Project Manual

100% Construction Documents

Cherokee Nation

WCCA

Remodel and Site Improvements

Ochelata, Oklahoma

Project Number 24-08-58

August 16, 2024

CHILDERS ARCHITECT
A NATIVE AMERICAN OWNED FIRM

Tel: 479.783.2480 Fax: 479.783.4844 E-mail: Breck@ChildersArchitect.com Web: www.ChildersArchitect.com

THIS PAGE INTENTIONALLY LEFT BLANK

CHEROKEE NATION

WCCA REMODEL AND SITE IMPROVEMENTS

100% CONSTRUCTION DOCUMENTS
PROJECT MANUAL AND SPECIFICATIONS

TABLE OF CONTENTS

DIVISION 05 - METALS

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

DIVISION 08 - OPENINGS

DIVISION 09 - FINISHES

DIVISION 10 - SPECIALTIES

DIVISION 22 - PLUMBING

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

DIVISION 26 - ELECTRICAL

DIVISION 27 - COMMUNICATIONS

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 00 01 07
PROFESSIONAL SEALS

ARCHITECT
James R. Childers Architect, Inc.
45 South 4th Street
Fort Smith, AR 72901
479.783.2480

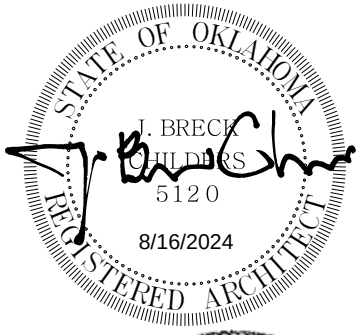
CIVIL ENGINEER
Wallace Design Collective
123 North Martin Luther King Blvd.
Tulsa OK 74103
918.584.5858

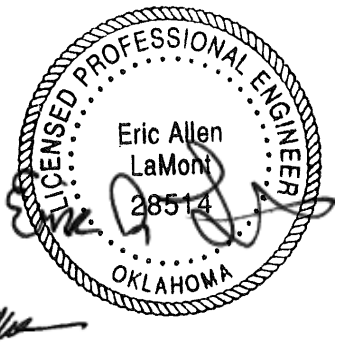
STRUCTURAL ENGINEER
Wallace Design Collective
123 North Martin Luther King Blvd.
Tulsa OK 74103
918.584.5858

MECHANICAL, ELECTRICAL, PLUMBING
HAS Engineering Consulting Services, Inc.
7405 Ellis St.
Fort Smith AK 72916
479.452.8922

LOW-VOLTAGE, IT, SECURITY
Crux Technology + Security Solutions
401 South Boston Ave, Suite 500-15
Tulsa, OK 74103
(800) 685-6440

FIRE PROTECTION / LIFE SAFETY
Mobley Fire Protection
6242 Llano Avenue
Dallas, TX
(817) 614-2361





8/16/2024

8.16.24

08/16/2024

8-16-2024

August 16, 2024

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 003100
AVAILABLE PROJECT INFORMATION

PART 1 GENERAL

1.01 EXISTING CONDITIONS

A. Certain information relating to existing surface and subsurface conditions and structures is available to bidders but will not be part of Contract Documents, as follows:

B. Geotechnical Report:
   1. Copy of Geotechnical Report is Bound into the Project Manual for Contractor's convenience.
   2. This report identifies properties of below grade conditions and offers recommendations for the design of foundations, prepared primarily for the use of Architect.
   3. The recommendations described shall not be construed as a requirement of this Contract, unless specifically referenced in Contract Documents.
   4. This report, by its nature, cannot reveal all conditions that exist on the site. Should subsurface conditions be found to vary substantially from this report, changes in the design and construction of foundations will be made, with resulting credits or expenditures to the Contract Price accruing to Owner.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

This page intentionally left blank

Form 750

Request for Information

Project _____ RFI No. _____

Project No. _____ Receiver _____

Sender _____

Date Sent _____ Date Initiated _____

Copies To _____ Date Response Requested _____

Subject _____

Request _____

Senders Proposed Answer/Solution _____

THE PROPOSED ANSWER/SOLUTION [ ] IS, [ ] IS NOT, INCLUDED IN THE CONTRACT.

Receivers Response _____

Response By _____ Company _____ Date _____

Distribution

THIS PAGE HAS BEEN INTENTIONALLY LEFT BLANK

SECTION 00 63 25
SUBSTITUTION REQUEST FORM

Project Name _____

Specified Item

Section	Page	Paragraph	Description

The undersigned General Contractor requests consideration of the following:

Proposed Substitution _

(Include all product data as indicated in Specification Section 01 2500 and any supplemental information as requested by the Architect.)

The undersigned General Contractor warrants to the Architect and Owner that the following paragraphs, unless modified on attachments, are correct.

1. The Proposed Substitution does not affect dimensions shown on Drawings.
2. The cost reduction/increase indicated in item 5 below includes costs for changes to the building design, including engineering, design, detailing and construction costs caused by the requested Substitution. Any additional costs resulting from this substitution will be reimbursed from the cost savings in item 5 or, in its absence, funded as a project cost.
3. The Proposed Substitution will have no adverse effect on other trades, the construction schedule, or specified warranty requirements.
4. Maintenance and service parts will be locally available for the Proposed Substitution.

   The General Contractor further warrants to the Architect and Owner that the function and quality of the Proposed Substitution are equivalent or superior to the Specified Item. The General Contractor further warrants that the intent of specification section 01 25 00, paragraph 2.1.C has been met.

5. Total Cost Savings/Increase to the Owner: $_____
6. Compensation to the Architect / Consultant for related Additional Service fee: $_____

Manufacturer's Certification of Equal Quality

I_____represent the manufacturer of the Proposed Substitution item and hereby certify and warrant to the Architect and Owner that the function and quality of the Proposed Substitution are equivalent or superior to the Specified Item.

Manufacturer's Representative	Date	Company

Acceptances

1.

General Contractor Acceptance	Date	Company

2.

Owner Acceptance	Date	Company

3.

Architect Acceptance	Date	Company

4.

Consultant Acceptance	Date	Company

Recommend Acceptance: ☐ ***Yes*** ☐ ***No***

THIS PAGE INTENTIONALLY LEFT BLANK

Form 757
Project Cost Summary

Project Name _____ Project No. _____ Latest Update _____

Start Construction Date _____ Substantial Completion Date _____

Submitted By _____

Building Type: (Select One Only)

☐ Assembly/Entertainment ☐ Aviation ☐ Commercial ☐ Education ☐ Government/Justice
☐ Healthcare ☐ Hospitality ☐ Religion ☐ Residential ☐ Sports

Structure Type: (Select One Only) ☐ Concrete ☐ Steel

SITEWORK CATEGORY	**SF FOR EACH AREA**	**COSTS**			
		BLDG. NEW CONST	GARAGE	**SITEWORK**	**BLDG. RENOVATION**
1. Sitework/Excavation					
2. Paving/Walks/Curbs					
3. Hardscape					
TOTAL SITEWORK		**$**	**$**	**$**	**$**

BUILDING/GARAGE CATEGORY	**SF FOR EACH AREA**	**COSTS**			
		BLDG. NEW CONST.	**GARAGE**	**SITEWORK**	**BLDG. RENOVATION**
4. Masonry					
5. Stucco/Plaster					
6. Waterproofing					
7. Insulation/Roofing					
8. Glass Curtain Wall					
9. Stone Exterior					
10. Precast Concrete					
11. Lobby Finish					
12. Pavers					
13. Toilet Partitions					
14. Toilet Accessories					
15. Elevators & Escalators					
16. Specialties					
17. Resilient/Carpet					
TOTAL EACH AREA		$	$	$	$

BUILDING/GARAGE CATEGORY	**REMARKS**	**COSTS**			
		BLDG. NEW CONST. BLDG. NEW CONST. AREA _____SF	GARAGE GARAGE AREA _____SF	SITEWORK SITEWORK AREA _____ SF	BLDG. RENOVATION BLDG. RENOV. AREA _____SF
18. Overhead/General Conditions					
19. General Contractor Fees					
20. Demolition					
21. Utilities					
22. Foundations					
23. Structural Frame					
24. Fireproofing					
25. Misc. Metals					
26. Carpentry/Millwork					
27. Doors and Frames					
28. Finish Hardware					
29. Gyp. Wallboard					
30. Painting					
31. Ceramic Tile					
32. Acoustical Ceiling					
33. Plumbing					
34. Fire Sprinklers					
35. Electrical					
36. Energy Management					
37. HVAC/Equipment					
38. Security System					
39. Kitchen Equipment					
40.					
41.					
42.					
43.					
44.					
45. Change Order Total					
TOTAL EACH AREA		**$**	**$**	**$**	**$**

TOTAL PROJECT COST $ _____

CHILDERS
ARCHITECT

Electronic Files Disclaimer, Release and Limitation of Liability Agreement

Request Date:
Project Number/Name:
Requested sheets:

The information contained within the electronic files for the aforementioned project was created by Childers Architect. The electronic documents are being released by Childers Architect for the purpose of reference, coordination, and/or facility management regarding the above referenced project. The electronic documents or modifications of same thereof shall not be used for construction. The electronic documents may not be reproduced for any purpose other than reference for the project as listed above. No additional authorization is granted without the written consent of Childers Architect.

The recipient agrees that Childers Architect will not be held responsible for issues arising from files which have been converted for use in non-native applications. Any use, reuse, or transfer of the electronic documents is at the receiver's sole risk.

Revisions or additions to the design file(s) may occur at any time. It is the recipient's responsibility to verify the latest information is in use prior to utilization. The receiver agrees to indemnify, defend, and hold harmless Childers Architect, its officers, agents, and employees from all claims, suits, losses, damages, or costs, including but not limited to reasonable attorney's fees and defense costs arising from the use of outdated design files, and such indemnification shall survive acceptance of said file(s) by recipient. In no event shall Childers Architect be liable for indirect or consequential damages because of the use or reuse of the electronic files.

Under no circumstances shall delivery of electronic files for use by the undersigned be deemed a purchase from Childers Architect. Childers Architect makes no warranties, either express or implied, of the fitness of these files for any particular purpose other than previously expressed. In no event shall Childers Architect be liable for indirect or consequential damages because of the use or reuse of the electronic files.

A signature below indicates execution of this Agreement and your acceptance of the terms and conditions of the release itemized within this release. Upon receipt of payment, we will transfer the files to the address or email provided below.

Company: _____

Signature: _____

Printed Name and Title: _____

Email: _____

SECTION 012000
PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Procedures for preparation and submittal of applications for progress payments.

B. Documentation of changes in Contract Sum and Contract Time.

C. Change procedures.

D. Procedures for preparation and submittal of application for final payment.

1.02 SCHEDULE OF VALUES

A. Use Schedule of Values Form: AIA G703, edition stipulated in the Agreement.

B. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit draft to Architect for approval.

C. Forms filled out by hand will not be accepted.

D. Submit Schedule of Values in duplicate within 15 days after date of Owner-Contractor Agreement.

E. Format: Utilize the Table of Contents of this Project Manual. Identify each line item with number and title of the specification section. Identify site mobilization.

F. Include separately from each line item, a direct proportional amount of Contractor's overhead and profit.

G. Revise schedule to list approved Change Orders, with each Application For Payment.

1.03 APPLICATIONS FOR PROGRESS PAYMENTS

A. Payment Period: Submit at intervals stipulated in the Agreement.

B. Use Form AIA G702 and Form AIA G703, edition stipulated in the Agreement.

C. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Architect for approval.

D. Forms filled out by hand will not be accepted.

E. For each item, provide a column for listing each of the following:
   1. Item Number.
   2. Description of work.
   3. Scheduled Values.
   4. Previous Applications.
   5. Work in Place and Stored Materials under this Application.
   6. Authorized Change Orders.
   7. Total Completed and Stored to Date of Application.
   8. Percentage of Completion.
   9. Balance to Finish.
   10. Retainage.

F. Execute certification by signature of authorized officer.

G. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed and for stored products.

H. List each authorized Change Order as a separate line item, listing Change Order number and dollar amount as for an original item of work.

I. Submit one electronic and 2 hard-copies of each Application for Payment.

J. Include the following with the application:
   1. Transmittal letter as specified for submittals in Section 013000.
   2. Construction progress schedule, revised and current as specified in Section 013000.

3. Current construction photographs specified in Section 013000.
4. Partial release of liens from major subcontractors and vendors.
5. Affidavits attesting to off-site stored products.

K. When Architect requires substantiating information, submit data justifying dollar amounts in question. Provide one copy of data with cover letter for each copy of submittal. Show application number and date, and line item by number and description.

1.04 MODIFICATION PROCEDURES

A. For minor changes not involving an adjustment to the Contract Sum or Contract Time, Architect will issue instructions directly to Contractor.

B. For other required changes, Architect will issue a document signed by Owner instructing Contractor to proceed with the change, for subsequent inclusion in a Change Order.
1. The document will describe the required changes and will designate method of determining any change in Contract Sum or Contract Time.
2. Promptly execute the change.

C. For changes for which advance pricing is desired, Architect will issue a document that includes a detailed description of a proposed change with supplementary or revised drawings and specifications, a change in Contract Time for executing the change . Contractor shall prepare and submit a fixed price quotation within 7 days unless a longer period of time is agreed upon.

D. Contractor may propose a change by submitting a request for change to Architect, describing the proposed change and its full effect on the work, with a statement describing the reason for the change, and the effect on the Contract Sum and Contract Time with full documentation. Document any requested substitutions in accordance with Section 016000.

E. Computation of Change in Contract Amount: As specified in the Agreement and Conditions of the Contract.
1. For change requested by Architect for work falling under a fixed price contract, the amount will be based on Contractor's price quotation.
2. For change requested by Contractor, the amount will be based on the Contractor's request for a Change Order as approved by Architect.

F. Substantiation of Costs: Provide full information required for evaluation.
1. Provide the following data:
   a. Quantities of products, labor, and equipment.
   b. Taxes, insurance, and bonds.
   c. Overhead and profit.
   d. Justification for any change in Contract Time.
   e. Credit for deletions from Contract, similarly documented.
2. Support each claim for additional costs with additional information:
   a. Origin and date of claim.
   b. Dates and times work was performed, and by whom.
   c. Time records and wage rates paid.
   d. Invoices and receipts for products, equipment, and subcontracts, similarly documented.

