</u>	<u>Sleeve Type</u>
3/4" to 1"	2-inch	PVC 160 or Sch.40 DWV pipe
1-1/4" to 1-1/2"	3-inch	PVC 160 or Sch.40 DWV pipe
2" to 2-1/2"	4-inch	PVC 160 or Sch.40 DWV pipe
3 inch	6-inch	PVC 160 or Sch.40 DWV pipe
4 inch	8-inch	PVC 160 or Sch.40 DWV pipe
6 inch	10-inch	PVC 160 or Sch.40 DWV pipe

(Sleeve sizes and locations are based on a single pipe being installed in a sleeve. Contractor shall verify sleeve sizes with drawing.)

C. Fittings

1. PVC Pipe Fittings: All fittings 1-1/2" through 3" shall be Schedule 40 PVC solvent weld, type 1, meeting the requirements of ASTM D-2466. No saddles allowed. All 4" fittings shall be gasketed joint Harco PVC Class 200 meeting ASTM D1784 DR21 requirements. Bell shall be gasket joint conforming to ASTM3139 with gaskets conforming to ASTM F477. Fittings 6" and larger shall be Harco Ductile Iron Fittings manufactured with a grade of 65-45-12 in accordance with ASTM F-477 requirements.
2. Polyethylene Fittings: All fittings 1-1/4" and smaller downstream of control valve shall be plastic or insert type fittings where applicable. All 1-1/4" fittings shall be double clamped with all stainless steel worm gear clamps. All 1" and smaller fittings shall be clamped with all stainless steel worm gear clamps or all stainless steel crimp clamps.

D. Valves and Valve Box

1. Valves: Hunter PGV
2. Valve Boxes: All valves shall be protected by a two-piece valve box assembly consisting of a removable cover and box. Enclosure shall be rigid plastic material composed of fibrous components chemically inert and unaffected by moisture, corrosion and temperature changes. Boxes shall be sized as follows:
 - a. Minimum of a 10" valve box and cover shall be used for all automatic valves 1-1/2" and smaller and for all manual gate valves and quick coupling valves.
 - i. Box Color: Green
 - ii. Lid Color: Green
 - b. Minimum of a 12" valve box and cover shall be used for all automatic valves 2" and larger.

- i. Box Color: Green
 - ii. Lid Color: Green
 - c. Side walls to extend at least 2 inches below the bottom of the valve body; for deep mainline appropriate extensions shall be used to reach depth of valves. Valve box shall not bear directly on pipe. Manufacturer shall be Pentek or Carson.
 - E. Backflow Prevention Devices: Utilize existing backflow prevention devices with new irrigation system. At Troy HS, Contractor shall modify existing backflow device to allow for enclosure of backflow/vacuum breaker in a new enclosure.
 - F. Vacuum Breaker: Utilize existing vacuum breaker with new irrigation system.
 - G. Quick Coupling Valves:
 1. Shall be 1" one-piece brass body with a locking rubber cover.
 2. Quick couplers shall also include a ductile iron stabilizer as manufactured by Leemco Piping Products, or approved equal.
 - a. ¾" – 1": Model #LS-120
 - b. 1-1/2": Model# LD-150
 3. Quick coupler valves shall be fitted to allow easy connection to standard garden hose.
 - H. Sprinkler Heads: Shall comply with Hunter I-25-06-SS: fixed stainless steel riser surface head required for coverage and application. Heads must perform at 70% efficiency.
 - I. Controllers
 1. The controller shall be a full-featured commercial product for the operation, management, and monitoring of control valves and sensors. The controller shall be of a modular design with a standard 8 station output, expandable in 4, 8, or 22 station modules up to 54 stations.
 2. Controller shall be available as follows:
 - a. Metal Wall Mount Enclosure: Model: Hunter I2C-800-M
 - b. Controller Housing: shall be furnished in an outdoor, weather resistant, wall mount metal enclosure, pre-wired for remote control, with a key lock. Provide (2) keys per controller.
 - c. All station outputs shall have MOV and copper induction coil surge suppression.
 - d. The enclosure shall be a NEMA 3R and IP-54 rated.
 3. Controller Hardware:
 - a. All programming shall be accomplished by use of a programming dial and selection buttons, backlit by a LCD display.
 - b. The front panel shall be removable to allow for programming without AC power, via a 9VDC battery.
 4. The controller transformer shall be equipped with an internal, self-resetting thermal circuit breaker to protect against overheating.
 5. Station Modules and Sensor Inputs
 - a. Controller shall provide (6) separate station module slots, expandable up to 54 stations.
 - b. The controller shall have self-diagnostic, electronic short circuit protection that detects a faulty circuit, continues watering the remainder of the program, and reports faulty station on the display.
 - c. The controller shall be incorporate an external weather sensor that can change for seasonal adjustment and include rain and freeze shutoff functions. Model #: SOLARSYNCSN.
 - J. Cloud Based Control and Monitoring
 1. Provide all required hardware and software components with irrigation controller to allow for cellular communication and Hunter Centrius Software. Software shall allow for desktop and mobile monitoring and control of irrigation system.
 - K. Solvent and Primer: Solvent and primer used on PVC pipe shall meet the requirements of ASTM D-2564 and shall be approved by the National Sanitation Foundation. All solvent and primer to be used in accordance with manufacturer's specification. Primer to be purple in color. Solvent shall be used as is from original container. No thinner shall be added to the solvent to change its viscosity. If viscosity or consistency is unsuitable, the solvent shall not be used.

- L. Swing Joints:
 - 1. All sprinkler heads 6 GPM or less shall be attached to the piping with two-elbow joints consisting of 3/8" flexible pipe and coordinating elbows.
 - 2. All sprinkler heads over 6 GPM shall be attached to the piping with a PVC three-elbow swing joint assembly to match the inlet size of the sprinkler head by Spears or Lasco.
 - 3. All quick coupling valves shall be attached to the piping with a PVC three elbow swing joint assembly with a brass thread to match the inlet size of the quick coupler by Spears or Lasco.
 - 4. All sprinkler heads with a 1" or larger inlet shall be attached to the PVC pipe using Spears 5807 series or Lasco one-piece swing joint assembly. Match model to inlet size of sprinkler head.
- M. Wire and Wire Splices
 - 1. Wire: All wire shall be 600 volt soft annealed copper, PVC insulated, UL approved, type UF. Minimum wire size to be No.14.
 - 2. Wire splices: All 24 volt wire connections shall be made using a water-tight 3M DBY connectors. All field splices shall be contained in a 6" valve box.
- N. Flow Sensor – Provide flow sensor at manufacturer recommended distances on irrigation mainline. Model #: Flow-Sync®
- O. Irrigation Enclosure
 - 1. Provide new backflow prevention assembly enclosure at Troy High School to replace existing enclosure. Work shall include modifying existing vacuum breaker to fit within new enclosure.
 - 2. Acceptable Manufacturer: Safe-T-Cover, or approved equal. Heating equipment not required.
 - 3. Materials:
 - a. Material shall be 5052-H32 marine grade aluminum, mill finish and shall meet ASTM B209.
 - b. Insulation shall be 1.5" (9.0 "R" value) minimum thickness polyisocyanurate foam laminated to a glass fiber reinforced facer, each side. Insulation shall have the following properties:
 - i. Dimensional stability – less than 2% linear change, ASTM D2126
 - ii. Compressive Strength – 20PSI, ASTM D-1621
 - iii. Water Absorption-Less than 1% by volume, ASTM C-209
 - iv. Moisture Vapor Transmission-Less than one (1) perm, ASTM E-96
 - v. Product Density-Nominal 2.0 lbs. per cubic foot, ASTM D-1622
 - vi. Flame Spread=25, ASTM E-84
 - vii. Service Temperature= -1000F to +2500F maximum
 - viii. The insulation shall be of uniform thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work. Contractor shall verify locations of all existing and new utilities prior to work.
- B. Verify that required utilities are available, in proper location and ready for use.
- C. Beginning of installation means installer accepts existing conditions.

3.2 LAYOUT AND STAKING

- A. Piping Layout: Piping layout is diagrammatic. Irrigation contractor shall verify site conditions and route piping to avoid plants, ground cover and structures. Any deviations from the plan shall be approved by the Owner's Representative prior to installation. Route piping to avoid plants and structures.
- B. Staking: All sprinkler heads, valves and mainline line routing shall be staked prior to installation for approval upon request of the Owner's Representative.

3.3 SYSTEM DESIGN

- A. Irrigation design is based on information and criteria provided by the Owner. Contractor is responsible to field verify existing conditions and modify irrigation system as necessary to meet the minimum design criteria noted herein and reflected on drawings.

- B. Minimum water coverage for general lawn areas is 100%, unless otherwise noted.
- C. Flow sensors to be placed downstream of backflow.

3.4 TRENCHING

- A. Trench to accommodate grade changes and slope to drains. Maintain trenches free of debris, material or obstructions that may damage pipe.
- B. Trench shall be excavated so that irrigation lines are installed with the following minimum depths for pipe cover:
 - 1. All Polyethylene Distribution Pipe – 12 inch deep for spray circuits, 15 inch deep for rotor pip-ups.
 - 2. All PVC Distribution/Main Pipe: Depth is specified below:

1-1/2" - 2" pipe size	16" cover
2 1/2" - 4" pipe size	20" cover
6" - 8" pipe size	24" cover
10" pipe size	30" cover
 - 3. All Piping in Plant Beds – 15 inch deep
- C. All wire:
 - 1. 115V power wire - 24" or as required by code.
 - 2. 24V control wire - 14" or as required by code.
 - 3. Hydraulic control tubing - 14" minimum.
- D. All PVC piping shall be trenched. PVC pipe of smaller sizes may be pulled with approval of owner's representative if proper soil conditions exist and minimum depth requirements are maintained.
- E. Polyethylene distribution pipe may be pulled, with approval of owner's representative, if proper soil conditions and minimum depth requirements are maintained.
- F. Trench excavation in excess of required depth shall have bottom graded and tamped to required gradient for proper drainage prior to any pipe placement.
- G. Where trenching of PVC or polyethylene pipe lines is not possible because of adverse soil conditions or obstructions, and backbone operation is required, provide labor, materials and equipment for this operation, including full trench backfilling with sand if required in operation of owner's representative.
 - 1. Site restoration of these areas, and as directed by the Owner's representative, shall be part of this contract and shall be performed in the following manner:
 - a. Return to grade with native soil, new 4" topsoil and new sod (see plans).
 - b. Backfill material shall be free from debris, including rocks, large stones, clay clumps or other unsuitable substances and care shall be taken to prevent settling and damage to pipe during and after backfilling operations. When backfilling, soil shall be tamped in 6-inch lifts with minimum of 6 inches of acceptable soil in turf areas and 12 inches in plant bed areas.
- H. Pavement: Where existing pavement must be cut to install irrigation system, cut smoothly in straight lines 6 inches wider than trench.
 - 1. Excavate to required depth and width.
 - 2. Remove cut-out pavement and excavated material from the site.
 - 3. Backfill with dry sand fill material, placing in 6-inch lifts.
 - 4. Repair or replace pavement cuts with equivalent materials and finishes.

3.5 INSTALLATION

- A. Install pipe, valves, control and outlets in accordance with manufacturer's instructions, and a minimum 24" from the edge of concrete or paved sidewalks, driveways or edges of parking lots.
- B. Polyethylene pipe connectors shall be made with insert fittings held tightly in place with worm gear driven stainless steel clamps and screws at ferrules. Pipe sizes 1-1/4" and larger in diameter shall be double clamped.
- C. PVC pipe shall be laid on solid undisturbed soil or on thoroughly compacted full bed of sand so as to assure full bedding, proper alignment and minimum slope for drainage.

- D. PVC pipe ends and PVC fittings shall be thoroughly cleaned for full depth of fitting with liquid cement. Method of application shall be in accordance with manufacturer's recommendations for solvent weld connections.
- E. Lay pipe on solid sub-base, uniformly sloped without humps or depressions.
- F. At wall penetrations, pack the opening around pipe with non-shrink grout. At exterior face, leave perimeter slot approximately ½ inch wide by 4/5 inch deep. Fill this slot with backer rod and an acceptable elastomeric sealant.
- G. Connection to Water Source: Point of connection shall be as indicated on drawings. Contractor shall verify point of connection with owner's representative or landscape architect.
- H. Cross Connection Protection: Install according to the state and local plumbing codes. All piping shall be galvanized steel pipe or copper pipe.
- I. Install control wiring and tubing in accordance with manufacturer's recommendations. Provide ten inch (10") expansion coil at each valve to which controls are connected, and at 100 foot intervals. Bury control tubing beside pipe.
- J. Sprinkler Heads: Flush circuit lines with full head of water and install heads after flushing is complete.
 - 1. Install lawn heads at manufacturer's recommended heights.
 - 2. Locate part-circle heads to maintain minimum distance of 4 inches from walls and 2 inches from their boundaries, unless otherwise indicated.
 - 3. All irrigation heads shall be installed on swing joints or as specified on drawing.
 - 4. All nozzles shall match sprinkler head manufacturer.
- K. Install PVC pipe in dry weather when temperature is above 40°F (4 degrees C) in strict accordance with manufacturer's instructions. Allow joints to cure at least 24 hours at temperature above 40°F (4 degrees C) before testing, unless otherwise recommended by manufacturer.
- L. Dielectric Protection: Use dielectric fittings at connections where pipes of dissimilar metals are joined.
- M. Install backflow prevention enclosure on new concrete pad per manufacturer's instructions, verify size in the field. Enclosure shall be assembled and mounted to concrete pad in such a manner that it will be locked and secured to pad even if outside screws are removed.

3.6 THRUST BLOCKS

- A. Provide concrete thrust blocks on side of mainline pipe wherever pipe changes direction at tees, bends, or dead ends, and at any other location where thrust is to be expected.
- B. Refer to pipe manufacturer's recommendations for type and method of thrust blocks.

3.7 BACKFILLING

- A. Provide minimum three (3) inches of sand cover over piping.
- B. Backfill trench and compact to specified subgrade elevation. Protect piping from displacement.

3.8 FIELD QUALITY CONTROL

- A. Prior to backfilling, test system for leakage at main piping to maintain 100 psi pressure for one hour.
- B. Contractor shall balance and adjust various components of sprinkler system to maximize performance and efficiency. This includes synchronization of controllers, adjustments to pressure regulators, pressure relief valves, part circle sprinkler heads, individual station adjustments, and any other adjustments necessary to obtain optimum performance of system.
 - 1. Adjust all electric remote control valve pressure regulators and flow control stems for system balance and optimum performance.
- C. The contractor shall flush all lines and evacuate all air and debris from the system.
- D. Upon completion of construction, the contractor will test the entire system under normal working conditions. Upon visual inspection of the ground, should any leak be found, it shall be promptly repaired. All components will be checked for proper operation. Any malfunctioning equipment or leak shall be repaired and retested until it is in satisfactory working condition.
 - 1. System is acceptable if no leakage or loss of pressure occurs and system self drains during test period.

3.9 TRAINING

- A. Contractor shall provide in-person training to maintenance personnel for all web-based or software based control systems.

3.10 MAINTENANCE, GUARANTEE AND WARRANTY

- A. After completion, testing and acceptance of the system, instruct the owner in the operation and maintenance of the system. Following acceptance, thoroughly flush and drain the system for winter, and in the following spring, put the system in operation at no additional expense to the Owner.
- B. For a period of 1 year from the date of final acceptance of work on the contract, contractor shall provide a labor warranty to promptly furnish and install, without cost to the owner, any and all parts which prove defective in material or workmanship.
 - 1. A full five-year manufacturer's warranty on all sprinkler heads, electric valves and controllers shall be provided by the irrigation contractor. Any part proven to be defective within the 5 year warranty period shall be replaced with no cost to the Owner for parts. After the 1 year labor warranty has expired, the Owner shall be responsible for the labor to replace defective sprinkler heads, electric valves or controllers.

END OF SECTION

SECTION 32 9119 – TOPSOIL

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section is a part of the entire set of Contract Documents and shall be coordinated with the applicable provisions of the other parts.
- B. Related Sections:
 - 1. Section 31 2010 Earthwork – Athletics
 - 2. Section 32 8400 Underground Irrigation
 - 3. Section 32 9223 Lawn - Sod

1.2 SCOPE

- A. The work under this section of the specifications shall consist of furnishing all labor, materials and equipment necessary to place and spread topsoil to required depths as indicated on Contract Documents.
- B. Contractor shall make all attempts to salvage and stockpile usable topsoil from site.

1.3 QUALITY ASSURANCE

- A. Testing and inspection: At the discretion of the Landscape Architect, Contractor shall employ a qualified independent testing laboratory, specializing in soils engineering. Testing facility, or lab, shall have American Association of Laboratory Accreditation (AALA).
 - 1. Provide and pay for testing and inspection during topsoil operations. Laboratory, inspection services and Soils Engineer shall be acceptable to the Landscape Architect.
 - 2. Test representative material samples for proposed use.
 - 3. Topsoil: (Supplied by Landscape Contractor).
 - a. pH factor.
 - b. Mechanical analysis.
 - c. Percentage of organic content.
 - 4. Recommendations on type and quantity of additives required to establish satisfactory pH factor and supply of nutrients to bring nutrients to satisfactory level for planting.
 - 5. Test reports shall be made available to the Owner and Landscape Architect.