G. Execution of Change Orders: Contractor will prepare and issue Change Orders for signatures of parties as provided in the Conditions of the Contract.

H. After execution of Change Order, promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Sum.

I. Promptly revise progress schedules to reflect any change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.

1.05 APPLICATION FOR FINAL PAYMENT

A. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Sum, previous payments, and sum remaining due.

B. Application for Final Payment will not be considered until the following have been accomplished:
   1. All closeout procedures specified in Section 017000.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

This page intentionally left blank

SECTION 012500
SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Procedural requirements for proposed substitutions.

1.02 RELATED REQUIREMENTS

A. Section 006325 - Substitution Request Form - During Construction: Required form for substitution requests made after award of contract (During construction).

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.
      a. Unavailability.
      b. Regulatory changes.
   2. Substitutions for Convenience: Proposed due to possibility of offering substantial advantage to the Project.
      a. Substitution requests offering advantages solely to the Contractor will not be considered.

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.
   6. Agrees to reimburse Owner and Architect for review or redesign services associated with re-approval by authorities.

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. No specific form is required. Contractor's Substitution Request documentation must include the following:
      a. Project Information:
         1) Official project name and number, and any additional required identifiers established in Contract Documents.
         2) Owner's, Architect's, and Contractor's names.
      b. Substitution Request Information:
         1) Discrete and consecutive Substitution Request number, and descriptive subject/title.
         2) Indication of whether the substitution is for cause or convenience.
         3) Issue date.

4) Reference to particular Contract Document(s) specification section number, title, and article/paragraph(s).
5) Description of Substitution.
6) Reason why the specified item cannot be provided.
7) Differences between proposed substitution and specified item.
8) Description of how proposed substitution affects other parts of work.

c. Attached Comparative Data: Provide point-by-point, side-by-side comparison addressing essential attributes specified, as appropriate and relevant for the item:
1) Physical characteristics.
2) In-service performance.
3) Expected durability.
4) Visual effect.
5) Warranties.
6) Other salient features and requirements.
7) Include, as appropriate or requested, the following types of documentation:
(a) Product Data:
(b) Samples.
(c) Certificates, test, reports or similar qualification data.
(d) Drawings, when required to show impact on adjacent construction elements.

d. Impact of Substitution:
1) Savings to Owner for accepting substitution.
2) Change to Contract Time due to accepting substitution.

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 CONSTRUCTION

A. Submittal Form (after award of contract):
1. Submit substitution requests by completing the form in Section 00 63 25; see this section for additional information and instructions. Use only this form; or other forms of submission acceptable to the Architect.

B. Architect will consider requests for substitutions only within 15 days after date of Agreement.

C. Submit request for Substitution for Cause within 14 days of 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.

D. 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.

E. 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.

3.03 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. Architect's decision following review of proposed substitution will be noted on the submitted form.

3.04 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.

3.05 CLOSEOUT ACTIVITIES

A. See Section 017800 - Closeout Submittals, for closeout submittals.

B. Include completed Substitution Request Forms as part of the Project record.

3.06 ATTACHMENTS

A. A facsimile of the Substitution Request Form (During Construction) required to be used on the Project is included in the Project Manual.

END OF SECTION

This page intentionally left blank

SECTION 013000
ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General administrative requirements.

B. Web-based project software service.

C. Electronic document submittal service.

D. Preconstruction meeting.

E. Progress meetings.

F. Construction progress schedule.

G. Contractor's daily reports.

H. Progress photographs.

I. Submittals for review, information, and project closeout.

J. Number of copies of submittals.

K. Requests for Interpretation (RFI) procedures.

L. Submittal procedures.

1.02 RELATED REQUIREMENTS

A. Section 016000 - Product Requirements: General product requirements.

B. Section 017000 - Execution and Closeout Requirements: Additional coordination requirements.

C. Section 017800 - Closeout Submittals: Project record documents; operation and maintenance data; warranties and bonds.

1.03 GENERAL ADMINISTRATIVE REQUIREMENTS

A. Comply with requirements of Section 017000 - Execution and Closeout Requirements for coordination of execution of administrative tasks with timing of construction activities.

B. Make the following types of submittals to Architect:
   1. Requests for Interpretation (RFI).
   2. Requests for substitution.
   3. Shop drawings, product data, and samples.
   4. Test and inspection reports.
   5. Design data.
   6. Manufacturer's instructions and field reports.
   7. Applications for payment and change order requests.
   8. Progress schedules.
   9. Coordination drawings.
   10. Correction Punch List and Final Correction Punch List for Substantial Completion.
   11. Closeout submittals.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 WEB-BASED PROJECT SOFTWARE SERVICE

A. Web-Based Project Software Service: Provide, administer, and use web-based project software to host and manage project communication and documentation.
   1. Include, at minimum, the following features:
      a. Project directory, including Owner, Contractor, subcontractors, Architect, Architect's consultants, and other entities involved in the project. Include names of contact persons and contact information for each entity.

b. Access control for each entity and for each workflow process to determine each entity's digital rights to create, modify, view, and print documents.
c. Workflow planning, allowing customization of workflow for each project entity.
d. Creation, logging, tracking, and notification for project communications.
e. Tracking of project communication statuses in real time, including timestamped response log.
f. Procedures for viewing PDFs or similar file formats, allowing markups by each entity. Provide security features to lock markups against changes once submitted.
g. Processing and tracking of payment applications.
h. Processing and tracking of contract modifications.
i. Creation and distribution of meeting minutes.
j. Document management for drawings, specifications, and coordination drawings, including revision control.
k. Management of construction progress photographs.
l. Mobile device compatibility.
m. Creation of data analytics reports.
n. Creation and export of editable logs for software functions. Provide Owner, Architect, and Architect's consultants with rights and ability to download logs when requested.
o. _____.

2. Cost: Pay cost of service. Include the cost of the service in the contract sum.
3. Provide up to 20 user licenses for use by Owner, Architect, Architect's consultants, and other entities involved in the project.
4. Comply with the software service's current published licensing agreements.
5. Training: Provide one-hour, web-based training session for users of software service. Further training is the responsibility of the user.
   a. Representatives of Owner are scheduled and included in this training.
6. Project Closeout: Architect determines when to terminate the software service for the project and is responsible for obtaining archive copies of files for Owner.
7. Web-Based Project Software Services: {CH#422232}
   a. Newforma, Inc.
   b. ProCore.
   c. Kahua.
   d. Substitutions: See Section 016000 - Product Requirements.

3.02 ELECTRONIC DOCUMENT SUBMITTAL

A. All documents transmitted for purposes of administration of the contract are to be in electronic (PDF) format, as appropriate to the document, and transmitted via Project Manageent software.
   1. Besides submittals for review, information, and closeout, this procedure applies to Requests for Interpretation (RFIs), progress documentation, contract modification documents (e.g. supplementary instructions, change proposals, change orders), applications for payment, field reports and meeting minutes, Contractor's correction punchlist, and any other document any participant wishes to make part of the project record.
   2. Contractor and Architect are required to use this process.
   3. It is Contractor's responsibility to submit documents in allowable format.
   4. Subcontractors, suppliers, and Architect's consultants are to be permitted to use the service at no extra charge.
   5. Users need an email address, internet access, and PDF review software that includes ability to mark up and apply electronic stamps (such as Adobe Acrobat, www.adobe.com, or Bluebeam PDF Revu, www.bluebeam.com), unless such software capability is provided by the service provider.
   6. All other specified submittal and document transmission procedures apply, except that electronic document requirements do not apply to samples or color selection charts.

B. Training: One, one-hour, web-based training session will be arranged for all participants, with representatives of Architect and Contractor participating; further training is the responsibility of

the user of the service.
1. Representatives of Owner are scheduled and included in this training.

C. Project Closeout: Architect will determine when to terminate the service for the project and is responsible for obtaining archive copies of files for Owner.

3.03 PRECONSTRUCTION MEETING

A. Owner will schedule a meeting after Notice of Award.

B. Attendance Required:
1. Owner.
2. Architect.
   a. Special Consultants
3. Contractor.
   a. Major Subcontractors.

C. Agenda:
1. Execution of Owner-Contractor Agreement.
2. Submission of executed bonds and insurance certificates.
3. Distribution of Contract Documents.
4. Submission of list of subcontractors, list of products, schedule of values, and progress schedule.
5. Designation of personnel representing the parties to Contract, _____ and Architect.
6. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
7. Scheduling.

D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.04 PROGRESS MEETINGS

A. Schedule and administer meetings throughout progress of the work at maximum weekly intervals.

B. Make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.

C. Attendance Required:
1. Contractor.
2. Owner.
3. Architect.
4. Special consultants as applicable.
5. Contractor's superintendent.
6. Major subcontractors.

D. Agenda:
1. Review minutes of previous meetings.
2. Review of work progress.
3. Field observations, problems, and decisions.
4. Identification of problems that impede, or will impede, planned progress.
5. Review of submittals schedule and status of submittals.
6. Review of RFIs log and status of responses.
7. Maintenance of progress schedule.
8. Corrective measures to regain projected schedules.
9. Planned progress during succeeding work period.
10. Maintenance of quality and work standards.
11. Effect of proposed changes on progress schedule and coordination.
12. Other business relating to work.

E. Record minutes and distribute copies within two days after meeting to participants, with copies to Architect, Owner, participants, and those affected by decisions made.

3.05 CONSTRUCTION PROGRESS SCHEDULE

A. Within 10 days after date of the Agreement, submit preliminary schedule defining planned operations for the first 60 days of work, with a general outline for remainder of work.

B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.

C. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.
   1. Include written certification that major contractors have reviewed and accepted proposed schedule.

D. Within 10 days after joint review, submit complete schedule.

E. Submit updated schedule with each Application for Payment.

3.06 DAILY CONSTRUCTION REPORTS

A. Include only factual information. Do not include personal remarks or opinions regarding operations and/or personnel.

B. Prepare a daily construction report recording the following information concerning events at Project site and project progress:
   1. Date.
   2. High and low temperatures, and general weather conditions.
   3. List of subcontractors at Project site.
   4. Safety, environmental, or industrial relations incidents.
   5. Meetings and significant decisions.
   6. Unusual events (submit a separate special report).
   7. Stoppages, delays, shortages, and losses. Include comparison between scheduled work activities (in Contractor's most recently updated and published schedule) and actual activities. Explain differences, if any. Note days or periods when no work was in progress and explain the reasons why.
   8. Directives and requests of Authority(s) Having Jurisdiction (AHJ).
   9. Testing and/or inspections performed.
   10. Signature of Contractor's authorized representative.

3.07 PROGRESS PHOTOGRAPHS

A. Submit photographs with each application for payment, taken not more than 3 days prior to submission of application for payment.

B. Submit new photographs at least once a month, within 3 days after being taken.

C. Photography Type: Digital; electronic files.

D. Provide photographs of site and construction throughout progress of work produced by a photographer, acceptable to Architect.

E. In addition to periodic, recurring views, take photographs of each of the following events:
   1. Completion of site clearing.
   2. Excavations in progress.
   3. Foundations in progress and upon completion.
   4. Structural framing in progress and upon completion.
   5. Enclosure of building, upon completion.
   6. Final completion, minimum of ten (10) photos.

F. Views:
   1. Provide non-aerial photographs from four cardinal views at each specified time, until date of Substantial Completion.
   2. Consult with Architect for instructions on views required.
   3. Provide factual presentation.
   4. Provide correct exposure and focus, high resolution and sharpness, maximum depth of field, and minimum distortion.

G. Digital Photographs: 24 bit color, minimum resolution of 1024 by 768, in JPG format; provide files unaltered by photo editing software.
   1. Delivery Medium: Via email.
   2. File Naming: Include project identification, date and time of view, and view identification.
   3. PDF File: Assemble all photos into printable pages in PDF format, with 2 to 3 photos per page, each photo labeled with file name; one PDF file per submittal.

3.08 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. Whenever possible, request clarifications at the next appropriate project progress meeting, with response entered into meeting minutes, rendering unnecessary the issuance of a formal RFI.

C. 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 in accordance with Section 00 63 13.
   3. Prepare using software provided by the Electronic Document Submittal Service.
   4. Combine RFI and its attachments into a single electronic file. PDF format is preferred.

D. 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. Unacceptable Uses for RFIs: Do not use RFIs to request the following::
      a. Approval of submittals (use procedures specified elsewhere in this section).
      b. Approval of substitutions (see Section - 016000 - Product Requirements)
      c. Changes that entail change in Contract Time and Contract Sum (comply with provisions of the Conditions of the Contract).
      d. Different methods of performing work than those indicated in the Contract Drawings and Specifications (comply with provisions of the Conditions of the Contract).
   3. Improper RFIs: Requests not prepared in compliance with requirements of this section, and/or missing key information required to render an actionable response. They will be returned without a response, with an explanatory notation.
   4. Frivolous RFIs: Requests regarding information that is clearly indicated on, or reasonably inferable from, Contract Documents, with no additional input required to clarify the question. They will be returned without a response, with 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.

E. 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. Owner's, Architect's, and Contractor's names.
   3. Discrete and consecutive RFI number, and descriptive subject/title.

4. Issue date, and requested reply date.
5. 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).
6. Annotations: Field dimensions and/or description of conditions which have engendered the request.
7. 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.

F. Attachments: Include sketches, coordination drawings, descriptions, photos, submittals, and other information necessary to substantiate the reason for the request.

G. 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. Highlight items requiring priority or expedited response.

H. Review Time: Architect will respond and return RFIs to Contractor within seven working days of receipt. For the purpose of establishing the start of the mandated response period, RFIs received after 12:00 noon 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.

I. 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.

3.09 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 specified in Section - 013216 - Construction Progress 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, submittal category (for review or for information), 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.

3.10 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 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 017800 - Closeout Submittals.

E. Submittals shall not include Material Safety Data Sheets (MSDS) or Safety Data Sheets (SDS).
1. Architect will delete MSDS and SDS and note as not reviewed.

3.11 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.

3.12 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 017800 - Closeout Submittals:
1. Project record documents.
2. Operation and maintenance data.
3. Warranties.
4. Bonds.
5. Other types as indicated.

D. Submit for Owner's benefit during and after project completion.

3.13 NUMBER OF COPIES OF SUBMITTALS

A. Electronic Documents: Submit one electronic copy in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.

B. Documents for Information: Submit one copy.

C. Samples: Submit the number specified in individual specification sections; one 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.

3.14 SUBMITTAL PROCEDURES

A. General Requirements:
1. Use a separate transmittal for each item.
2. Submit separate packages of submittals for review and submittals for information, when included in the same specification section.
3. Transmit using approved form.
a. Use form generated by Project Management software.
4. Sequentially identify each item. For revised submittals use original number and a sequential numerical suffix.

5. Identify: Project; Contractor; subcontractor or supplier; pertinent drawing and detail number; and specification section number and article/paragraph, as appropriate on each copy.
6. 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.
7. 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.
    a. Upload submittals in electronic form to Project Management software website.
8. Schedule submittals to expedite the Project, and coordinate submission of related items.
    a. For each submittal for review, allow 15 workingdays 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 working days.
    c. For sequential reviews involving approval from authorities having jurisdiction (AHJ), in addition to Architect's approval, allow an additional 30 working days.
9. Identify variations from Contract Documents and product or system limitations that may be detrimental to successful performance of the completed work.
10. Provide space for Contractor and Architect review stamps.
11. When revised for resubmission, identify all changes made since previous submission.
12. Distribute reviewed submittals. Instruct parties to promptly report inability to comply with requirements.
13. 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.
14. Submittals not requested will be recognized, and will be returned "Not Reviewed",

B. Product Data Procedures:
1. Submit only information required by individual specification sections.
2. Collect required information into a single submittal.
3. Do not submit (Material) Safety Data Sheets for materials or products.

C. Shop Drawing Procedures:
1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting Contract Documents and coordinating related work.
2. Use of reproductions of Contract Documents in digital data form to create shop drawings is only permitted as defined in Section 00 64 33.
3. Generic, non-project-specific information submitted as shop drawings do not meet the requirements for shop drawings.

D. 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. Include with transmittal high-resolution image files of samples to facilitate electronic review and approval. Provide separate submittal page for each item image.

3.15 SUBMITTAL REVIEW

A. Submittals for Review: Architect will review each submittal, and approve, or take other appropriate action.

B. Submittals for Information: Architect will acknowledge receipt and review. See below for actions to be taken.

C. Architect's actions will be reflected by marking each returned submittal using virtual stamp on electronic submittals.

D. Architect's and consultants' actions on items submitted for review:
1. Authorizing purchasing, fabrication, delivery, and installation:

a. "Approved", or language with same legal meaning.
b. "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.
c. "Approved as Noted, Resubmit for Record", or language with same legal meaning.
    1) Resubmit corrected item, with review notations acknowledged and incorporated. Resubmit separately, or as part of project record documents.

2. Not Authorizing fabrication, delivery, and installation:
    a. "Revise and Resubmit".
        1) Resubmit revised item, with review notations acknowledged and incorporated.
    b. "Rejected".
        1) Submit item complying with requirements of Contract Documents.

E. Architect's and consultants' actions on items submitted for information:
1. Items for which no action was taken:
    a. "Received" - to notify the Contractor that the submittal has been received for record only.
2. Items for which action was taken:
    a. "Reviewed" - no further action is required from Contractor.

END OF SECTION

This page intentionally left blank

SECTION 013216
CONSTRUCTION PROGRESS SCHEDULE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Preliminary schedule.

B. Construction progress schedule, with network analysis diagrams and reports.

1.02 REFERENCE STANDARDS

A. M-H (CPM) - CPM in Construction Management - Project Management with CPM; 2016.

1.03 SUBMITTALS

A. Within 10 days after date of Agreement, submit preliminary schedule.

B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.

C. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.
   1. Include written certification that major contractors have reviewed and accepted proposed schedule.

D. Within 10 days after joint review, submit complete schedule.

E. Submit updated schedule with each Application for Payment.

F. Submit in PDF format.

1.04 QUALITY ASSURANCE

A. Scheduler: Contractor's personnel or specialist Consultant specializing in CPM scheduling with one years minimum experience in scheduling construction work of a complexity comparable to this Project, and having use of computer facilities capable of delivering a detailed graphic printout within 48 hours of request.

1.05 SCHEDULE FORMAT

A. Listings: In chronological order according to the start date for each activity. Identify each activity with the applicable specification section number.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PRELIMINARY SCHEDULE

A. Prepare preliminary schedule in the form of a horizontal bar chart.

3.02 CONTENT

A. Show complete sequence of construction by activity, with dates for beginning and completion of each element of construction.

B. Identify each item by specification section number.

C. Include conferences and meetings in schedule.

D. Show accumulated percentage of completion of each item, and total percentage of Work completed, as of the first day of each month.

E. Provide separate schedule of submittal dates for shop drawings, product data, and samples, owner-furnished products, and dates reviewed submittals will be required from Architect. Indicate decision dates for selection of finishes.

F. Coordinate content with schedule of values specified in Section 012000 - Price and Payment Procedures.

G. Provide legend for symbols and abbreviations used.

3.03 NETWORK ANALYSIS

A. Prepare network analysis diagrams and supporting mathematical analyses using the Critical Path Method.

B. Illustrate order and interdependence of activities and sequence of work; how start of a given activity depends on completion of preceding activities, and how completion of the activity may restrain start of subsequent activities.

C. Mathematical Analysis: Tabulate each activity of detailed network diagrams, using calendar dates, and identify for each activity:
   1. Preceding and following event numbers.
   2. Activity description.
   3. Estimated duration of activity, in maximum 15 day intervals.
   4. Earliest start date.
   5. Earliest finish date.
   6. Actual start date.
   7. Actual finish date.
   8. Latest start date.
   9. Latest finish date.
   10. Total and free float; float time shall accrue to Owner and to Owner's benefit.
   11. Monetary value of activity, keyed to Schedule of Values.
   12. Percentage of activity completed.
   13. Responsibility.

D. Analysis Program: Capable of compiling monetary value of completed and partially completed activities, accepting revised completion dates, and recomputation of all dates and float.

E. Required Reports: List activities in sorts or groups:
   1. By preceding work item or event number from lowest to highest.
   2. By amount of float, then in order of early start.

3.04 REVIEW AND EVALUATION OF SCHEDULE

A. Participate in joint review and evaluation of schedule with Architect at each submittal.

B. Evaluate project status to determine work behind schedule and work ahead of schedule.

C. After review, revise as necessary as result of review, and resubmit within 10 days.

3.05 UPDATING SCHEDULE

A. Maintain schedules to record actual start and finish dates of completed activities.

B. Indicate progress of each activity to date of revision, with projected completion date of each activity.

C. Annotate diagrams to graphically depict current status of Work.

D. Identify activities modified since previous submittal, major changes in Work, and other identifiable changes.

E. Indicate changes required to maintain Date of Substantial Completion.

F. Submit reports required to support recommended changes.

G. Provide narrative report to define problem areas, anticipated delays, and impact on the schedule. Report corrective action taken or proposed and its effect.

3.06 DISTRIBUTION OF SCHEDULE

A. Distribute copies of updated schedules to Contractor's project site file, to subcontractors, suppliers, Architect, Owner, and other concerned parties.

B. Instruct recipients to promptly report, in writing, problems anticipated by projections indicated in schedules.

END OF SECTION

SECTION 014000
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 construction-related professional design services.

F. Control of installation.

G. Tolerances.

H. Defect Assessment.

1.02 RELATED REQUIREMENTS

A. Section 012100 - Allowances: Allowance for payment of testing services.

B. Section 014216 - Definitions.

1.03 REFERENCE STANDARDS

A. ASTM C1077 - Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation; 2024.

B. ASTM C1093 - Standard Practice for Accreditation of Testing Agencies for Masonry; 2023.

C. ASTM E543 - Standard Specification for Agencies Performing Nondestructive Testing; 2021.

D. ASTM E699 - Standard Specification for Agencies Involved in Testing, Quality Assurance, and Evaluating of Manufactured Building Components; 2016.

1.04 DEFINITIONS

A. Contractor's Quality Control Plan: Contractor's management plan for executing the Contract for Construction.

B. 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. Construction-Related: Services Contractor needs to provide in order to carry out the Contractor’s sole responsibilities for construction means, methods, techniques, sequences, and procedures.

1.05 CONTRACTOR'S CONSTRUCTION-RELATED PROFESSIONAL DESIGN SERVICES

A. Coordination: Contractor's professional design services are subject to requirements of project's Conditions for Construction Contract.

B. Provide such engineering design services as may be necessary to plan and safely conduct certain construction operations, pertaining to, but not limited to the following:
   1. Temporary sheeting, shoring, or supports.
   2. Temporary scaffolding.
   3. Temporary bracing.
   4. Temporary hoist(s) and rigging.

1.06 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

1.07 QUALITY ASSURANCE

A. Quality-Control Personnel Qualifications. Engage a person with requisite training and experience to implement and manage quality assurance (QA) and quality control (QC) for the

project.

1.08 REFERENCES AND STANDARDS

A. For products and 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 reference standard of date of issue current on date of Contract Documents, except where a specific date is established by applicable code.

C. Maintain copy at project site during submittals, planning, and progress of the specific work, until Substantial Completion.

D. Should specified reference standards conflict with Contract Documents, request clarification from Architect before proceeding.

E. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of Architect shall be altered from Contract Documents by mention or inference otherwise in any reference document.

1.09 TESTING AND INSPECTION AGENCIES AND SERVICES

A. Owner will employ services of an independent testing agency to perform certain specified testing; payment for cost of services will be derived from allowance specified in Section 012100; see Section 012100 and applicable sections for description of services included in allowance.

B. Contractor shall employ and pay for services of an independent testing agency to perform other specified testing.

C. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

D. Contractor Employed Agency:

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 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.

3.03 TESTING AND INSPECTION

A. See individual specification sections for testing and inspection required.

B. Testing Agency Duties:
   1. Test samples of mixes submitted by Contractor.
   2. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
   3. Perform specified sampling and testing of products in accordance with specified standards.
   4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
   5. Promptly notify Architect and Contractor of observed irregularities or non-compliance of Work or products.
   6. Perform additional tests and inspections required by Architect.
   7. 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 and to manufacturers' facilities.
   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 24 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.

3.04 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

This page intentionally left blank

SECTION 014216
DEFINITIONS

PART 1 GENERAL

1.01 SUMMARY

A. 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

This page intentionally left blank

SECTION 014219
REFERENCE STANDARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Requirements relating to referenced standards.

B. Reference standards full title and edition date.

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. Obtain copies of standards when required by Contract Documents.

D. Should specified reference standards conflict with Contract Documents, request clarification from the Architect before proceeding.

E. 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 CONSTRUCTION INDUSTRY ORGANIZATION DOCUMENTS

2.01 AA -- ALUMINUM ASSOCIATION, INC.

A. AA DAF-45 - Designation System for Aluminum Finishes; 2003 (Reaffirmed 2009).

B. AA SAAA-46 - Standards for Anodized Architectural Aluminum; 1978.

2.02 AABC -- ASSOCIATED AIR BALANCE COUNCIL

A. AABC (NSTSB) - AABC National Standards for Total System Balance, 7th Edition; 2016.

B. AABC MN-1 - AABC National Standards for Total System Balance; 2002.

2.03 AAMA -- AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION

A. AAMA/WDMA/CSA 101/I.S.2/A440 - North American Fenestration Standard/Specification for Windows, Doors, and Skylights; 2022.

B. AAMA 501.1 - Standard Test Method for Water Penetration of Windows, Curtain Walls and Doors Using Dynamic Pressure; 2017.

C. AAMA 502 - Voluntary Specification for Field Testing of Newly Installed Fenestration Products; 2021.

D. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.

2.04 ASTM A SERIES -- ASTM INTERNATIONAL

2.05 UL -- UNDERWRITERS LABORATORIES INC.

A. UL (FRD) - Fire Resistance Directory; Current Edition.

END OF SECTION

This page intentionally left blank

SECTION 014533
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. IAS: International Accreditation Service, Inc.

C. NIST: National Institute of Standards and Technology.

1.03 DEFINITIONS

A. Code or Building Code: ICC (IBC), International Building Code, Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements and 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; 2023.

B. ASTM E543 - Standard Specification for Agencies Performing Nondestructive Testing; 2021.

C. IAS AC291 - Accreditation Criteria for Special Inspection Agencies AC291; 2019.

D. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.05 SUBMITTALS

A. See Section 013000 - 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 registered Engineer 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. Testing Agency Qualifications: Prior to the start of work, the Testing Agency is required to:
   1. Submit agency name, address, and telephone number, and names of full time registered Engineer 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 Testing Agency is acceptable to AHJ.

D. 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.

E. Fabricator Special Inspection Reports: After each special inspection of fabricated items at the Fabricator's facility, Special Inspector is required to promptly submit copy 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).

F. Test Reports: After each test or inspection, promptly submit copy 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.

G. Certificates: When specified in individual special inspection requirements, Special Inspector shall submit certification by the manufacturer, fabricator, and installation subcontractor to Architect and AHJ, 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.

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. The Special Inspection Agency may employ and pay for services of an independent testing agency to perform testing and sampling associated with special inspections and required by the building code.

C. Employment of agency in no way relieves Contractor of obligation to perform work in accordance with requirements of Contract Documents.

1.07 TESTING AND INSPECTION AGENCIES

A. Owner may employ services of an independent testing agency to perform additional testing and sampling associated with special inspections but not 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.

1.08 QUALITY ASSURANCE

A. Special Inspection Agency Qualifications:
   1. Independent firm specializing in performing testing and inspections of the type specified in this section.
   2. Accredited by IAS according to IAS AC291.

B. Testing Agency Qualifications:
   1. Independent firm specializing in performing testing and inspections of the type specified in this section.

C. Copies of Documents at Project Site: Maintain at the project site a copy of each referenced document.

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 REQUIRED SPECIAL INSPECTIONS

A. See Structural Engineering Construction Documents and Specification Sections for required Special Inspectionsl

END OF SECTION

This page intentionally left blank

SECTION 015000
TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Dewatering

B. Temporary utilities.

C. Temporary telecommunications services.

D. Temporary sanitary facilities.

E. Temporary Controls: Barriers, enclosures, and fencing.

F. Vehicular access and parking.

G. Waste removal facilities and services.

H. Project identification sign.

1.02 DEWATERING

A. Provide temporary means and methods for dewatering all temporary facilities and controls.

1.03 TEMPORARY UTILITIES

A. Owner will provide the following:
   1. Electrical power and metering, consisting of connection to existing facilities.
   2. Water supply, consisting of connection to existing facilities.