1.4 PROJECT CONDITIONS

- A. Underground and surface utility lines are to be located in field prior to construction.
- B. Protect existing trees, plants, lawns and other features designated to remain as part of the landscaping work. Protect existing trees to drip line.
- C. Promptly repair damage to adjacent facilities caused by topsoil operations. Cost of repair at Contractor's expense.
- D. Promptly notify the Landscape Architect of unexpected sub-surface conditions.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Topsoil: Natural, friable fertile soil characteristic of productive soil in the vicinity, reasonably free of stones larger than 1", clay lumps, roots and other foreign matter.
 - 1. Proposed topsoil material for shall be screened and acceptable to Landscape Architect.
 - 2. Utilize and screen on-site stockpiled topsoil as required to complete the work.
- B. Provide topsoil as required to complete job. Topsoil must meet testing criteria results specified. All processing, cleaning and preparation of this stored topsoil to render it acceptable for use is the responsibility of this Contractor.
- C. Supplied topsoil, shall be fertile, friable and representative of local productive soil, capable of sustaining vigorous plant growth and free of clay lumps, subsoil, noxious weeds or other foreign matter such as stones, roots, sticks and other extraneous materials: not frozen or muddy.
 - 1. Ph of soil to range between 5.0 and 7.5.
 - 2. Mechanical Analysis
 - a. Sand 70-85%
 - b. Silt 10-20%
 - c. Clay 10-15%
- D. Provide earth crowning where indicated on drawings.

- E. Crowning/mounding to be free flowing in shape and design, as indicated, and to blend into existing grades gradually so that toe of slope is not readily visible. Landscape Architect to verify final contouring before planting.
- F. Regardless of finish grading elevations indicated, it is intended that grading be such that proper drainage of surface water will occur and that no low areas created to allow ponding. Contractor to consult with Owner or Landscape Architect regarding minor variations in grade elevations before rough grading is completed.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine rough grades and installation conditions performed by General Contractor. Do not start topsoil work until unsatisfactory conditions are corrected and site is accepted by Landscape Contractor.

3.2 PREPARATION

- A. Establish extent of grading by area and elevation. Designate and identify datum elevation and project engineering reference points. Set required lines, levels and elevations.
- B. Do not cover or enclose work of this Section before obtaining required inspections, tests, approvals and location recording.
- C. Use of equipment of excessive weight or excessive travel over grade will not be permitted.

3.3 SITE GRADING

- A. Perform grading within contract limits, including adjacent transition areas, to new elevations, levels, profiles, and contours indicated. Provide subgrade surfaces parallel to finished surface grades. Provide uniform levels and slopes between new elevations and existing grades.
- B. Contractor shall utilize low pressure ground track equipment or flotation tires for moving soil, to prevent compaction and/or damage to the soil structure during construction.
- C. Grade surfaces to assure areas drain away from structures and to prevent ponding and pockets of surface drainage. Provide subgrade surfaces free from irregular surface changes and as follows:
 - 1. Rough grading: Plus or minus 0.10 ft. subgrade tolerance. Finish required will be that ordinarily obtained from either blade-grader or scraper operations.
 - 2. Provide subgrade surface free of exposed boulders or stones exceeding 4" in greatest dimension in paved areas; 2" lawn areas.
 - 3. Lawn and planting areas: Allow for 4" average depth of topsoil at lawn areas, except as otherwise indicated on the drawings.

3.4 FINISH GRADING

- A. Uniformly distribute and spread stockpiled topsoil. Provide 4" average depth at lawn areas, 12" at planting areas. Provide additional imported topsoil as required to complete the work. Use loose, dry topsoil. Do not use frozen or muddy topsoil. Place during dry weather.
- B. Fine grade topsoil eliminating rough and low areas to ensure positive drainage. Maintain levels, profiles, and contours of subgrades.
- C. Remove stones, roots, weeds, and debris while spreading topsoil materials. Rake surface clean of stones 1" or larger in any dimensions and all debris. Provide surfaces suitable for soil preparation provided under lawn and planting work.
- D. Manually install topsoil at trees to remain. Avoid damage to root systems.
- E. Maintenance:
 - 1. Protect finish graded areas from traffic and erosion. Keep free of trash and debris. Repair and re-establish grades in settled, eroded, and damaged areas.
 - 2. Where completed areas are disturbed by construction operations or adverse weather, scarify, re-shape, and compact to required density.

3.5 DISPOSAL OF WASTE MATERIALS

- A. Stockpile, haul from site, and legally dispose of waste materials, including excess excavated materials, rock, trash, and debris.
- B. Maintain disposal route clear, clean, and free of debris.

3.6 CLEANING

- A. Upon completion of earthwork operations, clean areas within contract limits, remove tools and equipment. Provide site clear, clean, free of debris, and suitable for site work operations.

END OF SECTION

SECTION 32 9223 – LAWNS – ATHLETIC SOD

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section is a part of the entire set of Contract Documents and shall be coordinated with the applicable provisions of the other parts.
- B. Related Sections:
 - 1. Section 31 2010 Earthwork - Athletics
 - 2. Section 32 8400 Underground Irrigation System
 - 3. Section 32 9119 Topsoil
- C. Section Includes:
 - 1. Sod (Big Roll)
 - 2. Pre-plant and post fertilizer
 - 3. Maintaining lawns until acceptance

1.2 QUALITY ASSURANCE

- A. Submit to Landscape Architect for prior approval, samples and certified analysis of fertilizer.
- B. Grass seed shall meet the tolerance for germination and purity of the Official Seed Analysis of North America.
- C. The Contractor, and its Subcontractors, shall provide a staff adequate to coordinate and expedite the work properly and shall maintain competent supervision of its own work to insure compliance with contract requirements.

1.3 DELIVERY, STORAGE AND HANDLING

- A. Deliver sod in big rolls, showing analysis of seed mixture, percentage of pure seed, year of production, net weight, date of packaging and location of packaging. Damaged packages are not acceptable.
- B. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

1.4 EXISTING CONDITIONS

- A. Lawn work Contractor shall inspect finish grade for acceptability. Beginning work means acceptance of existing conditions.

PART 2 - PRODUCTS

2.1 SOD (mineral based)

- A. Contractor is to sod areas designated on plans. Topsoiling, finish grading and fertilizing to remain the same.
 - 1. Sod shall be a tri-blend mix of Kentucky Bluegrass grown on a mineral base soil. Sod grown on a peat based soil is unacceptable and will not be permitted on site. Sod shall contain a minimum of three (3) varieties. Weed content shall not be over three tenths of one percent (0.03%). Submit a sample to the Landscape Architect for approval before delivery to the site.
 - 2. Topsoil shall be worked to a smooth, uniform surface and compacted firmly. Any lumps or depressions which occur shall be regraded and re-rolled until a satisfactory grade is obtained. Areas adjacent to existing lawn shall be notched so new sod will be at the same grade. Immediately before sodding, rework the surface until it is fine, pulverized smooth sodbed, varying not more than 1/8" in 10'. Sod shall be moist and laid on moist friable (easily crumbled) ground within twenty-four (24) hours after cutting. All inequalities and soft spots shall be corrected before the sod is laid, and finished surface shall be true to grade, smooth, even and equally firm at all points. Sodded areas shall be kept moist for maintenance period. After the sod is installed, all areas greater than one (1) inch which fail to show a uniform stand of grasses shall be re-sodded.
 - 3. Sod suppliers shall be one of the following:
 - a. Hugget Sod Farm
4114 Marlette Road
Marlette, MI 48453
Phone: (989) 635-7482
 - c. Van Agen Sod Farm
10549 Bancroft Road
Bancroft, MI 48414
Phone: (989) 634-5658

- | | |
|---|---|
| b. B & B Sod & Lawn Sprinklers
5120 McDowell Road
Lapeer, MI 48446
Phone: (810) 667-4010 | d. AAA Turf, Inc.
6041 36 th Street
Hudsonville, MI 49426
Phone: (866) 639-8873 |
|---|---|

2.2 COMMERCIAL FERTILIZER

- A. Fertilizer shall be uniform in composition, free-flowing and suitable for application with approved spreader, granular or pelleted with 50 percent (50%) of total nitrogen derived from natural organic material in a slowly available form, delivered in original unopened containers with the analysis, type and trade name attached to each container. The composition shall be:
1. Pre-plant Fertilizer composition shall be:
 - 7% Nitrogen (N)
 - 7% Phosphoric Acid (P₂O₅)
 - 7% Potash (K₂O)
 2. Post Sodding Fertilizer composition shall be:
 - 12% Nitrogen (N)
 - 2% Phosphoric Acid (P₂O₅)
 - 12% Potash (K₂O)

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect existing underground improvements from damage.
- B. Remove all foreign materials, plants, roots, stones, and debris larger than 1" in any dimension from site. Do not bury foreign material.
- C. Loosen soil to a depth of four inches (4") in lawn areas by approved method of scarification and grade to remove ridges and depressions. Remove all stones or foreign matter from top two inches (2") of soil.
- D. If above steps have had rain in sufficient quantity to cause soil to recompact, entire steps are to be done prior to seeding.
- E. Where no grades are shown, areas shall have a smooth and continual grade between existing or fixed controls and elevations shown on plans. Roll, scarify, rake and level as necessary to obtain true, even lawn surfaces. All finish grades shall meet approval of the Owner.
- F. Grade lawn areas to finish grades, filling as needed or removing surplus dirt and floating areas to a smooth, uniform grade as indicated on grading plans. All lawn areas shall slope to drain.