1.04 TELECOMMUNICATIONS SERVICES

A. Provide, maintain, and pay for telecommunications services to field office at time of project mobilization.

B. Telecommunications services shall include:
   1. Project web site.

1.05 TEMPORARY SANITARY FACILITIES

A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.

B. Maintain daily in clean and sanitary condition.

1.06 BARRIERS

A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public, to allow for owner's use of site and to protect existing facilities and adjacent properties from damage from construction operations and demolition.

B. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing building.

C. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.07 FENCING

A. Construction: Commercial grade chain link fence.

B. Provide 6 foot (1.8 m) high fence around construction site; equip with vehicular and pedestrian gates with locks.

1.08 EXTERIOR ENCLOSURES

A. Provide temporary insulated weather tight closure of exterior openings to accommodate acceptable working conditions and protection for Products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual specification sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.

1.09 INTERIOR ENCLOSURES

A. Provide temporary partitions as indicated to separate work areas from un-occupied areas, to prevent penetration of dust and moisture into un-occupied areas, and to prevent damage to existing materials and equipment.

B. Construction: Framing and gypsum board sheet materials with closed joints and sealed edges at intersections with existing surfaces:

C. Paint surfaces exposed to view from Owner-occupied areas.

1.10 VEHICULAR ACCESS AND PARKING

A. Comply with regulations relating to use of streets and sidewalks, access to emergency facilities, and access for emergency vehicles.

B. Coordinate access and haul routes with governing authorities and Owner.

C. Provide and maintain access to fire hydrants, free of obstructions.

D. Provide means of removing mud from vehicle wheels before entering streets.

E. Provide temporary parking areas to accommodate construction personnel. When site space is not adequate, provide additional off-site parking.

1.11 WASTE REMOVAL

A. See Section 017419 - Construction Waste Management and Disposal, for additional requirements.

B. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.

C. Provide containers with lids. Remove trash from site periodically.

D. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.

E. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.12 PROJECT IDENTIFICATION

A. Provide project identification sign of design and construction indicated on drawings.

B. Erect on site at location established by Architect.

C. No other signs are allowed without Owner permission except those required by law.

1.13 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary utilities, equipment, facilities, materials, prior to Date of Substantial Completion inspection.

B. Remove underground installations to a minimum depth of 2 feet (600 mm). Grade site as indicated.

C. Clean and repair damage caused by installation or use of temporary work.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 016000
PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General product requirements.

B. Transportation, handling, storage and protection.

C. Product option requirements.

D. Substitution limitations.

E. Maintenance materials, including extra materials, spare parts, tools, and software.

1.02 RELATED REQUIREMENTS

A. Section 012500 - Substitution Procedures: Substitutions made during procurement and/or construction phases.

B. Section 014000 - Quality Requirements: Product quality monitoring.

C. Section 017419 - Construction Waste Management and Disposal: Waste disposal requirements potentially affecting product selection, packaging and substitutions.

1.03 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 NEW PRODUCTS

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

B. See Section 014000 - Quality Requirements, for additional source quality control requirements.

C. Use of products having any of the following characteristics is not permitted:
   1. Made outside the United States, its territories, Canada, or Mexico.

2.02 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.

2.03 MAINTENANCE MATERIALS

A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.

B. Deliver to Project site; obtain receipt prior to final payment.

PART 3 EXECUTION

3.01 SUBSTITUTION LIMITATIONS

A. See Section 012500 - Substitution Procedures.

3.02 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. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.

F. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.

G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.

H. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.03 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. See Section 017419.

1. Structural Loading Limitations: Handle and store products and materials so as not to exceed static and dynamic load-bearing capacities of project floor and roof areas.

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. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.

G. Comply with manufacturer's warranty conditions, if any.

H. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

I. Prevent contact with material that may cause corrosion, discoloration, or staining.

J. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

K. 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 017000
EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Examination, preparation, and general installation procedures.

B. Pre-installation meetings.

C. Cutting and patching.

D. Surveying for laying out the work.

E. Cleaning and protection.

F. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.

G. General requirements for maintenance service.

1.02 RELATED REQUIREMENTS

A. Section 078400 - Firestopping.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Survey work: Submit name, address, and telephone number of Surveyor before starting survey work.
   1. On request, submit documentation verifying accuracy of survey work.
   2. Submit a copy of site drawing signed by the Land Surveyor, that the elevations and locations of the work are in compliance with Contract Documents.
   3. Submit surveys and survey logs for the project record.

C. 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.

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.

H. Pest and Rodent Control: Provide methods, means, and facilities to prevent pests and insects from damaging the work.

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.

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 016000 - 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 four 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 two 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. Protect survey control points prior to starting site work; preserve permanent reference points during construction.

D. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.

E. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.

F. Utilize recognized engineering survey practices.

G. 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; and _____.
   2. Grid or axis for structures.
   3. Building foundation, column locations, ground floor elevations, and _____.

H. Periodically verify layouts by same means.

I. Maintain a complete and accurate log of control and survey work as it progresses.

3.05 GENERAL INSTALLATION REQUIREMENTS

A. 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.

B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.

C. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.

D. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.

E. Make neat transitions between different surfaces, maintaining texture and appearance.

3.06 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-complying 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 original installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.

E. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.

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 078400, to full thickness of the penetrated element.

I. 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.
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.

3.07 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.

3.08 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.

3.09 ADJUSTING

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

3.10 FINAL CLEANING

A. Execute final cleaning prior to final project assessment.

B. Use cleaning materials that are nonhazardous.

C. 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.

D. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.

E. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.

F. Clean filters of operating equipment.

G. Clean debris from roofs, gutters, downspouts, scuppers, overflow drains, area drains, drainage systems, and _____.

H. Clean site; sweep paved areas, rake clean landscaped surfaces.

I. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

3.11 CLOSEOUT PROCEDURES

A. Make submittals that are required by governing or other authorities.

B. Accompany Project Coordinator 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.

3.12 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 017419
CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 GENERAL

1.01 WASTE MANAGEMENT REQUIREMENTS

A. Owner requires that this project generate the least amount of trash and waste possible.

B. Employ processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors.

C. Minimize trash/waste disposal in landfills; reuse, salvage, or recycle as much waste as economically feasible.

D. Contractor Reporting Responsibilities: Submit periodic Waste Disposal Reports; report landfill disposal, incineration, recycling, salvage, and reuse regardless of to whom the cost or savings accrues; use the same units of measure on required reports.

E. Develop and follow a Waste Management Plan designed to implement these requirements.

F. The following sources may be useful in developing the Waste Management Plan:

G. Methods of trash/waste disposal that are not acceptable are:
   1. Burning on the project site.
   2. Burying on the project site.
   3. Dumping or burying on other property, public or private.
   4. Other illegal dumping or burying.

H. Regulatory Requirements: Contractor is responsible for knowing and complying with regulatory requirements, including but not limited to Federal, state and local requirements, pertaining to legal disposal of all construction and demolition waste materials.

1.02 RELATED REQUIREMENTS

A. Section 013000 - Administrative Requirements: Additional requirements for project meetings, reports, submittal procedures, and project documentation.

B. Section 015000 - Temporary Facilities and Controls: Additional requirements related to trash/waste collection and removal facilities and services.

C. Section 016000 - Product Requirements: Waste prevention requirements related to delivery, storage, and handling.

D. Section 017000 - Execution and Closeout Requirements: Trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.

E. Section 311000 - Site Clearing: Handling and disposal of land clearing debris.

1.03 DEFINITIONS

A. Clean: Untreated and unpainted; not contaminated with oils, solvents, caulk, or the like.

B. Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, remodeling, repair and demolition operations.

C. Hazardous: Exhibiting the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity or reactivity.

D. Nonhazardous: Exhibiting none of the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity, or reactivity.

E. Nontoxic: Neither immediately poisonous to humans nor poisonous after a long period of exposure.

F. Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.

G. Recycle: To remove a waste material from the project site to another site for remanufacture into a new product for reuse by others.

H. Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste.

I. Return: To give back reusable items or unused products to vendors for credit.

J. Reuse: To reuse a construction waste material in some manner on the project site.

K. Salvage: To remove a waste material from the project site to another site for resale or reuse by others.

L. Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water.

M. Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.

N. Toxic: Poisonous to humans either immediately or after a long period of exposure.

O. Trash: Any product or material unable to be reused, returned, recycled, or salvaged.

P. Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Submit Waste Management Plan within 10 calendar days after receipt of Notice of Award of Bid, or prior to any trash or waste removal, whichever occurs sooner; submit projection of all trash and waste that will require disposal and alternatives to landfilling.

C. Waste Management Plan: Include the following information:
   1. Analysis of the trash and waste projected to be generated during the entire project construction cycle, including types and quantities.
   2. Landfill Options: The name, address, and telephone number of the landfill(s) where trash/waste will be disposed of, the applicable landfill tipping fee(s), and the projected cost of disposing of all project trash/waste in the landfill(s).
   3. Landfill Alternatives: List all waste materials that will be diverted from landfills by reuse, salvage, or recycling.
   4. Meetings: Describe regular meetings to be held to address waste prevention, reduction, recycling, salvage, reuse, and disposal.
   5. Materials Handling Procedures: Describe the means by which materials to be diverted from landfills will be protected from contamination and prepared for acceptance by designated facilities; include separation procedures for recyclables, storage, and packaging.
   6. Transportation: Identify the destination and means of transportation of materials to be recycled; i.e. whether materials will be site-separated and self-hauled to designated centers, or whether mixed materials will be collected by a waste hauler.

D. Waste Disposal Reports: Submit at specified intervals, with details of quantities of trash and waste, means of disposal or reuse, and costs; show both totals to date and since last report.
   1. Submit updated Report with each Application for Progress Payment; failure to submit Report will delay payment.
   2. Submit Report on a form acceptable to Owner.
   3. Landfill Disposal: Include the following information:
      a. Identification of material.
      b. Amount, in tons or cubic yards (cubic meters), of trash/waste material from the project disposed of in landfills.
      c. State the identity of landfills, total amount of tipping fees paid to landfill, and total disposal cost.

d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.

4. Incinerator Disposal: Include the following information:
   a. Identification of material.
   b. Amount, in tons or cubic yards (cubic meters), of trash/waste material from the project delivered to incinerators.
   c. State the identity of incinerators, total amount of fees paid to incinerator, and total disposal cost.
   d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
5. Recycled and Salvaged Materials: Include the following information for each:
   a. Identification of material, including those retrieved by installer for use on other projects.
   b. Amount, in tons or cubic yards (cubic meters), date removed from the project site, and receiving party.
   c. Transportation cost, amount paid or received for the material, and the net total cost or savings of salvage or recycling each material.
   d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
   e. Certification by receiving party that materials will not be disposed of in landfills or by incineration.
6. Material Reused on Project: Include the following information for each:
   a. Identification of material and how it was used in the project.
   b. Amount, in tons or cubic yards (cubic meters).
   c. Include weight tickets as evidence of quantity.
7. Other Disposal Methods: Include information similar to that described above, as appropriate to disposal method.

PART 2 PRODUCTS -- NOT USED

PART 3 EXECUTION

3.01 WASTE MANAGEMENT PROCEDURES

A. See Section 013000 for additional requirements for project meetings, reports, submittal procedures, and project documentation.

B. See Section 015000 for additional requirements related to trash/waste collection and removal facilities and services.

C. See Section 016000 for waste prevention requirements related to delivery, storage, and handling.

D. See Section 017000 for trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.

3.02 WASTE MANAGEMENT PLAN IMPLEMENTATION

A. Manager: Designate an on-site person or persons responsible for instructing workers and overseeing and documenting results of the Waste Management Plan.

B. Communication: Distribute copies of the Waste Management Plan to job site foreman, each subcontractor, Owner, and Architect.

C. Instruction: Provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the project.

D. Meetings: Discuss trash/waste management goals and issues at project meetings.
   1. Prebid meeting.
   2. Preconstruction meeting.
   3. Regular job-site meetings.

E. Facilities: Provide specific facilities for separation and storage of materials for recycling, salvage, reuse, return, and trash disposal, for use by all contractors and installers.
   1. Provide containers as required.
   2. Provide adequate space for pick-up and delivery and convenience to subcontractors.
   3. Keep recycling and trash/waste bin areas neat and clean and clearly marked in order to avoid contamination of materials.

F. Hazardous Wastes: Separate, store, and dispose of hazardous wastes according to applicable regulations.

G. Recycling: Separate, store, protect, and handle at the site identified recyclable waste products in order to prevent contamination of materials and to maximize recyclability of identified materials. Arrange for timely pickups from the site or deliveries to recycling facility in order to prevent contamination of recyclable materials.

H. Reuse of Materials On-Site: Set aside, sort, and protect separated products in preparation for reuse.

I. Salvage: Set aside, sort, and protect products to be salvaged for reuse off-site.

END OF SECTION

SECTION 017800
CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Project record documents.

B. Operation and maintenance data.

C. Warranties and bonds.

1.02 RELATED REQUIREMENTS

A. Section 013000 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.

B. Individual Product Sections: Specific requirements for operation and maintenance data.

C. Individual Product Sections: Warranties required for specific products or Work.

1.03 SUBMITTALS

A. Project Record Documents: Submit documents to Architect with claim for final Application for Payment.

B. Operation and Maintenance Data:
   1. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
   2. 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.
   3. Submit 1 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. Maintain on site one set of the following record documents; record actual revisions to the Work:
   1. Drawings.
   2. Addenda.
   3. Change Orders and other modifications to the Contract.

B. Ensure entries are complete and accurate, enabling future reference by Owner.

C. Store record documents separate from documents used for construction.

D. Record information concurrent with construction progress.

E. Record Drawings: Legibly mark each item to record actual construction including:
   1. Measured depths of foundations in relation to finish first floor datum.
   2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
   3. Field changes of dimension and detail.
   4. Details not on original Contract drawings.

3.02 OPERATION AND MAINTENANCE DATA

A. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.

B. 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.

C. 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. 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. 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.

D. 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.
   1. Include HVAC outdoor and exhaust air damper calibration strategy.
      a. Include provisions which ensure that full closure of dampers can be achieved.