3.2 PREPLANT FERTILIZING

- A. Incorporate fertilizer into topsoil at a rate of 14 lbs. /1000 S.F. Work into topsoil to a four inch (4") minimum depth.

3.3 SODDING

- A. Topsoil shall be worked to a smooth, uniform surface and compacted firmly. Any lumps or depressions that occur shall be regraded and re-rolled until a satisfactory grade is obtained. Areas adjacent to existing lawn shall be notched so new sod will be at the same grade. Immediately before sodding, rework the surface until it is fine, pulverized smooth sodbed, varying not more than 1/8" in 10'. Sod shall be moist and laid on moist friable (easily crumbled) ground within twenty-four (24) hours after cutting. All inequalities and soft spots shall be corrected before the sod is laid, and finished surface shall be true to grade, smooth, even and equally firm at all points. Sodded areas shall be kept moist for maintenance period. After the sod is installed, all areas greater than one inch (1") which fail to show a uniform stand of grasses shall be re-sodded.
- B. Maintenance of all lawns consists of mowing, rolling, watering and repairing erosion. Maintenance of lawns shall commence when any portion of the sodding has been completed.

- C. If, for reasons beyond the Sub-contractor's control, the height of the grass has exceeded three (3) inches, the mower blades shall be raised so that at no time will more than 1/3 of the grass leaf surface be removed. The Owner will accept the lawns after three (3) cuttings and if a uniform cover of grass is established.
- D. Post Sodding Fertilizer: Supply 20-10-10 fertilizer when grass reaches height of two (2) inches. Rate of application shall be indicated by manufacturer.
- E. The Contractor shall be responsible for rolling of the field, as necessary, to provide a safe, smooth playable surface free of undulations, high spots and low spots. This shall include topdressing and fill of settlement areas, including inequalities related to drainage and irrigation trenches, and utilities prior to acceptance by the Owner. The Contractor shall further guarantee sod material and workmanship for a period of not less than one (1) year from the date of final acceptance.
- F. Contractor shall notify the Owner through the Landscape Architect in writing one (1) week in advance of the final lawn cutting to allow the Owner and the Landscape Architect to inspect the lawns and schedule his maintenance work.
- G. If an infestation of weeds or crab grass develops prior to acceptance of the lawn, the Contractor shall treat the infestation by hand weeding or chemical control. The chemical control shall be furnished and installed by the Contractor as recommended by the manufacturer and approved by the Landscape Architect. At least two weeks shall elapse after chemical control is applied before a request or inspection for acceptance is made to the Landscape Architect.

3.4 SATISFACTORY TURF

- A. Turf installations shall meet the following criteria as determined by Architect:
 - 1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over a 10 square foot and bare spots not exceeding 5 by 5 inches.
 - 2. Use specified materials to re-establish turf that does not comply with the requirements and continue watering and maintenance until turf is satisfactory.

END OF SECTION

SECTION 32 9227 – GENERAL LAWN RESTORATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section is a part of the entire set of Contract Documents and shall be coordinated with the applicable provisions of the other parts.
- B. Related Sections:
 - 1. Section 31 2010 Earthwork - Athletics
 - 2. Section 32 9119 Topsoil

1.2 SCOPE

- A. The work under this section of the specifications shall consist of furnishing all labor, materials and equipment necessary for restoring disturbed lawn areas and maintaining lawns until final acceptance.

1.3 QUALITY ASSURANCE AND WARRANTY GUARANTEE

- A. Grass seed shall meet the tolerance for germination and purity of the Official Seed Analysis of North America.
- B. Submit all seed tags after completion of seeding.
- C. The Contractor, and its Subcontractors, shall provide a staff adequate to coordinate and expedite the work properly and shall maintain competent supervision of its own work to insure compliance with contract requirements.
- D. Contractor responsible for seeding and fertilizing shall inspect the finish grade for acceptability prior to application. Areas of discrepancy shall be indentified and Landscape Architect or Owner's Representative shall be notified.
- E. It is the responsibility of the Contractor to establish a dense lawn of permanent grasses, free from lumps, depressions and settlement. Any part of the area that fails to show a uniform germination shall be re-seeded and such re-seeding shall continue until a dense lawn is established. Damage to seeded areas resulting from erosion and through no fault of the Owner shall be repaired by the Contractor, at his expense.
 - 1. Guarantee shall extend for one year from the date of acceptance.

1.4 SUBMITTALS

- A. Submit product data for seed and fertilizer to Landscape Architect for approval, prior to application.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver grass seed in original containers showing analysis of seed mixture, percentage of pure seed, year of production, net weight, date of packaging and location of packaging. Damaged packages are not acceptable.
- B. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

PART 2 - PRODUCTS

2.1 SEED

- A. Seed shall be provided from one of the following suppliers
 - EcoGreen Supply- 616-877-5326
 - Site One Landscapes - (800) 347-4272
 - Target Specialty – (248) 437-1427
 - BFG – (800) 243-4769- closed
 - Rhino Seed & Supply - (800) 482-3130
 - Lacrosse Seeds - (800) 647-8873
- B. Contractors shall seed all areas disturbed during construction and not otherwise developed or indicated to be sodded. Topsoiling, finish grading and fertilization is to remain the same. *Seed shall be new crop, cleaned, and comprising of the following varieties:
 - 1. Athletic Field Seed blend shall consist of a minimum of 3 of the listed bluegrass varieties and one of the listed ryegrass varieties. Blend shall be 80% Kentucky Bluegrass and 20% Perennial Ryegrass by weight. Only Elite bluegrasses (according to NTEP characteristics ratings) will be allowed on Athletic surfaces. No "named common" types will be accepted. Elite

varieties coated with XALT will be allowed at same seeding rates.

2. General Seeding Areas: "Varieties Named" blend shall be 50-60% Kentucky Bluegrass and 40-50% Perennial Ryegrass by weight for irrigated fields. A "Varieties Named" blend of 60-70% bluegrass, 30-40% perennial ryegrass for non-irrigated fields, and a blend of 20-40% bluegrass, 20-40% perennial ryegrass and 20-30% creeping red fescue for general turf areas.(VNS-varieties not stated- blends will not be accepted)
3. Athletic Fields

Seed Varieties	Purity	Germination
Shannon Kentucky Bluegrass	95%	85%
Lunar Kentucky Bluegrass	95%	85%
SPF 30 Kentucky Bluegrass	95%	85%
Fullback Kentucky Bluegrass	95%	85%
Midnight Kentucky Bluegrass	95%	85%
Hampton Kentucky Bluegrass	95%	85%
Gaelic Kentucky Bluegrass	95%	85%
Jumpstart Kentucky Bluegrass	95%	85%
Bewitched Kentucky Bluegrass	95%	85%
Lunar Kentucky Bluegrass	95%	85%
BlueBank Kentucky Bluegrass	95%	85%
Noble Kentucky Bluegrass	95%	85%
Touchdown Kentucky Bluegrass	95%	85%
Spark Perennial Ryegrass	95%	85%
Majesty Perennial Ryegrass	95%	85%
Gallop Perennial Ryegrass	95%	85%
Salinas Perennial Ryegrass	95%	85%
Gray Star Perennial Ryegrass	95%	85%
Sox Fan Perennial Ryegrass	95%	85%

4. General Seeding Areas

Seed Varieties	Purity	Germination
Shannon or Bluestar Kentucky Bluegrass	95%	85%
Gaelic or Corsair Kentucky Bluegrass	95%	85%
Lunar or Avalanche Kentucky Bluegrass	95%	85%
Yellowstone Kentucky Bluegrass	95%	85%
Gray Star or Salinas Perennial Ryegrass	98%	85%
SoxFan or Showtime Perennial Ryegrass	98%	90%
Expedite Perennial Ryegrass	95%	90%
Xcelerator Perennial Ryegrass	95%	90%
Charger 2 Perennial Ryegrass	98%	90%
Oracle Creeping Red Fescue	98%	85%
Fairmont Chewings Fescue	95%	85%
Marvel Creeping Red Fescue	95%	85%
Sword Hard Fescue	95%	85%
Minimus Hard Fescue	95%	85%

2.2 COMMERCIAL FERTILIZER

- A. Fertilizer shall be uniform in composition, free-flowing and suitable for application with approved spreader, granular or pelleted with 50 percent (50%) of total nitrogen derived from a synthetic or natural organic material, delivered in original unopened containers with the analysis, type and trade name attached to each container. The composition shall be:

Fertilizer "A": applied at the time of seeding at 50 lbs. per 8000 square feet.

16-32-4 (14.3% Ammoniacal Nitrogen, 1.7% Urea Nitrogen, 32% Phosphorus, 4% Available Potassium (SOP)

Fertilizer "B": applied 3-4 weeks after seeding at 50 lbs. per 8,000-10,000 square feet.

22-16-6 (6.3% Ammoniacal Nitrogen, 15.7% Urea Nitrogen, 16% Phosphorus, 6% Soluble Potassium).

Fertilizer "C" for enhanced establishment program (seed in lieu of sod)

Healthy Grow 4-2-2 CPM(2.15% Ammoniacal Nitrogen, 1.85% Water Insoluble Nitrogen, 2% Phosphoric Acid, 2% Sulfate of Potash, 8% Calcium. 0.8% Sulfur, endo and ecto mycorrhizae, sea plant meal, molasses meal, yucca).

Fertilizer "D" for enhanced establishment program (seed in lieu of sod)

Healthy Grow 8-3-5 CPM(4.5% Ammoniacal Nitrogen, 3.5% Water Insoluble Nitrogen, 3% Phosphoric Acid, 5% Sulfate of Potash, 5% Calcium. 1.0% Iron, 0.3% Magnesium).

- B. Complete Soil testing for both fertility (including micronutrients, CEC, pH) and particle size is required on all new establishment sites
- C. A critical establishment fertilizer application comes at planting whereas fertilizer in a ratio of 2-4-1 is applied directly adjacent to the seed to compensate for the seeds inability to extract phosphorus and other nutrients out of the soil Usually approx. 1lb. of P205 is applied with ½ lb. of N and ¼- ½ lb of K20 is applied. An analysis of 16-32-4 would be an example. Fertilizer ingredients with lower chloride index are preferred at seeding, such as Ammonium Sulfate and Sulfate of Potash.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect existing underground improvements from damage.
- B. Remove all foreign materials, plants, roots, stones, and debris larger than 1" in any dimension from site. Do not bury foreign material.
- C. Loosen soil to a depth of four inches (4") in lawn areas by approved method of scarification and grade to remove ridges and depressions. Remove all stones or foreign matter from top two inches (2") of soil.
- D. If above steps have had rain in sufficient quantity to cause soil to recompact, entire steps are to be done prior to seeding.
- E. Where no grades are shown, areas shall have a smooth and continual grade between existing or fixed controls and elevations shown on plans. Roll, scarify, rake and level as necessary to obtain true, even lawn surfaces. All finish grades shall meet approval of the Owner.
- F. Grade lawn areas to finish grades, filling as needed or removing surplus dirt and floating areas to a smooth, uniform grade. All lawn areas shall slope to drain.

3.2 PREPLANT FERTILIZING

- A. Broadcast spread fertilizer "A" (or Alternates "C" and "D") after seeding at a rate of 2 lbs. of Phosphorus per 1000 square feet. (Apply Alternate "C" at 50 lbs. per 5000 square feet and Alternate "D" at 50 lbs. per 10,000 square feet.)

3.3 SEEDING

- A. Dates of Seeding:
 - 1. Grass seed shall be sown in the fall from August 15th until October 15th or in the spring between March 1st and May 15th or at such other times as approved by the Landscape Architect. All seeding is to be done in dry or moderately dry soil and at times when the wind does not exceed a velocity of five (5) miles per hour.
 - 2. If special conditions exist, which may warrant a variance in the above dates, submit a written request to the Landscape Architect stating the conditions and proposed variance. Permission for the variance will be given if, in the opinion of the Landscape Architect, the variance is warranted.
- B. Seed Application:
 - 1. Immediately before sowing the seed, the earth surface shall be re-worked until it is a fine, pulverized, smooth seedbed, showing not more than 1/4" variance from grade.
 - 2. Apply seed mixture, as specified, at a rate of two and one half to four (2.5-4) lbs/1000 sq. ft.

- Apply seed in two directions where possible at a rate of 1.25-2 lbs. /1000 sq. ft. in each direction with seeder, using a cultipacker type seeder such as Brillion (or equal) mounted on tractor. Seed shall be uniformly spread over the previously fine graded and fertilized topsoil. The surface shall be dry when seed is planted. Hand sew seed around each irrigation system head. Hydro-seeding is not acceptable.
3. Mulching: Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended steel wire staples, 6 inches (150mm) long.
 4. Contractor shall return to site six (6) weeks after installation to evaluate germination. If germination of seed exceeds 70%, Contractor to remove mesh. If germination of seeds is less than 70%, mesh shall remain and Contractor shall reevaluate in ten (10) days.
- C. Summer Seeding:
1. If seeding is authorized between June 1 and August 15, annual rye shall be sown separately in addition to specified seed mix. Sow at the rate of (one) 1 lbs./1000 sq. ft.
 2. Cultipacker or approved similar equipment may be used to cover the seed and to firm the seed bed in one operation. In areas inaccessible to cultipacker, the seeded ground shall be lightly raked and rolled in two directions with a water ballast roller. Extreme care shall be taken during seeding and raking to insure that the seed is not raked from one spot to another.
 3. The seeded areas are to be protected, watered, mowed and otherwise maintained until Owner Acceptance.
- D. Post Seeding Fertilizer: Supply fertilizer "B" when grass reaches height of one (1) inch or 3 weeks after seeding at .75-1 lbs Phosphorus per 1000 square feet.
- E. Maintenance
1. Maintenance of all lawns consist of mowing, watering and repairing erosion. Maintenance of lawns shall commence when any portion of the seeding has been completed. Seeded lawns shall never reach a height of three (3) inches prior to a cutting and shall be cut to a height of two (2) inches.
 2. If, for reasons beyond the Sub-contractor's control, the height of the grass has exceeded three (3) inches, the mower blades shall be raised so that at no time will more than 1/3 of the grass leaf surface be removed.
 3. Contractor shall notify the Owner through the Landscape Architect in writing one (1) week in advance of the final lawn cutting to allow the Owner and the Landscape Architect to inspect the lawns and schedule his maintenance work. The Owner will accept the lawns after a minimum of three (3) cuttings if a uniform cover of grass is established and is acceptable to Owner and Landscape Architect. **If a uniform stand of grass is not established, contractor shall continue maintenance and cutting until lawn is accepted.**
 4. If an infestation of weeds or crab grass develops prior to acceptance of the lawn, the Contractor shall treat the infestation by hand weeding or chemical control. The chemical control shall be furnished and installed by the contractor as recommended by the manufacturer and approved by the Landscape Architect. At least two weeks shall elapse after chemical control is applied before a request or inspection for acceptance is made to the Landscape Architect.
- 3.4 SATISFACTORY TURF**
- A. Turf installations shall meet the following criteria as determined by Architect:
1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over a 10 square foot and bare spots not exceeding 5 by 5 inches.
 2. Use specified materials to reestablish turf that does not comply with the requirements and continue watering and maintenance until turf is satisfactory.
 3. If the lawn is not acceptable after 18 months, the owner shall contract with an independent contractor, of their choosing, to complete the work.

3.5 CLEAN UP AND DISPOSAL

- A. Remove from the site all equipment, materials, and debris resulting from construction work including this section. Leave work area neat and clean and in a condition acceptable by the Landscape Architect and Owner. All work shall be complete, ready for use, at the time of final acceptance.

END OF SECTION

SECTION 32 9300 – EXTERIOR PLANT

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section is a part of the entire set of Contract Documents and shall be coordinated with the applicable provisions of the other parts.
- B. Related Sections:
 - 1. Section 32 9119 Topsoil

1.2 SCOPE

- A. This work under this section specifications shall consist of the following:
 - 1. Preparation of subsoil and topsoil
 - 2. Topsoil bedding
 - 3. Trees
 - 4. Mulch
 - 5. Fertilizer
 - 6. Pruning
 - 7. Maintenance

1.3 DEFINITIONS

- A. Balled and Burlapped Stock: Exterior plants dug with firm, natural balls of earth in which they are grown, with ball size not less than sizes indicated; wrapped, tied, rigidly supported, and drum-laced as recommended by ANSI Z60.1.
- B. Balled and Potted Stock: Exterior plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than sizes indicated.
- C. Bare-Root Stock: Exterior plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than minimum root spread according to ANSI Z60.1 for kind and size of exterior plant required.
- D. Container-Grown Stock; healthy, 'vigorous, well-rooted exterior plants grown in a container with well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for kind, type, and size of exterior plant required.
- E. Fabric Bag-Grown Stock Healthy, vigorous, well-rooted exterior plants established and grown in-ground in a porous fabric bag with well-established root system reaching sides of fabric bag. Fabric bag size is not less than diameter, depth, and volume required by ANSI Z60. 1 for type and size of exterior plant.
- F. Finish Grade: Elevation of finished surface of planting soil.
- G. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
- H. Planting Soil: Native or imported topsoil, manufactured topsoil, or surface soil modified to become topsoil; mixed with soil amendments.
- I. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill, before placing planting soil.