E. Provide servicing and lubrication schedule, and list of lubricants required.

F. Include manufacturer's printed operation and maintenance instructions.

G. Include sequence of operation by controls manufacturer.

H. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

I. Include test and balancing reports.

3.05 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS

A. 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.

B. Where systems involve more than one specification section, provide separate tabbed divider for each system.

C. Binders: Commercial quality, 8-1/2 by 11 inch (216 by 280 mm) three D side ring binders with durable plastic covers; 2 inch (50 mm) maximum ring size. When multiple binders are used, correlate data into related consistent groupings.

D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.

E. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.

F. 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.

G. 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.

H. Text: Manufacturer's printed data, or typewritten data on 20 pound paper.

I. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

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.

END OF SECTION

This page intentionally left blank

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
   1. Footings.
   2. Foundation walls.
   3. Slabs-on-grade.
   4. Building walls.
   5. Concrete toppings.
   6. Concrete formwork.
   7. Steel reinforcement.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's data in accordance with specifications indicating product compliance to these specifications.

   1. Only complete shop drawing submittals will be reviewed. Shop drawings not in compliance with the Submittal portion of this document will be rejected. Time required by Wallace Engineering Structural Consultants, Inc. to review shop drawing submittals a second or third time will be billed to the General Contractor at Wallace Engineering Structural Consultants, Inc. hourly rates.
   2. Requirements for Submittals:
      a. Review of shop drawings is for bar sizes, spacing, details and general compliance with the Contract Drawings only.
      b. Reproduction of Contract Drawings shall not be used for shop drawings.
      c. Do not begin fabrication of materials prior to review of shop drawings.
      d. Material quantities, fit, verification of job conditions and coordination with other trades are the responsibility of the General Contractor.

B. Samples: For waterstops and vapor retarder.

C. Welding certificates.

D. Material Certificates: For each of the following, signed by manufacturers:
   1. Cementitious materials.
   2. Admixtures.
   3. Form materials and form-release agents.

4. Steel reinforcement and accessories.
5. Fiber reinforcement.
6. Waterstops.
7. Curing compounds.
8. Floor and slab treatments.
9. Bonding agents.
10. Adhesives.
11. Vapor retarders.
12. Semirigid joint filler.
13. Joint-filler strips.
14. Repair materials.

E. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

F. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

G. Field quality-control test and inspection reports.

H. Minutes of preinstallation conference.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94 requirements for production facilities and equipment.
1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. 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. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

E. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code - Reinforcing Steel."

F. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
1. ACI 301, "Specifications for Structural Concrete."
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

G. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation.

H. Concrete Formwork:
1. Design and construct forms to withstand stresses due to weight of fresh concrete, vibration during consolidation and loads of equipment and workmen. Comply with ACI 318.
2. Limit deflection of forms to provide smooth, straight surfaces without unsightly bulges and deformations.
3. Limit deformations of forms for architecturally exposed surfaces to 0.0025 times the span of each component (facing materials, studs and walers).

1.6 DELIVERY, STORAGE, AND HANDLING

A. Transporting: Ready-mixed concrete supplier shall have sufficient capacity and adequate facilities to provide continuous delivery at the rate required for continuous placement throughout any sequence of placement.

B. Storage of Concrete Materials:
1. Store cement in weather tight buildings or bins which prevent intrusion of moisture or contaminants. Store different types of cement in separate facilities.
2. Stockpile aggregates to prevent segregation and contamination with other materials. Thaw frozen aggregates before use.
3. Sand shall be drained to a uniform moisture content before use.
4. Store admixtures securely to prevent contamination, evaporation damage or temperature variation in excesses of the range recommended by the manufacturer.

C. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement.

D. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1

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

B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706, deformed.

C. Steel Bar Mats: ASTM A 184, fabricated from ASTM A 615, Grade 60, or A706, deformed bars, assembled with clips.

D. Plain-Steel Wire: ASTM A 82, as drawn.

E. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.

F. Deformed-Steel Welded Wire Reinforcement: ASTM A 497, flat sheet.

2.2 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.

B. 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," of greater compressive strength than concrete and as follows:
1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

C. Plate Dowel System:
1. Diamond Dowel System by PNA Construction Technologies or approved equal.

2.3 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type I, II or III. Cement shall be supplied from a single manufacturer. Supplement with the following:
   a. Fly Ash: ASTM C 618, Class C or F. Use only one type and source throughout project.
2. Blended Hydraulic Cement: ASTM C 595, Type IP, portland-pozzolan, or Type I (PM), pozzolan-modified portland cement.

B. Silica Fume: ASTM C 1240, amorphous silica.

C. Normal-Weight Aggregates: ASTM C 33 coarse aggregate or better, graded. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size: As noted in “Concrete Mixtures for Building Elements.” Coarse aggregate shall conform to applicable requirements of ASTM C 33 gravel or crushed stone, suitably processed, washed and screened, consisting of hard, durable particles without adherent coatings.
2. Fine Aggregate: conform to applicable requirements of ASTM C 33, natural bank or river sand, washed and screened, consisting of hard, durable, uncoated particles free of deleterious matter, free of materials with deleterious reactivity to alkali in cement, and graded from coarse to fine to produce a minimum percentage of voids.

D. Water: ASTM C 94 and potable.

2.4 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494, Type A.
2. Retarding Admixture: ASTM C 494, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017, Type II.

2.5 VAPOR RETARDERS

A. Plastic Vapor Retarder: ASTM E 1745, Class A, single or multi-layer, not less than 15 mils thick:

1. Maximum perm rating of 0.01 perms (U.S.) per ASTM E 96 or F 1249.
2. Puncture resistance of 2200g or greater per ASTM D 1709, B.
3. Include manufacturer's recommended adhesive or pressure-sensitive joint tape, and include manufacturer's proprietary penetration flashing for all through-slab penetrations.
4. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    a. Vapor Block 15; Raven Industries Inc.
    b. Stego Wrap, 15 mil; Stego Industries, LLC.
    c. Moistop Ultra 15; Fortifiber Corporation.

B. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.

C. Fine-Graded Granular Material: Clean mixture of crushed stone, crushed gravel, and manufactured or natural sand; ASTM D 448, Size 10, with 100 percent passing a 3/8-inch sieve, 10 to 30 percent passing a No. 100 sieve, and at least 5 percent passing No. 200 sieve; complying with deleterious substance limits of ASTM C 33 for fine aggregates.

2.6 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    a. Axim Italcementi Group, Inc.; CATEXOL CimFilm.
    b. BASF Construction Chemicals - Building Systems; Confilm.
    c. ChemMasters; SprayFilm.
    d. Conspec by Dayton Superior; Aquafilm.
    e. Dayton Superior Corporation; Sure Film (J-74).
    f. Edoco by Dayton Superior; BurkeFilm.
    g. Euclid Chemical Company (The), an RPM company; Eucobar.
    h. Kaufman Products, Inc.; Vapor-Aid.
    i. Lambert Corporation; LAMBCO Skin.
    j. L&M Construction Chemicals, Inc.; E-CON.
    k. Meadows, W. R., Inc.; EVAPRE.
    l. Metalcrete Industries; Waterhold.

m. Nox-Crete Products Group; MONOFILM.
n. Sika Corporation; SikaFilm.
o. SpecChem, LLC; Spec Film.
p. Symons by Dayton Superior; Finishing Aid.
q. TK Products, Division of Sierra Corporation; TK-2120 TRI-FILM.
r. Unitex; PRO-FILM.
s. Vexcon Chemicals, Inc.; Certi-Vex Envio Set.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
a. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
b. BASF Construction Chemicals - Building Systems; Kure 200.
c. ChemMasters; Safe-Cure Clear.
d. Conspec by Dayton Superior; W.B. Resin Cure.
e. Dayton Superior Corporation; Day-Chem Rez Cure (J-11-W).
f. Edoco by Dayton Superior; Res X Cure WB.
g. Euclid Chemical Company (The), an RPM company; Kurez W VOX; TAMMSCURE WB 30C.
h. Kaufman Products, Inc.; Thinfilm 420.
i. Lambert Corporation; AQUA KURE - CLEAR.
j. L&M Construction Chemicals, Inc.; L&M Cure R.
k. Meadows, W. R., Inc.; 1100-CLEAR.
l. Nox-Crete Products Group; Resin Cure E.
m. Right Pointe; Clear Water Resin.
n. SpecChem, LLC; Spec Rez Clear.
o. Symons by Dayton Superior; Resi-Chem Clear.
p. TK Products, Division of Sierra Corporation; TK-2519 DC WB.
q. Vexcon Chemicals, Inc.; Certi-Vex Enviocure 100.

F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
a. Anti-Hydro International, Inc.; AH Clear Cure WB.
b. BASF Construction Chemicals - Building Systems; Kure-N-Seal WB.
c. ChemMasters; Safe-Cure & Seal 20.
d. Conspec by Dayton Superior; Cure and Seal WB.
e. Cresset Chemical Company; Crete-Trete 309-VOC Cure & Seal.
f. Dayton Superior Corporation; Safe Cure and Seal (J-18).
g. Edoco by Dayton Superior; Spartan Cote WB II.
h. Euclid Chemical Company (The), an RPM company; Aqua Cure VOX; Clearseal WB 150.
i. Kaufman Products, Inc.; Cure & Seal 309 Emulsion.
j. Lambert Corporation; Glazecote Sealer-20.
k. L&M Construction Chemicals, Inc.; Dress & Seal WB.
l. Meadows, W. R., Inc.; Vocomp-20.

m. Metalcrete Industries; Metcure.
n. Nox-Crete Products Group; Cure & Seal 150E.
o. Symons by Dayton Superior; Cure & Seal 18 Percent E.
p. TK Products, Division of Sierra Corporation; TK-2519 WB.
q. Vexcon Chemicals, Inc.; Starseal 309.

G. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, 18 to 25 percent solids, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. BASF Construction Chemicals - Building Systems; Kure-N-Seal W.
   b. ChemMasters; Safe-Cure Clear.
   c. Conspec by Dayton Superior; High Seal.
   d. Dayton Superior Corporation; Safe Cure and Seal (J-19).
   e. Edoco by Dayton Superior; Spartan Cote WB II 20 Percent.
   f. Euclid Chemical Company (The), an RPM company; Diamond Clear VOX; Clearseal WB STD.
   g. Kaufman Products, Inc.; SureCure Emulsion.
   h. Lambert Corporation; Glazecote Sealer-20.
   i. L&M Construction Chemicals, Inc.; Dress & Seal WB.
   j. Meadows, W. R., Inc.; Vocomp-20.
   k. Metalcrete Industries; Metcure 0800.
   l. Nox-Crete Products Group; Cure & Seal 200E.
   m. Symons by Dayton Superior; Cure & Seal 18 Percent E.
   n. Vexcon Chemicals, Inc.; Starseal 0800.

H. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. BASF Construction Chemicals - Building Systems; Kure-N-Seal 25 LV.
   b. ChemMasters; Spray-Cure & Seal Plus.
   c. Conspec by Dayton Superior; Sealcure 1315.
   d. Dayton Superior Corporation; Day-Chem Cure and Seal (J-22UV).
   e. Edoco by Dayton Superior; Cureseal 1315.
   f. Euclid Chemical Company (The), an RPM company; Super Diamond Clear; LusterSeal 300.
   g. Kaufman Products, Inc.; Sure Cure 25.
   h. Lambert Corporation; UV Super Seal.
   i. L&M Construction Chemicals, Inc.; Lumiseal Plus.
   j. Meadows, W. R., Inc.; CS-309/30.
   k. Metalcrete Industries; Seal N Kure 30.
   l. Right Pointe; Right Sheen 30.
   m. Vexcon Chemicals, Inc.; Certi-Vex AC 1315.

I. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. BASF Construction Chemicals - Building Systems; Kure 1315.
   b. ChemMasters; Polyseal WB.

c. Conspec by Dayton Superior; Sealcure 1315 WB.
d. Edoco by Dayton Superior; Cureseal 1315 WB.
e. Euclid Chemical Company (The), an RPM company; Super Diamond Clear VOX; LusterSeal WB 300.
f. Kaufman Products, Inc.; Sure Cure 25 Emulsion.
g. Lambert Corporation; UV Safe Seal.
h. L&M Construction Chemicals, Inc.; Lumiseal WB Plus.
i. Meadows, W. R., Inc.; Vocomp-30.
j. Metalcrete Industries; Metcure 30.
k. Right Pointe; Right Sheen WB30.
l. Symons by Dayton Superior; Cure & Seal 31 Percent E.
m. Vexcon Chemicals, Inc.; Vexcon Starseal 1315.

2.7 RELATED MATERIALS

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

B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.

C. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:

1. Types I and II, non-load bearing for bonding hardened or freshly mixed concrete to hardened concrete.

E. Reglets: Fabricate reglets of not less than 0.022-inch thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

F. Non-Shrink Grout: Pre-mixed, non-shrinking, minimum compressive strength of 5000 psi in 28 days, conforming to U.S. Army Corps of Engineers specifications No. CRD-C621. Grout exposed to view shall be non-oxidizing.

2.8 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109.

2.9 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixtures, strength test records, or field test data, according to ACI 301.

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
2. Required Average Strength for each type of concrete:
    a. Where suitable test records for the concrete production facility are available, design strength may be tested on the standard deviation in accordance with ACI 318.
    b. Where strength test records are not available, design strength and documentation of average strength as noted in ACI 318, Chapter 5.

B. Cementitious Materials:

1. Minimum cement content:
    a. Cementitious Materials content shall not be less than 520 pounds per cubic yard, unless noted otherwise in Contract Documents.
2. Use fly ash and pozzolan as needed to reduce the total amount of portland cement, which would otherwise be used. If used, limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
    a. Fly Ash: 25 percent maximum, 15 percent minimum.
    b. Combined Fly Ash and Pozzolan: 25 percent maximum.

C. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing or plasticizing admixture in pumped concrete, , and concrete with a water-cementitious materials ratio below 0.50.
4. Slump limits noted in the following building elements are values before adding water-reducing admixtures. Slump limits shall be no more than 8” after adding the water-reducing admixture.

D. For concrete exposed to freeze thaw, air content shall be 6 percent plus or minus 1.5 percent, unless noted otherwise in Contract Documents. For concrete not exposed to freeze thaw, do not add air-entraining agents.

E. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup. Reference Contract Drawings for locations.

2.10 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Footings, Piers and Grade Beams: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 3000 psi at 28 days.
2. Maximum Water-Cementitious Materials Ratio: 0.58.
3. Slump Limit: 4 inches plus or minus 1 inch.
4. Maximum Coarse Aggregate Size: 1 1/2 inch.
5. Minimum Cementitious Materials Content: 470 pounds per cubic yard.

B. Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Maximum Water-Cementitious Material Ratio: 0.50.
3. Slump Limit: 4 inches plus or minus 1 inch.
4. Maximum Coarse Aggregate Size: 1 inch.

C. Steel Stair Pans and Slabs on Composite Form Deck: Proportion normal weight concrete mixture as follows:

1. Minimum Composite Strength: 4000 psi at 28 days.
2. Maximum Water-Cementitious Material Ratio: 0.50.
3. Slump Limit: 4 inches, plus or minus 1 inch.
4. Maximum Coarse Aggregate Size: 1/2 inch.

D. Exterior Structural Concrete and Sidewalks: Proportion normal weight concrete mixture as follows:

1. Minimum Compressive Strength: 4500 psi at 28 days.
2. Maximum Water-Cementitious Material Ratio: 0.45.
3. Slump Limit: 4 inches, plus or minus 1 inch.
4. Maximum Coarse Aggregate Size: 1 inch.
5. Air Content: 6 percent, plus or minus 1.5 percent.

2.11 FABRICATING REINFORCEMENT

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

2.12 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

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. At Architectural Appearance Quality Smooth-Formed Finished Concrete Walls coordinate snap-tie hole layout and spacing with Architect.

D. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:

1. Class A, 1/8 inch for smooth-formed finished surfaces.
2. Class C, 1/2 inch for rough-formed finished surfaces.

E. Construct forms tight enough to prevent loss of concrete mortar.

F. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.

G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

I. Chamfer exterior corners and edges of permanently exposed concrete.

J. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

K. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

L. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

M. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

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.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

3.3 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 75 percent of its 28-day design compressive strength.
2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 VAPOR RETARDERS

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions. Reference Contract Drawings for locations requiring vapor retarder placement.

1. Lap vapor retarder over footings and seal to foundation walls.
2. Lap joints 6 inches and seal with manufacturer’s recommended tape.
3. Seal penetrations (including pipes) per manufacturer’s instructions.
4. Repair damaged areas by cutting patches of vapor retarder, overlapping damaged area 6 inches and taping all four sides with manufacturer’s recommended tape.

B. Place vapor retarder on top of the drainage course material and directly below slab at all interior slabs.

3.5 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

1. Weld reinforcing bars according to AWS D1.4, where indicated on Contract Drawings.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.6 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.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete or as indicated on Contract Drawings.
3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
4. Do not locate construction joints between lateral bracing elements of walls and columns.
5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
6. Space vertical joints in walls as indicated on the Contract Drawings or on the approved submittals. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
7. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
8. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction (Control) Joints in Slabs-on-Grade: Within 12 hours of pouring slabs, form weakened-plane contraction joints, sectioning concrete into areas as indicated on the Contract Drawings. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
   a. Primary Method: Soft-Cut System method, by Soff-Cut International, Corona, CA (800) 776-3328. Finisher must have documented successful experience in the use of this method prior to this project. Install cuts within 2 hours after final finish at each saw cut location. Use 1/4 inch thick blade, cutting 1-1/4 inch into slab.
   b. Optional Method (Where Soft-Cut System Method Equipment is Not Available): Properly time cutting with the set of the concrete. Saw-Cut control joints within 12 hours after finishing. Start cutting as soon as the concrete has hardened sufficiently to prevent aggregates being dislodged by the saw. Complete cutting before shrinkage stresses become sufficient to produce cracking. Use 1/4 inch thick blade, cutting 1-1/4 inch into slab.
2. Spacing: Provide joints at locations as noted on Contract Drawings.
   a. Placement of saw joints must be coordinated with the tile joints and this requirement governs over locations shown on the Contract Drawings.

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 on Contract Drawings.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated on Contract Drawings.
2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints: Install dowel bars and support assemblies at joints as noted on the Contract Drawings. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint. In lieu of dowels, plate dowel system approved by the Engineer of Record may be used at Contractor's option.

3.7 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Precautions to protect fresh concrete from developing plastic shrinkage cracks must be taken in advance of concrete placement when evaporation rate due to any combination of temperature, humidity, and wind velocity is expected to approach 0.2 lb./sq. ft./hr. as determined by ACI 305R. Acceptable precautions to reduce the rate of evaporation include use of wind breaks, fog spray, covering with polyethylene sheeting, or wet cover.

C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by the Structural Engineer-of-Record.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be 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. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Lack of Slope: Confirm with Architect before proceeding when Contract Drawings show exterior flatwork without a specific slope.
6. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

F. Cold-Weather Placement: Comply with ACI 306.1, ACI 306R and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When the average of the highest and lowest ambient temperature from midnight to midnight is expected to be less than 40 degrees F for more than three successive days, deliver concrete to meet the following minimum temperatures immediately after placement:
   a. 55 degrees F for sections less than 12 inches in the least dimension;
   b. 50 degrees F for sections 12 to 36 inches in the least dimension;
   c. 45 degrees F for sections 36 to 72 inches in the least dimension; and
   d. 40 degrees F for sections greater than 72 inches in the least dimension.
2. The temperature of concrete as placed shall not exceed these values by more than 20 degrees F.
3. The minimum requirements may be terminated when temperatures above 50 degrees F occur during more than half of any 24 hour duration.
4. When the outdoor temperature is less than 40 degrees F, maintain temperature of placed concrete at not less than 50 degrees F for required curing time.
5. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
6. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

G. Hot-Weather Placement: Comply with ACI 301, ACI 305.1, ACI 305R, and as follows:

1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.
3. Precautions to protect fresh concrete from developing plastic shrinkage cracks must be taken in advance of concrete placement when evaporation rate due to any combination of temperature, humidity, and wind velocity is expected to approach 0.2 lb./sq. ft./hr. as determined by ACI 305R. Acceptable precautions to reduce the rate of evaporation include use of wind breaks, fog spray, covering with polyethylene sheeting, or wet cover.

H. Windy Weather Placement: Comply with ACI 301, ACI 305.1, ACI 305R and as follows:

1. Precautions to protect fresh concrete from developing plastic shrinkage cracks must be taken in advance of concrete placement when evaporation rate due to any combination of temperature, humidity, and wind velocity is expected to approach 0.2 lb./sq. ft./hr. as determined by ACI 305R. Acceptable precautions to reduce the rate of evaporation include use of wind breaks, fog spray, covering with polyethylene sheeting, or wet cover.

3.8 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. Fill holes and honeycombs.

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, 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 on Contract Documents:

1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.

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 on the Contract Drawings.

3.9 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. 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 as indicated on the Contract Drawings.

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 restraightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces of all slabs.

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 of all floor slabs unless noted otherwise on Contract Drawings.
2. Finish surfaces to the following tolerances, according to ASTM E 1155 (ASTM E 1155M), for a randomly trafficked floor surface:

a. Specified overall values of flatness for areas to receive carpet, F(F) 25; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and of levelness, F(L) 15.
b. Specified overall values of flatness for areas to receive thin floor coverings, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17; for slabs-on-grade.
c. Specified overall values of flatness for areas to receive Special Concrete Stain and Polishing Finish, F(F) 75; and of levelness, F(L) 30; with minimum local values of flatness, F(F) 50; and of levelness, F(L) 30; for slabs-on-grade.

3. Where floor drains occur, slope slabs uniformly to drains as indicated on Contract Drawings, or if not indicated at 1/4 inch per 12 inch in small areas and 1/8 inch per 12 inch in large areas.

E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated on Contract Drawings. 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 on Contract Drawings.

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.

G. Contractor will retain a qualified independent testing and inspecting agency to measure floor and slab flatness and levelness according to ASTM E 1155 within 24 hours of finishing.

3.10 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Contract Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Contract Drawings. Screed, tamp, and trowel finish concrete surfaces.

3.11 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. Curing shall be continued for a period of 7 days for Type I cement, or 3 days for Type III cement, or until tests indicate that the concrete has attained 75 percent of required strength.

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 as determined by ACI 305R 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 the remainder of the curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, and 308R by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
    a. Water – Ponding or continuous sprinkling.
    b. Continuous water-fog spray.
    c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
    d. Application of sand kept continuously wet.
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.
    a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
    b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
    c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period. If used, Contractor is responsible for verifying that

compound is compatible with and will have no detrimental effect on adhesives and final finishes specified over the concrete surface.

a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.12 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least one month. Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

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

3.13 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Notify Architect and Engineer of Record if structural repairs are necessary. Perform structural repairs with prior approval of method and materials from Architect and Engineer of Record. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

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

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.14 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections as noted below along with inspection schedule items included in the Contract Drawings. Testing agency shall prepare tests and inspection reports and submit to Owner and Owner’s Consultants.

B. Inspections:

1. Steel reinforcement placement.
2. Steel reinforcement welding.
3. Headed bolts and studs.
4. Anchor rods.
5. Verification of use of required design mixture.
6. Concrete placement, including conveying and depositing.

7. Curing procedures and maintenance of curing temperature.
8. Verification of concrete strength before removal of shores and forms from beams and slabs.
9. All other special inspection items as noted on the Contract Drawings.

C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least one composite sample for each 150 cu. yd. or fraction thereof of each concrete mixture placed each day. For slabs, obtain at least one composite sample for the minimum of each 150 cu. yd. or each 5,000 square feet of slab placed each day. For shotcrete mixtures, obtain at least one composite sample for each 50 cu. yd. or fraction thereof placed each day.
   a. One composite sample shall consist of a minimum of four cylinders.
   b. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
2. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C 31.
   a. Cast and laboratory cure four standard cylinder specimens for each composite sample of 6x12” cylinder specimens or cast and laboratory cure five standard cylinder specimens for each composite sample of 4x8” cylinder specimens.
   b. Cast and field cure four standard cylinder specimens for each composite sample of 6x12” cylinder specimens or cast and field cure five standard cylinder specimens for each composite sample of 4x8” cylinder specimens.
6. Compressive-Strength Tests: ASTM C 39; test one laboratory-cured specimen at 7 days and either two 6x12” cylinder specimens or three 4x8” cylinder specimens at 28 days. The remaining laboratory-cured specimen shall be a hold cylinder to be broken at the discretion of the Engineer-of-Record.
   a. Test two field-cured specimens at 7 days and either two 6x12” cylinder specimens or three 4x8” cylinder specimens at 28 days.
   b. A compressive-strength test shall be the average compressive strength from two 6x12” cylinder specimens or three 4x8” cylinder specimens obtained from same composite sample and tested at age indicated.
7. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
9. Test results shall be reported in writing to Architect, Structural Engineer, Owner, Owner’s consultant, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of

concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests. Inspection reports shall include items inspected, inspection locations and verification of compliance or deviations from the Contract Documents.

10. Concrete strength tests made and tested by testing laboratory shall be the sole criteria of concrete strength unless in-situ tests are made in accordance with Building Code by a qualified independent testing laboratory. Concrete for which strength tests do not meet criteria for acceptance shall be considered inadequate until proven otherwise.
11. In any case, where strength tests of concrete fail to meet criteria specified herein, Structural Engineer of Record shall be the sole judge of structural adequacy of concrete. In such case, burden of proof of structural adequacy shall be the responsibility of Contractor. Strength evaluation shall conform to requirements of ACI 318. If strength evaluation testing indicates, in opinion of Structural Engineer of Record, that structure is of inadequate strength; portions of structure in questions shall be repaired or removed and replaced as directed by the Structural Engineer of Record at no additional expense to Owner. If strength test falls below specified strength, but not so low as to cause concern for structural adequacy, Architect may request improved conditions curing or modifications of design mixes to improve strength.
12. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
13. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by Architect.
14. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
15. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

END OF SECTION

SECTION 044313
STONE MASONRY VENEER

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal anchors and accessories for anchored veneer.

B. Setting mortar.

1.02 RELATED REQUIREMENTS

A. Section 079200 - Joint Sealants: Sealing joints indicated to be left open for sealant.

1.03 REFERENCE STANDARDS

A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.

B. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019a, with Editorial Revision.

C. ASTM C568/C568M - Standard Specification for Limestone Dimension Stone; 2022.

D. ASTM C1242 - Standard Guide for Selection, Design, and Installation of Dimension Stone Attachment Systems; 2022a.

E. ASTM C1528/C1528M - Standard Guide for Selection of Dimension Stone; 2020.

F. ASTM C1714/C1714M - Standard Specification for Preblended Dry Mortar Mix for Unit Masonry; 2019a.

G. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2022, with Errata (2024).

1.04 ADMINISTRATIVE REQUIREMENTS

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

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on stone units, mortar, and reinforcement.

C. Samples: Submit two stone samples illustrating minimum and maximum stone sizes, color range, texture, and markings.

D. Samples: Submit mortar color samples.

1.06 QUALITY ASSURANCE

A. Stone Fabricator Qualifications: Company specializing in fabricating cut stone with minimum ten years of documented experience.

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

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect stone from discoloration during storage on site.

B. Provide ventilation to prevent condensation from forming on stone.

1.08 FIELD CONDITIONS

A. Cold Weather Requirements: Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

PART 2 PRODUCTS

2.01 STONE

A. Stone, General: See recommendations in ASTM C1528/C1528M.

B. Stone: Match Existing Cobblestone variety.

1. Acceptable Producers:
    a. Impressions In Stone.
    b. Substitutions: See Section 016000 - Product Requirements.

2.02 MORTAR APPLICATIONS

A. At Contractor's option, mortar may be field-mixed from packaged dry materials, made from factory premixed dry materials with addition of water only, or ready-mixed.

B. Mortar Color: Natural gray unless otherwise indicated.

2.03 MORTAR MIXES

A. Packaged Dry Material for Mortar for Unit Masonry: 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.
    1. Type: N.
    2. Color: Standard gray.

2.04 ACCESSORIES - ANCHORED VENEER

A. Other Anchors in Direct Contact with Stone: ASTM A666 Type 304, stainless steel, of sizes and configurations required for support of stone and applicable superimposed loads.

B. Weep/Cavity Vents: _____.

C. Back Coating:

D. Cleaning Solution: Type that will not harm stone, joint materials, or adjacent surfaces.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that support work and site conditions are ready to receive work of this section.
    1. Per ASTM C1242, exterior walls to receive thin natural stone veneers should be designed with a stiffness ratio of L/1000 minimum.