1.4 SUBMITTALS

- A. Nursery Source: For all nursery stock indicated on Plans.
 - 1. Submit list of growers for each plant species to be installed within 30 days following award of contract. Include substitution requests based on plant unavailability at that time. Substitution requests after this period will not be accepted.
- B. Submit material samples to Landscape Architect: peat moss, shredded hardwood bark mulch, planting accessories, pre-emergent herbicides, and plant fertilizers.
- C. Submit materials certification to Landscape Architect: Topsoil source and pH value, peat moss and plant fertilizer.
- D. Material Test Reports: For existing native surface topsoil and imported topsoil. Contractor shall be responsible to provide and pay for material testing. Testing agency shall be acceptable to the

Landscape Architect.

- E. Planting Schedule: Indicating anticipated planting dates for exterior plants.
- F. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before start of required maintenance periods.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of exterior plants.
 - 1. The Contractor, and its Subcontractors, shall provide a staff adequate to coordinate and expedite the work properly and shall maintain competent supervision of its own work to insure compliance with contract requirements.
 - 2. Installer Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when exterior planting is in progress.
- B. Soil-Testing Laboratory Qualifications: An independent laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.
- C. Topsoil Analysis: Furnish soil analysis by a qualified soil-testing laboratory stating percentages of organic matter gradation of sand, silt, and clay content; cation exchange capacity; sodium absorption ratio; deleterious material; pH; and mineral and plant-nutrient content of topsoil.
 - 1. Report suitability of topsoil for plant growth. State recommended quantities of nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory topsoil.
- D. Comply with sizing and grading standards of the latest edition of 'American Standard for Nursery Stock'. A plant shall be dimensioned as it stands in its natural position. Stock furnished shall be at least the minimum size indicated. Larger size is acceptable, at no additional charge. Larger plants shall not be cut back to size indicated.
- E. Before proceeding with work, check and verify quantities and dimensions. Report variations between Drawings and the site to the Landscape Architect before proceeding with work of this section. Plant totals are for convenience only and are not guaranteed. All plantings indicated on Drawings are required unless indicated otherwise.
- F. Evaluation: Landscape Architect may evaluate trees and shrubs either at place of growth or at site before planting for compliance with requirements for genus, species, variety, size, and quality. Landscape Architect retains right to observe trees and shrubs further for size and condition of balls and root systems, insects, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.
 - 1. Notify Landscape Architect of sources of planting materials seven days in advance of delivery to site.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver exterior plants freshly dug.
 - 1. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting.
- B. Do not prune trees and shrubs before delivery, except as approved by Landscape Architect. Protect bark, branches, and root systems from sun scald, drying, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of exterior plants during delivery. Do not drop exterior plants during delivery.
- C. Take all precautions customary in good trade practice in preparing plants for moving. Workmanship that fails to meet the highest standards will be rejected. Plants transported on open vehicles shall be covered to prevent wind burn.
- D. Inspection certificates required by law shall accompany each shipment invoice or order to stock

on arrival. The certificate shall be filed with the General Contractor's representative.

- E. Deliver exterior plants after preparations for planting have been completed and install immediately. If planting is delayed more than six hours after delivery, set exterior plants trees in shade, protect from weather and mechanical damage, and keep roots moist.
 - 1. Heel-in bare-root stock. Soak roots in water for two hours if dried out.
 - 2. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
 - 3. Do not remove container-grown stock from containers before time of planting.
 - 4. Water root systems of exterior plants stored on-site with a fine-mist spray. Water as often as necessary to maintain root systems in a moist condition.

1.7 COORDINATION

- A. Planting Restrictions: Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.
 - 1. Evergreen Material: Plant Evergreen materials between September 1 and October 15 or in Spring before new growth begins. If project requirements require planting at other times, plants shall be sprayed with anti-disiccant prior to planting operations.
 - 2. Deciduous material: Plant deciduous materials in a dormant condition. If deciduous trees are planted in leaf, they shall be sprayed with anti-desiccant prior to planting operation.
- B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit.
- C. Coordination with Lawns & Irrigation: Plant trees and shrubs after finish grades are established and irrigation has been installed, and before planting lawns.
 - 1. When planting trees and shrubs after lawns, protect lawn areas and promptly repair damage caused by planting operations.

1.8 WARRANTY

- A. Special Warranty: Warrant the following exterior plants, for the warranty period indicated, against defects including death and unsatisfactory growth, except for defects resulting from lack of: adequate maintenance, neglect, or abuse by Owner, or incidents that are beyond the Contractor's control.
 - 1. Warranty Period: One year from date of Substantial Completion.
 - 2. Remove dead exterior plants immediately. Replace immediately unless required to plant in the succeeding planting season.
 - 3. Replace exterior plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
 - 4. A limit of one replacement of each exterior plant will be required, except for losses or replacements due to failure to comply with requirements.

1.9 MAINTENANCE

- A. Trees and Shrubs: Maintain for the following maintenance period by pruning, cultivating, watering, weeding, fertilizing, restoring planting saucers, tightening and repairing stakes and guy supports, and resetting to proper grades or vertical position, as required to establish healthy, viable plantings. Spray as required to keep trees and shrubs free of insects and disease. Restore or replace damaged tree wrappings.
 - 1. Maintenance Period: Six (6) months from date of Substantial Completion.
- B. Ground Cover and Plants: Maintain for the following maintenance period by watering, weeding, fertilizing, and other operations as required to establish healthy, viable plantings:
 - 1. Maintenance Period: Three (3) months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 TREE AND SHRUB MATERIAL

- A. General: Furnish nursery-grown trees and shrubs complying with ANSI Z60.1, with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock free of disease, insects, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
- B. Grade: Provide trees and shrubs of sizes and grades complying with ANSI Z60.1 for type of trees and shrubs required. Trees and shrubs of a larger size may be used if acceptable to Landscape Architect, with a proportionate increase in size of roots or balls.
- C. Label each tree and shrub with securely attached, waterproof tag bearing legible designation of botanical and common name.
- D. Label at least one tree and one shrub of each variety and caliper with a securely attached, waterproof tag bearing legible designation of botanical and common name.
- E. If formal arrangements or consecutive order of trees or shrubs is shown, select stock for uniform height and spread, and number label to assure symmetry in planting.

2.2 SHADE AND FLOWERING TREES

- A. Shade Trees: Single-stem trees with straight trunk, well-balanced crown, and intact leader, of height and caliper indicated, complying with ANSI Z60.1 for type of trees required.
 - 1. Provide balled and burlapped trees.
 - 2. Branching Height: One-third to one-half of tree height.
- B. Small Upright or Spreading Trees: Branched or pruned naturally according to species and type, with relationship of caliper, height, and branching according to ANSI Z60 1; stem form as follows:
 - 1. Stem Form: Single stem.
 - 2. Provide balled and burlapped trees.
- C. Multistem Trees: Branched or pruned naturally according to species and type, with relationship of caliper, height, and branching according to ANSI Z60.1; stem form as follows:
 - 1. Stem Form: Clump.
 - 2. Provide balled and burlapped trees.

2.3 DECIDUOUS SHRUBS

- A. Form and Size; Deciduous shrubs with not less than the minimum number of canes required by and measured according to ANSI Z60.1 for type, shape, and height of shrub.
 - 1. Provide balled and potted and container-grown trees.

2.4 CONIFEROUS EVERGREENS

- A. Form and Size: Normal-quality, well-balanced, coniferous evergreens, of type, height, spread, and shape required, complying with ANSI Z60.1.
- B. Form and Size: Specimen-quality, exceptionally heavy, tightly knit, symmetrically shaped coniferous evergreens and the following grade:
 - 1. Provide balled and potted and container-grown trees.

2.5 BROADLEAF EVERGREENS

- A. Form and Size: Normal-quality, well-balanced, broadleaf evergreens, of type, height, spread, and shape required, complying with ANSI Z60. 1.
 - 1. Provide balled and burlapped trees or container-grown shrubs.

2.6 PLANTS

- A. Annuals: Provide healthy, disease-free plants of species and variety shown or listed. Provide only plants that are acclimated to outdoor conditions before delivery and that are in bud but not yet in bloom.
- B. Perennials: Provide healthy, field-grown plants from a commercial nursery, of species and variety shown or listed
- C. Fast-Growing Vines: Provide vines of species indicated complying with requirements in ANSI Z60. 1 as follows:
 - 1. Two-year plants with heavy, well-branched tops, with not less than 3 runners 18 inches or more ,in length, and with a vigorous well-developed root system.

2. Provide field-grown vines. Vines grown in pots or other containers of adequate size and acclimated to outside conditions will also be acceptable.

D. Groundcover Plants: Provide ground cover of species indicated, established and well rooted in pots or similar containers, and complying with ANSI Z60.1.