B. Verify that substrates to receive mortar scratch coat or setting bed comply with stone veneer manufacturer's instructions.
    1. Metal Lath and Accessories: Verify lath is flat, secured to substrate, and joint and surface perimeter accessories are in place.

3.02 PREPARATION - ANCHORED VENEER

A. Establish lines, levels, and coursing. Protect from disturbance.

B. Clean stone prior to installation. Do not use wire brushes or implements that mark or damage exposed surfaces.

C. Coat back surfaces not to be in contact with setting mortar with back coating material. Allow coating to cure.

3.03 INSTALLATION - ANCHORED VENEER

A. Install flashings of longest practical length and seal watertight to back-up. Lap end joints minimum 6 inches (150 mm) and seal watertight.

B. Cut stone at site to produce clean faces.

C. Size stone units to fit opening dimensions and perimeter conditions.

D. Wet absorptive stone in preparation for placement to minimize moisture suction from mortar.

E. Arrange stone coursing in running bond with consistent joint width.

F. Set stone in full mortar setting bed to fully support stone over bearing surface. Use setting buttons or shims to maintain correct joint width.

G. Install weep/cavity vents in vertical stone joints at 24 inches (609.6 mm) on center horizontally; immediately above horizontal flashings, above shelf angles and supports, and at top of each cavity space; do not permit mortar accumulation in cavity space.

3.04 JOINTS - ANCHORED VENEER

A. Leave the following joints open for sealant; see Section 079200:
   1. Head joints in top courses, including copings, parapets, cornices, sills, and steps.
   2. Joints in projecting units.
   3. Joints between rigidly anchored units, including soffits, panels, and column covers.
   4. Joints below lugged sills and stair treads.
   5. Joints below ledge and relieving angles.
   6. Joints labeled "expansion joint".

B. Rake out mortar joints 5/8 to 3/4 inch (16 to 19 mm) and brush joints clean to accommodate pointing mortar. Fill joints with pointing mortar.

C. Pack mortar into joints and work into voids. Neatly tool surface to concave joint.

D. At joints to be sealed, clean mortar out of joint before it sets. Brush joints clean.

3.05 TOLERANCES

A. Install masonry within the site tolerances found in TMS 402/602.

B. Maximum Variation From Unit to Adjacent Unit: 1/16 inch (1.6 mm).

C. Maximum Variation from Plumb: 1/4 inch (6 mm) per story non-cumulative; 1/2 inch (13 mm) in two stories or more.

D. Maximum Variation from Level Coursing: 1/8 inch in 3 feet (3 mm in 1 m) and 1/4 inch in 10 feet (6 mm in 3 m); 1/2 inch in 30 feet (13 mm in 9 m).

E. Maximum Variation of Joint Thickness: 1/8 inch in 3 feet (3 mm in 1 m).

3.06 CLEANING

A. Remove excess mortar as work progresses, and upon completion of work.

B. Clean soiled surfaces with cleaning solution.

C. Use non-metallic tools in cleaning operations.

3.07 PROTECTION

A. During temporary storage on site, at the end of working day, and during rainy weather, cover stone work exposed to weather with non-staining waterproof coverings, securely anchored.

END OF SECTION

This page intentionally left blank

SECTION 05 12 00

STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Structural steel.
2. Miscellaneous angles and plates.
3. Bolts and anchor rods.
4. Steel assemblies to be embedded in concrete or masonry.
5. Supplementary parts and members necessary to complete and erect structural steel frame.
6. Shop painting.
7. Grout.

1.3 DEFINITIONS

A. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

B. Seismic-Load-Resisting System: Elements of structural-steel frame designated as "SLRS" or along grid lines designated as "SLRS" on Drawings, including columns, beams, and braces and their connections.

C. Heavy Sections: Rolled and built-up sections as follows:
1. Shapes included in ASTM A 6 with flanges thicker than 1-1/2 inches.
2. Welded built-up members with plates thicker than 2 inches.
3. Column base plates thicker than 2 inches.

D. Protected Zone: Structural members or portions of structural members indicated as "Protected Zone" on Drawings. Connections of structural and nonstructural elements to protected zones are limited.

E. Demand Critical Welds: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the Seismic-Load-Resisting System and which are indicated as "Demand Critical" or "Seismic Critical" on Drawings.

1.4 PERFORMANCE REQUIREMENTS

A. Connections: Provide details of simple shear, axial and moment connections required by the Contract Documents to be selected or completed by structural-steel fabricator, including comprehensive engineering analysis by a qualified professional engineer, to withstand LRFD loads indicated and comply with other information and restrictions indicated.

1. Select and complete connections using schematic details indicated and AISC's "Steel Construction Manual, 13th Edition".

B. Detail bolted connections using bolts conforming to ASTM A325N, Bearing Type Connections with threads allowed in shear plane, unless noted otherwise on Contract Drawings.
   1. Select and complete connections using schematic details indicated and AISC's "Steel Construction Manual, 14th Edition".

C. Moment Connections: Type FR, fully restrained.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's data in accordance with specifications indicating product compliance to these specifications.

B. Shop Drawings: Show fabrication of structural-steel components.
   1. Submit three bond sets of shop drawings and calculations for review by the Structural Engineer-of-Record. The Structural Engineer-of-Record will mark three sets with red and will return one set to the contractor through the Architect. The contractor shall make the number of photocopies required of the approved shop drawings for distribution to other parties, and the contractor shall be responsible for transmitting the original red-marked set to the fabricator for corrections.
   2. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
   3. Include embedment drawings.
   4. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
   5. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
   6. Do not begin fabrication of materials prior to review of shop drawings.
   7. Review of shop drawings is for member sizes, spacings, details, and general compliance with the Contract Drawings only.
   8. Material quantities, lengths, fit, verification of job conditions and coordination with other trades are responsibility of Contractor.
   9. Reproductions of Contract Drawings shall not be used for shop drawings.
   10. Identify members and connections of the seismic-load-resisting system.
   11. Indicate locations and dimensions of protected zones.
   12. Identify demand critical welds.
   13. For structural-steel connections indicated to comply with design loads, include structural analysis data and design calculations prepared by and signed and sealed by the qualified professional engineer responsible for their preparation and licensed in the state where the project is located.
   14. Coordination of the structural-steel connection calculations with the structural-steel shop drawings is the responsibility of the structural-steel connections calculations engineer.

C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1, "Structural Welding Code - Steel," for each welded joint whether prequalified or qualified by testing, including the following:
   1. Power source (constant current or constant voltage).
   2. Electrode manufacturer and trade name, for demand critical welds.

D. Qualification Data: For qualified installer and fabricator.

E. Welding certificates.

F. Mill test reports for structural steel, including chemical and physical properties.

G. Product Test Reports: For the following:
   1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
   2. Direct-tension indicators.
   3. Tension-control, high-strength bolt-nut-washer assemblies.
   4. Shear stud connectors.
   5. Shop primers.
   6. Nonshrink grout.

1.6 QUALITY ASSURANCE AND QUALITY CONTROL

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD. Not less than 5 years of experience in fabrication of structural steel.

B. Installer Qualifications: A qualified installer with not less than 5 years of experience in installation of structural steel.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code - Steel."
   1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.

D. Quality Control Welding Inspector Qualifications: Qualified to the satisfaction of the fabricator's or erector's Quality Control Program, as applicable, and in accordance with either of the following:
   1. Associate welding inspectors (AWI) or higher as defined in AWS B5.1, Standard for the Qualification of Welding Inspectors.
   2. Qualified under the provisions of AWS D1.1 subclause 6.1.4.

E. Quality Control Bolting Inspector Qualifications: Qualified on the basis of documented training and experience in structural bolting inspection.

F. Quality Assurance Welding Inspector Qualifications: Qualified to the satisfaction of the quality assurance agency's written practice, the requirements of the Authority Having Jurisdiction, and either of the following:
   1. Welding inspectors (WIs) or senior welding inspectors (SWIs) as defined in AWS B5.1, Standard for the Qualification of Welding Inspectors, except associate welding inspectors (AWIs) are permitted to be used under the direct supervision of WIs, who are on the premises and available when weld inspection is being conducted.
   2. Qualified under the provisions of AWS D1.1, subclause 6.1.4.

G. Quality Assurance Bolting Inspector Qualifications: Qualified on the basis of documented training and experience in structural bolting inspections.

H. Nondestructive Testing (NDT) Personnel Qualifications: Qualified in accordance with their employer's written practice, which shall meet or exceed the criteria of AWS D1.1 Structural Welding Code – Steel, subclause 6.14.6 and either of the following:
   1. American Society of Nondestructive Testing (ASNT) SNT-TC-1A, Recommended Practice for the Qualification and Certification of Nondestructive Testing Personnel.
   2. ASNT CP-189, Standard for the Qualification and Certification of Nondestructive Testing Personnel.

I. Comply with applicable provisions of the following specifications and documents:
   1. AISC 303.
   2. AISC 341 and AISC 341s1.
   3. AISC 360.
   4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

J. Preinstallation Conference: Conduct conference at Project site.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
   1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
   1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
   2. Clean and relubricate bolts and nuts that become dry or rusty before use.
   3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

1.8 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A 992.

B. Channels, Angles, M-Shapes and S-Shapes: ASTM A 36.

C. Plate and Bar: ASTM A 36.

D. Corrosion-Resisting Structural-Steel Shapes, Plates, and Bars: ASTM A 588, Grade 50.

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

F. Corrosion-Resisting Cold-Formed Hollow Structural Sections: ASTM A 847, structural tubing.

G. Steel Pipe: ASTM A 53, Type E or S, Grade B.
   1. Finish: Black except where indicated to be galvanized.

H. Steel Castings: ASTM A 216, Grade WCB with supplementary requirement S11.

I. Steel Forgings: ASTM A 668.

J. Welding Electrodes: 70 ksi low-hydrogen.

2.2 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers; all with plain finish.
   1. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with plain finish.

B. Zinc-Coated High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade DH heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers.
   1. Finish: Hot-dip or mechanically deposited zinc coating.
   2. Direct-Tension Indicators: ASTM F 959, Type 325,compressible-washer type with mechanically deposited zinc coating finish.

C. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, round head assemblies consisting of steel structural bolts with splined ends, ASTM A 563 heavy-hex carbon-steel nuts, and ASTM F 436 hardened carbon-steel washers.

D. Unheaded Anchor Rods: **ASTM F 1554, Grade 36**.
   1. Configuration: Straight.
   2. Nuts: ASTM A 563 heavy-hex carbon steel.
   3. Plate Washers: ASTM A 36 carbon steel.
   4. Washers: ASTM F 436, Type 1, hardened carbon steel.

5. Finish: Plain, except where indicated to be galvanized.

E. Threaded Rods: ASTM A 36.
1. Nuts: ASTM A 563 heavy-hex carbon steel.
2. Washers: ASTM F 436, Type 1, hardened carbon steel.
3. Finish: Plain, except where indicated to be galvanized.

F. Clevises and Turnbuckles: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1035.

G. Eye Bolts and Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1030.

H. Sleeve Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1018.

I. Headed Stud Anchors for Embedded Assemblies:
1. Steel shall conform to ASTM A 108 grades C1010-1020, minimum tensile strength of 60,000 psi.
2. Studs shall be of uniform diameter, heads concentric and normal to shaft, and weld end chamfered and solid flux.

2.3 PRIMER

A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat, unless noted otherwise in Division 09 painting Sections.

C. Galvanizing Repair Paint: ASTM A 780.

2.4 GROUT

A. Compressive strength in 28 days: 5000 psi minimum but not less than specified strength of base concrete. Non-oxidizing, if grout will be permanently exposed to view.
1. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.
2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
a. Sonogrout 10K, manufactured by Sonneborn/ChemRex, Inc.
b. Masterflow 713, manufactured by Master Builders Co.
c. Supreme Grout, manufactured by Gifford Hill Co.

2.5 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.
1. Camber structural-steel members where indicated.
2. Fabricate beams with rolling camber up.
3. Identify high-strength structural steel according to ASTM A 6 and maintain markings until structural steel has been erected.

4. Mark and match-mark materials for field assembly.
5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Steel Bearing Plates: Fabricate steel bearing plates with headed stud anchors of sizes and thicknesses indicated on Contract Drawings.

C. Headed Stud Anchors:
1. Comply with AWS D1.1, Section 7.
2. Clean surfaces to be welded of rust, oil, grease, paint and dirt. Remove mill scale by scraping or sandblasting.
3. Weld headed studs with appropriate equipment properly adjusted for climatic conditions.
4. Remove ceramic ferrules after welding.

D. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.

E. Bolt Holes: Cut, drill, mechanically thermal cut, or punch standard bolt holes perpendicular to metal surfaces. Short-slotted holes shall not be used for primary frame connections (members connecting to columns), trusses and wind bracing unless specifically allowed by the Engineer of Record. Where used, short slotted holes shall be oriented normal to the direction of load.

F. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

G. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 3, "Power Tool Cleaning."

H. Shear Connectors: Do not paint steel surfaces that receive welded shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.

I. Steel Wall-Opening Framing: Select true and straight members for fabricating steel wall-opening framing to be attached to structural steel. Straighten as required to provide uniform, square, and true members in completed wall framing.

J. Welded Door Frames: Build up welded door frames attached to structural steel. Weld exposed joints continuously and grind smooth. Plug-weld fixed steel bar stops to frames. Secure removable stops to frames with countersunk machine screws, uniformly spaced not more than 10 inches o.c. unless otherwise indicated.

K. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel framing members.
1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces. Holes for anchor rods in base plates may be oversized in accordance with AISC Specifications. Provide washers as indicated on Contract Drawings.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.6 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
1. Joint Type: Snug tightened, unless indicated otherwise on Contract Documents.
a. High Strength bolts for bearing connections shall be tightened in accordance with RCSC Specifications to a snug-tight condition. Provide hardened washers as required by the RCSC specification.

b. High strength bolts for pretensioned or slip-critical joints, as noted on the Contract Drawings, shall be tightened in accordance with the RCSC specifications by turn-of-nut with matchmarking, twist-off type tension control bolt assemblies (ASTM F1852) or direct tension indicators (ASTM F959) methods of installation. Provide hardened washers as required by the RCSC specification.
   1) High strength bolts for pretensioned or slip-critical joints, as noted on the Contract Drawings, may be tightened in accordance with the RCSC specifications by calibrated wrench method in an AISC-Certified Plant.