1. Groundcover shall be grown in its container for one year prior to installation.

2.7 TOPSOIL

A. Topsoil: ASTM D 5268, pH range of 5.5 to 7, a minimum of 6 percent organic material content; free of stones 1 inch or larger in any dimension and other extraneous materials harmful to plant growth.

1. Topsoil Source: Reuse surface soil stockpiled on-site. Verify suitability of stockpiled surface soil to produce topsoil. Clean surface soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.

a. Supplement with imported or manufactured topsoil from off-site sources when quantities are insufficient. Obtain topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 4 inches deep. Do not obtain from agricultural land, bogs or marshes.

b. Amend topsoil as necessary.

2.8 INORGANIC SOIL AMENDMENTS

A. Lime: ASTM C 602, agricultural limestone containing a minimum 80 percent calcium carbonate equivalent and as follows:

1. Class: Class T, with a minimum 99 percent passing through No. 8 sieve and a minimum 75 percent passing through No. 60 sieve.

2. Provide lime in form of ground dolomitic limestone. Use to adjust soil pH only, under discretion of Landscape Architect.

B. Sulfur: Granular, biodegradable, containing a minimum of 90 percent sulfur, with a minimum 99 percent passing through No. 6 sieve and a maximum 10 percent passing through No. 40 sieve.

C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.

D. Aluminum Sulfate: Commercial grade, unadulterated.

E. Perlite: Horticultural perlite, soil amendment grade.

F. Agricultural Gypsum: Finely ground, containing a minimum of 90 percent calcium sulfate.

G. Sand: Clean, washed, natural or manufactured, free of toxic materials.

2.9 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1/2-inch sieve; soluble salt content of 5 to 10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

1. Organic Matter Content: 50 to 60 percent of dry weight.

B. Peat: Finely divided or granular texture, with a pH range of 6 to 7.5, containing partially decomposed moss peat, native peat, or reed-sedge peat and having a water absorbing capacity of 1100 to 2000 percent.

C. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, and material harmful to plant growth.

2.10 FERTILIZER

A. Bonemeal: Commercial raw or steamed, finely ground; a minimum of 1 percent nitrogen and 10 percent phosphoric acid.

B. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.

- C. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
 - 1. Composition: 1 lb/1000 sq. ft. of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
 - 2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.
- D. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
 - 1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
 - 2. Composition Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.

2.11 MULCH

- A. Shredded bark mulch shall be double-processed, dark shredded hardwood bark mulch that is clean and free of debris and sticks. Materials shall be uniform in size, shape, and texture. Submit samples to Landscape Architect for approval prior to installation. Install mulch to finish grade, level smooth, without ridges, humps or depressions. Shredded pallet and dyed mulch will not be accepted.
- B. All areas to receive mulch shall receive pre-emergent granular herbicide safe for perennials and grasses prior to installing mulch. Apply per manufacturer's recommendations.
- C. Hold mulch away from trunks of trees.
- D. Install to depth shown on plans.

2.12 WEED CONTROL BARRIERS

- A. Nonwoven Fabric: Polypropylene or polyester fabric, 3 oz./sq. yd. minimum.
- B. Composite Fabric: Woven, needle-punched polypropylene substrate bonded to a nonwoven polypropylene fabric, 4.8 oz./sq. yd.

2.13 STAKES AND GUYS

- A. Upright and Guy Stakes: Rough-sawn, sound, new hardwood, redwood, or pressure preservative-treated softwood, free of knots, holes, cross grain, and other defects, 2 by 2 inches by length indicated, pointed at one end.
- B. Guy and Tie Wire: ASTM A 641/A 641M, Class 1, galvanized-steel wire, 2-strand, twisted, 0.106 inch in diameter.
- C. Guy Cable: 5-strand, 3/16-inch- diameter, galvanized-steel cable, with zinc-coated turnbuckles, a minimum of 3 inches long, with two 3/8-inch galvanized eyebolts.
- D. Hose Chafing Guard; Reinforced rubber or plastic hose at least 1/2 inch in diameter, black, cut to lengths required to protect tree trunks from damage.
- E. Flags: Standard surveyor's plastic flagging tape, white, 6 inches long.

2.14 MISCELLANEOUS PRODUCTS

- A. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.
- B. Trunk-Wrap Tape: Two layers of crinkled paper cemented together with bituminous material, 4-inch- wide minimum, with stretch factor of 33 percent.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive exterior plants for compliance with requirements and conditions affecting installation and performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities, and la' and existing exterior plants from damage caused by planting operations.
- B. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- C. Lay out individual tree and shrub locations and areas for multiple exterior plantings. Stake locations, outline areas, adjust locations when requested, and obtain Landscape Architect's acceptance of layout before planting. Make minor adjustments as required.
- D. Lay out exterior plants at locations directed by Landscape Architect Stake locations of individual trees and shrubs and outline areas for multiple plantings.
- E. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks, branches, stems, twigs, and foliage to protect during digging, handling, and transportation.
 - 1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.

3.3 TREE AND SHRUB EXCAVATION

- A. Pits and Trenches: Excavate circular pits with sides sloped inward. Trim base leaving center area raised slightly to support root ball and assist in drainage. Do not further disturb base. Scarify sides of plant pit smeared or smoothed during excavation.
 - 1. Excavate approximately three times as wide as ball diameter for balled and burlapped, balled and potted, container grown, or fabric bag-grown stock.
 - 2. Excavate at least 12 inches wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
 - 3. If drain tile is required under planted areas, excavate to top of porous backfill over tile.
- B. Subsoil removed from excavations may not be used as backfill.
- C. Obstructions: Notify Landscape Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.
 - 1. Hardpan Layer: Drill 6-inch- diameter holes into free-drawing strata or to a depth of 10 feet, whichever is less and backfill with free-draining material.
- D. Drainage: Notify Landscape Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub pits.
- E. Fill excavations with water and allow to percolate away before positioning trees and shrubs

3.4 TREE AND SHRUB PLANTING

- A. Set balled and burlapped stock plumb and in center of pit or trench with top of root ball 1 inch above adjacent finish grades.
 - 1. Place stock on setting layer of compacted planting soil.
 - 2. Remove burlap and wire baskets from tops of root balls and partially from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
 - 3. Place planting soil mix around root ball in layers, tamping to settle mix and eliminate voids and air pockets. When pit is approximately one-half backfilled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed. Water again after placing and tamping final layer of planting soil mix.
- B. Set container grown stock plumb and in center of pit or trench with top of root ball 1 inch above adjacent finish grades.
 - 1. Carefully remove root ball from container without damaging root ball or plant.
 - 2. Place planting soil mix around root ball in layers, tamping to settle mix and eliminate voids and air pockets. When pit is approximately one-half backfilled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed. Water again after placing and tamping final layer of planting soil mix.
 - 3. Organic Mulching: Apply 3-inch average thickness of organic mulch extending 12 inches beyond edge of planting pit or trench. Do not place mulch within 3 inches of trunks or stems.
 - 4. Wrap trees of 2-inch caliper and larger with trunk-wrap tape. Start at base of trunk and spiral cover trunk to height of first branches. Overlap wrap, exposing half the width, and securely

- attach without causing girdling. Inspect tree trunks for injury, improper pruning, and insect infestation; take corrective measures required before wrapping.
- C. Set fabric bag-grown stock plumb and in center of pit or trench with top of root ball 1 inch above adjacent finish grades.
 - 1. Carefully remove root ball from fabric bag without damaging root ball or plant. Do not use planting stock if root ball is cracked or broken before or during planting operation.
 - 2. Place planting soil mix around root ball in layers, tamping to settle mix and eliminate voids and air pockets. When pit is approximately one-half backfilled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed. Water again after placing and tamping final layer of planting soil mix.
 - D. Set and support bare-root stock in center of pit or trench with root collar or trunk flare 1 inch below adjacent finish grade. Spread roots without tangling or turning toward surface, and carefully work backfill around roots by hand. Puddle with water until backfill layers are completely saturated. Plumb before backfilling, and maintain plumb while working backfill around roots and placing layers above roots. Tamp final layer of backfill. Remove injured roots by cutting cleanly; do not break.
 - 1. Organic Mulching: Apply 3-inch average thickness of organic mulch extending 12 inches beyond edge of planting pit or trench. Do not place mulch within 3 inches of trunks or stems.
 - 2. Wrap trees of 2-inch caliper and larger with trunk-wrap tape. Start at base of trunk and spiral cover trunk to height of first branches. Overlap wrap, exposing half the width, and securely attach without causing girdling. Inspect tree trunks for injury, improper pruning, and insect infestation; take corrective measures required before wrapping.
 - 3. Organic Mulching: Apply 3-inch average thickness of organic mulch extending 12 inches beyond edge of planting pit or trench. Do not place mulch within 3 inches of trunks or stems.
 - 4. Wrap trees of 2-inch caliper and larger with trunk-wrap tape. Start at base of trunk and spiral cover trunk to height of first branches. Overlap wrap, exposing half the width, and securely attach without causing girdling. Inspect tree trunks for injury, improper pruning, and insect infestation; take corrective measures required before wrapping.

3.5 TREE AND SHRUB PRUNING

- A. Prune, thin, and shape trees and shrubs according to standard horticultural practice. Prune trees to retain required height and spread. Unless otherwise indicated by Landscape Architect, do not cut tree leaders; remove only injured or dead branches from flowering trees. Prune shrubs to retain natural character. Shrub sizes indicated are sizes after pruning.

3.6 GUYING AND STAKING

- A. Upright Staking and Tying: Stake trees of 2- through 5-inch caliper. Stake trees of less than 2-inch caliper only as required to prevent wind tip-out. Use a minimum of 2 stakes of length required to penetrate at least 18 inches below bottom of backfilled excavation and to extend at least 72 inches above grade. Set vertical stakes and space to avoid penetrating root balls or root masses. Support trees with two strands of tie wire encased in hose sections at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree. Use the number of stakes as follows:
 - 1. Use 2 stakes for trees up to 12 feet high and 2-1/2 inches or less in caliper; 3 stakes for trees less than 14 feet high and up to 4 inches in caliper. Space stakes equally around trees.
- B. Guying and Staking: Guy and stake trees exceeding 14 feet in height and more than 3 inches in caliper, unless otherwise indicated. Securely attach no fewer than 3 guys to stakes 30 inches long, driven to grade.
 - 1. For trees more than 6 inches in caliper, anchor guys to pressure-preservative-treated deadmen 8 inches in diameter and 48 inches long buried at least 36 inches below grade. Provide turnbuckles for each guy wire and tighten securely.
 - 2. Attach flags to each guy with, 30 inches above finish grade.
 - 3. Paint turnbuckles with luminescent white paint.

3.7 PLANTERS

- A. Planters: Place a layer of gravel at least 4 inches thick in bottom of planters, cover with nonwoven fabric, and fill with planter soil mix. Place soil in lightly compacted layers to an elevation of 1-1/2 inches below top of planter, allowing natural settlement.
 - 1. Planter Soil Mix: One part topsoil, one part coarse sand, one part peat, and 3 lb of dolomitic limestone per cubic yard of mix.

3.8 GROUND COVER AND PLANT PLANTING

- A. Set out and space ground cover and plants as indicated on plans.
- B. Dig holes large enough to allow spreading of roots, and backfill with planting soil.
- C. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.
 - 1. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.
- D. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.9 PLANTING BED MULCHING

- A. Install weed-control barriers before mulching according to manufacturer's written instructions. Completely cover area to be mulched, overlapping edges a minimum of 6 inches.
- B. Mulch backfilled surfaces of planting beds and other areas indicated.
 - 1. Organic Mulch: Apply 3 inch average thickness of organic mulch, and finish level with adjacent finish grades. Do not place mulch against plant stems.

3.10 EDGING INSTALLATION

- A. Aluminum Edging: Install aluminum edging where indicated according to manufacturer's written instructions. Anchor with aluminum stakes spaced approximately 48 inches apart; driven below top elevation of edging.

3.11 CLEANUP AND PROTECTION

- A. During exterior planting, keep adjacent paving's and construction clean and work area in an orderly condition.
- B. Protect exterior plants from damage due to landscape operations, operations by other contractors and trades, and others. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged exterior planting.

3.12 DISPOSAL

- A. Disposal: Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property

END OF SECTION

SECTION 33 4605 – SUBDRAINAGE SYSTEMS – SAND

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section is a part of the entire set of Contract Documents and shall be coordinated with the applicable provisions of the other parts.
- B. Related Sections
 - 1. Section 31 2010 Earthwork – Athletics
 - 2. Section 33 4413 Manholes, Catch Basins and Similar Structures

1.2 SCOPE

- A. The work under this section consists of furnishing all labor, materials and equipment to install the drainage system, couplings and accessories for an operating sub-drainage system.

1.3 QUALITY ASSURANCE

- A. Reference Standards:
 - 1. American Society for Testing and Materials (ASTM):
 - a. ASTM D1785 – Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe
 - b. ASTM D3350 – Standard Specification for Polyethylene Plastics Pipe and Fitting Materials
 - c. ASTM F405 – Standard Specification for Corrugated Polyethylene Pipe and Fittings
 - 2. American Association of State Highway and Transportation Officials (AASHTO):
 - a. AASHTO M294 – Standard Specification for Corrugated Polyethylene Pipe

1.4 SUBMITTALS

- A. Manufacturer's Literature: Furnish to Landscape Architect, copies of manufacturer's specifications, maintenance, and installation instructions for each item specified herein. Include photographs, catalogue cuts, and other data as may be required to show compliance with these specifications.

PART 2 - PRODUCTS

2.1 DRAINAGE TILE

- A. Single wall corrugated polyethylene tubing (without filter wrap) complete with required couplings and fittings. Perforation Type: Fine Slot
- B. Schedule 40 PVC complete with accessories and appropriate solvent to be used where indicated. SDR 35 may be substituted where the pipe has a minimum of 18" cover.

2.2 BACKFILL

- A. MDOT 2NS approved sand to be used as backfill material.

PART 3 - EXECUTION

3.1 INSTALLATION FOR CORRUGATED POLYETHYLENE TUBING

- A. Hand trim excavating to required elevations. Do not over excavate. Remove large stones or other hard matter which could damage drain tile.
- B. Place a two inch (2") thick bed of filter aggregate.
- C. Install the drainage tile on the filter aggregate bed.
- D. Ensure complete connection to storm sewer using perforated pipe.
- E. Cover the pipe with filter aggregate to top of trench and compact to 90% Modified Proctor.

END OF SECTION

SECTION 33 4615 – SUBDRAINAGE SYSTEMS – TURF DRAINTILE

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section is a part of the entire set of Contract Documents and shall be coordinated with the applicable provisions of the other parts.
- B. Related Sections
 - 1. Section 31 2010 Earthwork - Athletics
 - 2. Section 31 3219 Geotextile Fabric
 - 3. Section 32 1815 Synthetic Turf – Multi-Purpose
 - 4. Section 32 1819 Synthetic Turf - Baseball & Softball

1.2 SCOPE

- A. The work under this section consists of furnishing all labor, materials and equipment to install the drainage system, couplings and accessories for the artificial turf subdrainage system.

1.3 QUALITY ASSURANCE

- A. Reference Standards:
 - 1. American Society for Testing and Materials (ASTM):
 - a. ASTM D2729 – Standard Specification for Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
 - b. ASTM D3350 – Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
 - 2. American Association of State Highway and Transportation Officials (AASHTO):
 - a. AASHTO M294 – Standard Specification for Corrugated Polyethylene Pipe

1.4 SUBMITTALS

- A. Manufacturer's Literature: Furnish to Landscape Architect, copies of manufacturer's specifications, maintenance, and installation instructions for each item specified herein. Include photographs, catalogue cuts, and other data as may be required to show compliance with these specifications.

PART 2 - PRODUCTS

2.1 DRAINTILE - GENERAL

- A. High Density corrugated polyethylene (HDPE), tubular-style perforated type, pipe and fittings.
- B. Hancor "HI-Q", ADS N-12, or approved equal.
- C. Diameter of systems lateral and collector lines as shown on plans.

2.2 DRAINTILE - FLAT DRAIN

- A. AdvanEDGE pipe with geotextile sock manufactured by Advanced Drainage Systems, Inc. (800) 733-9554. Size as indicated on Drawings.
- B. Multi-Flow manufactured by Varicore Technologies, Inc., (800) 978-8007. Size as indicated on Drawings.

2.3 TRENCH MATERIAL

- A. Filter Aggregate: Evenly graded mixture of $\frac{3}{4}$ " diameter clean crushed stone.

PART 3 - EXECUTION

3.1 INSTALLATION FOR CORRUGATED POLYETHYLENE TUBING

- A. Hand trim excavating to required elevations. Do not over excavate. Remove large stones or other hard matter which could damage drain tile.
- B. Place a two inch (2") thick bed of filter aggregate.
- C. Install the drainage tile on the filter aggregate bed.
- D. Ensure complete connection to storm sewer using perforated pipe.
- E. Cover the pipe with filter aggregate to top of trench and compact to 90% Modified Proctor.

3.2 INSTALLATION FOR "FLAT DRAIN" PIPE

- A. Install flat drain pipe horizontally, being sure to allow for a minimum of 8" of stone below turf material.
- B. Joints shall be made using manufacturers couplers prior to placing flat drain on subgrade. Use 2 coupling pins for each coupler. Couplers shall be placed under the fabric at the joint to prevent backfill infiltration. To accomplish this, split the fabric seam and lay back the fabric approximately

- 8". Install the coupler with 2 pins. Replace fabric over the coupler and secure the fabric with suitable tape.
- C. End caps shall be used at all termination points to prevent soil infiltration into system.
 - D. Compact stone to appropriate modified proctor density value.

END OF SECTION