B. Weld Connections: Comply with AWS D1.1 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
   1. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
   2. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.7 SHOP PRIMING

A. Shop prime steel surfaces except the following:

   1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
   2. Surfaces to be field welded.
   3. Surfaces to be high-strength bolted with slip-critical connections.
   4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
   5. Galvanized surfaces.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
   1. SSPC-SP 3, "Power Tool Cleaning."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
   1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
   2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

D. Prepare faying surfaces of slip critical connections in accordance with RCSC.

2.8 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123.
   1. Fill vent and drain holes that will be exposed in the finished Work unless they will function as weep holes, by plugging with zinc solder and filing off smooth.
   2. Galvanize with a minimum G60 coating lintels, shelf angles, plates and welded door frames attached to structural-steel frame and located in exterior walls.

2.9 SOURCE QUALITY CONTROL

A. Testing Agency: Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.
   1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents at no additional cost to owner.

C. Bolted Connections: Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Welded Connections: Visually inspect shop welds according to AWS D1.1. In addition to visual inspection, complete penetration shop-welded connections will be tested by either of the following:
   1. Ultrasonic Inspection: ASTM E 164.
   2. Radiographic Inspection: ASTM E 94.

E. In addition to visual inspection, shop-welded shear connectors will be tested and inspected according to requirements in AWS D1.1 for stud welding and as follows:
   1. Bend tests will be performed if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
   2. Tests will be conducted on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with steel Erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
   1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.
   1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

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

B. Base, Bearing, and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
   1. Set plates for structural members on wedges, shims, or setting nuts as required.
   2. Weld plate washers to top of baseplate as required on Contract Drawings.
   3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
   4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
   1. Level and plumb individual members of structure.
   2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
   1. Joint Type: Snug tightened unless noted otherwise on Contract Drawings.
      a. High strength bolts for bearing connections shall be tightened in accordance with RCSC Specifications to a snug-tight condition. Provide hardened washers as required by the RCSC specifications.
      b. High strength bolts for pretensioned or slip-critical joints, as noted on the Contract Drawings, shall be tightened in accordance with the RCSC specifications by turn-of-nut with matchmarking, twist-off type tension control bolt assemblies (ASTM F1852) or direct tension indicators (ASTM F959) methods of installation. Provide hardened washers as required by the RCSC specification.

B. Weld Connections: Comply with AWS D1.1 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
   1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
   2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth if radiographic testing (RT) of the welds is required by the testing agency of the engineer or record.
   3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

3.5 FIELD QUALITY CONTROL

A. Contractor shall retain a duly designated person who acts for, and in behalf of, the Contractor on all inspection and quality matters within the scope of AISC 360-10, AWS D1.1 and of the Contract Documents.

3.6 FIELD QUALITY ASSURANCE

A. Owner will engage a qualified independent testing and inspecting agency to perform testing and verification inspections as noted below along with inspection schedule items included in the Contract Drawings. Testing Agency shall prepare test and inspection reports and submit in writing to Owner, Authority Having Jurisdiction, Engineer of Record, and Owner's consultants within 48 hours of testing or inspections. Reports shall contain Project identification name and number, date of inspection, name of testing and inspecting agency and location of inspected or tested work. In addition, reports shall include verification of compliance or deviations from the Contract Documents.

B. In addition to the above, the Testing Agency shall submit the following to the fabricator and erector:
   1. Inspection reports
   2. Nondestructive testing reports
   3. Nonconformance reports
   4. Reports of repair, replacement or acceptance of nonconforming items

C. Bolted Connections: Bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Welded Connections: Field welds will be visually inspected according to AWS D1.1.
   1. In addition to visual inspection, field welds will be tested and inspected according to AWS D1.1 and the following inspection procedures, at testing agency's option:
      a. Liquid Penetrant Inspection: ASTM E 165.
      b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
      c. Ultrasonic Inspection: ASTM E 164.
      d. Radiographic Inspection: ASTM E 94.
   2. In addition to visual inspections, field complete penetration groove welds shall be tested by either of the following, at testing agency's option or as specified on the Contract Documents:
      a. Ultrasonic Inspection: ASTM E 164
      b. Radiographic Inspection: ASTM E 94
   3. In addition to visual inspections, ultrasonic testing (UT) of welds shall be performed as specified on the Contract Documents. The percentage of required testing may be reduced or shall be increased according to the following:
      a. The rate of UT is permitted to be reduced if approved by the Engineer of Record and the Authority Having Jurisdiction. Where the initial rate of UT is 100%, the nondestructive testing (NDT) rate for an individual welder or welding operator is permitted to be reduced to 25%, provided the reject rate, the number of welds containing unacceptable defects divided by the number of welds completed, is demonstrated to be 5% or less of the welds tested for the welder or welding operator. A sampling of at least 40 completed welds for a job shall be made for such reduction evaluation. For evaluating the reject rate of continuous welds over 3 feet in length where the effective throat is 1 inch or less, each 12 inch increment of fraction thereof shall be considered as one weld. For evaluating the reject rate on continuous welds over 3 feet in length where the effective throat is greater than 1 inch, each 6 inches of length or fraction thereof shall be considered one weld.
      b. For structures in Risk Category II, where the initial rate for UT is 10%, the NDT rate for an individual welder or welding operator shall be increased to 100% should

the reject rate, the number of welds containing unacceptable defects divided by the number of welds completed, exceeds 5% of the welds tested for the welder or welding operator. A sampling of at least 20 completed welds for a job shall be made prior to implementing such an increase. When the reject rate for the welder or welding operator, after a sampling of at least 40 completed welds, has fallen to 5% or less, the rate of UT shall be returned to 10%. For evaluation the reject rate of continuous welds over 3 feet in length where the effective throat is 1 inch or less each 12 inch increment or fraction thereof shall be considered as one weld. For evaluating the reject rate on continuous welds over 3 feet in length where the effective throat is greater than 1 inch, each 6 inches of length or fraction thereof shall be considered one weld.

E. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1 for stud welding and as follows:
   1. Initial testing of shear studs at start of work period: Test weld on at least 2 shear studs at start of each work period to determine proper generator control unit, and stud welder settings. Bend studs 45 degrees from vertical by striking with hammer. Inspect weld. Do not include these studs in required total number of studs required on beam. Contractor shall add replacement studs to supplement studs tested by bending 45 degrees.
   2. Visually inspect welds at shear studs: Visually inspect all studs. Test studs that do not appear to have full sound 360 degrees fillet weld at base. Test by bending 15 degrees from vertical toward nearest end of beam by striking with hammer. Contractor shall replace studs that fail this test.
   3. Periodic field testing of shear studs: Test one stud on each beam or girder after weld cools. Test by bending 15 degrees from vertical toward nearest end of beam by striking with hammer. If a tested stud fails at weld, all studs on the same beam or girder shall be tested by same procedure. Contractor shall replace studs that fail this test.

F. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents at no additional cost to owner.

3.7 REPAIRS AND PROTECTION

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780.

B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces, unless noted otherwise in Division 09 painting Section.
   1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
   2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.

END OF SECTION

SECTION 05 31 00

STEEL DECKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Roof deck.
2. Acoustical roof deck.
3. Composite floor deck.
4. Framing for openings less than 10 inches.

B. Related Requirements:
1. Section 033000 – Cast-in-Place Concrete
2. Section 051200 – Structural Steel Framing
3. Section 052100 – Steel Joist Framing
4. Section 055000 – Metal Fabrications
5. Section 078100 – Applied Fireproofing
6. Section 099113 – Exterior Painting
7. Section 099123 – Interior Painting

1.3 SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated.

B. Shop Drawings: Submit shop drawings for review prior to fabrication or installation of materials.
1. Submit shop drawings electronically in PDF format via email for review by the Structural Engineer-of-Record. The Structural Engineer-of-Record will review the shop drawings and forward stamped electronic documents to the contractor through the Architect via email. The contractor shall be responsible for transmitting the reviewed set to the fabricator for corrections. The printing of shop drawings as required for review is considered a reimbursable expense and will be billed at cost.
2. Only complete shop drawing submittals will be reviewed. Shop drawings not in compliance with the Submittal portion of this document will be rejected. Time required by Wallace Engineering Structural Consultants, Inc. to review shop drawing submittals a second or third time will be billed to the General Contractor at Wallace Engineering Structural Consultants, Inc. hourly rates.
3. Indicate erection layouts, details, steel deck dimensions, profile, gage, section properties, coatings and installation instructions. Show supporting framing, lengths, and markings of deck to correspond with sequence and procedure to be followed in installing and fastening deck. Show size and number of holes to be cut in deck.
4. Indicate allowable diaphragm shear capacity corresponding to pattern and type of connections provided on Contract Drawings.
5. Indicate method of installing and connecting accessories.

6. Indicate methods of fastening deck. Show fastener locations, types, sizes and sequence of connections for deck units.
    a. Welds: Use standard ASW welding symbols.
    b. Screws: Use type, size and manufacturer as noted on the Contract Drawings.
    c. Powder Actuated Fasteners: Use type, size and manufacturer as noted on the Contract Drawings.
    d. Button Punches: Use type and manufacturer.

C. Welding certificates.

D. Product Certificates: For each type of steel deck, signed by product manufacturer.
1. Certify that all deck, shear studs, and deck accessories provided meet or exceed specified requirements.
2. Certify that product and coatings conform to UL, FM, or other agency rated assembly noted on Contract Drawings.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
1. Power-actuated mechanical fasteners.

F. Evaluation Reports: For steel deck.

G. Field quality-control and inspection reports.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."

C. Fire-Test-Response Characteristics: Where indicated, provide steel deck units identical to those tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
1. Fire-Resistance Ratings: Indicated by design designations of applicable testing and inspecting agency for rated assembly noted on the Contract Drawings.
2. Steel deck units shall be identified with appropriate markings of applicable testing and inspecting agency for rated assembly noted on the Contract Drawings.

D. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

E. FM Global Listing: Provide steel roof deck evaluated by FM Global and listed in its "Approval Guide, Building Materials" for Class 1 fire rating and Class 1-90 windstorm ratings.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling. Each unit or bundle shall be labeled and marked in accordance with UL requirements, indicating manufacturer, testing, and inspection.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

C. Do not overload deck during construction by workers or storage of materials.

D. Rusted, crimped or bent deck shall not be installed in the work. Replace damaged deck with new material at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

B. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 ROOF DECK

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. ASC Profiles, Inc.; a Blue Scope Steel company.
   2. Canam United States; Canam Group Inc.
   3. Consolidated Systems, Inc.; Metal Dek Group.
   4. Cordeck.
   5. DACS, Inc.
   6. Epic Metals Corporation.
   7. Marlyn Steel Decks, Inc.
   8. New Millennium Building Systems, LLC.
   9. Nucor Corp.; Vulcraft Group.
   10. Roof Deck, Inc.
   11. Valley Joist; Subsidiary of EBSCO Industries, Inc.
   12. Verco Manufacturing Co.
   13. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.

B. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:
   1. Galvanized-Steel Sheet: ASTM A 653, Structural Steel (SS), Grade 33, G60 zinc coating.

2. Deck Profile: As indicated on Contract Drawings.
3. Profile Depth: As indicated on Contract Drawings.
4. Design Uncoated-Steel Thickness: As indicated on Contract Drawings.
5. Span Condition: Triple span or more.
6. Side Laps: Overlapped.

2.3 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, powder-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile recommended by SDI Publication No. 31 for overhang and slab depth unless noted otherwise on the Contract Drawings.

G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.

H. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0598 inch thick, with factory-punched hole of 3/8-inch minimum diameter.

I. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.

J. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck, with 3-inch- wide flanges and level recessed pans of 1-1/2-inch minimum depth. For drains, cut holes in the field.

K. Galvanizing Repair Paint: ASTM A 780.

L. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.

B. Where deck is indicated to be shored for placement of concrete, install shoring prior to placement of concrete.

C. Clean rust, oil, grease, and debris away from areas to which shear studs are to be welded. Remove mill scale by grinding or by sandblasting.

D. Locate deck bundles to prevent overloading of supporting members.

E. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

F. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

G. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

H. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

I. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

3.3 ROOF-DECK INSTALLATION

A. Weld Attachments: Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches long, and as follows:
   1. Weld Diameter: 5/8 inch, nominal.
   2. Weld Spacing: Weld edge and interior ribs of deck units with a minimum of seven welds per deck unit at each support. Space as indicated on the Contract Drawings.
   3. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports as indicated on Contract Drawings.

B. Mechanical Fasteners: Deck shall be attached to supporting members as noted on the Contract Drawings.
   1. Spacing of fasteners shall not exceed 12 inches along each support, unless noted otherwise on the Contract Drawings.
   2. Attachment shall be done immediately after the deck units are aligned.

3. Deck units shall have side laps fastened at 36 inches on center or at midspan (whichever is smaller) for spans greater than 5 feet unless otherwise specified on the Contract Drawings. Fasten deck to perimeter members parallel to deck span at 36 inches on center maximum for spans greater than 5 feet unless otherwise specified on the Contract Drawings.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
   1. End Joints: Lapped 2 inches minimum.

D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and mechanically fasten flanges to top of deck. Space mechanical fasteners not more than 6 inches apart with at least one fastener at each corner.

E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Mechanically fasten to substrate to provide a complete deck installation.
   1. Install 6 inch minimum wide sheet steel cover plates, of same thickness as deck, where deck changes direction. Mechanically attach at 6 inches on center maximum.

F. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

G. Reinforce steel deck openings less than 10 inches in size with 2x2x1/4 inch steel angles. Place framing angles perpendicular to flutes; extend minimum two flutes beyond each side of opening and mechanically attach to deck at each flute.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing agency to perform tests and inspections as noted below along with inspection schedule items included in the Contract Drawings. Testing agency shall prepare test and inspection reports and submit to the Owner and the Owner's consultants.

B. Inspect condition of deck units for damage and corrosion. Report deficiencies.

C. Inspect size, spacing, and quality of connections of deck to structure and at side laps for conformance with Contract Drawings. Report deficiencies.

D. Deck: Inspect deck at welded connections. Connections do not conform to specifications where deck is not intact after welding and where blow holes occurred.

E. Testing agency will report inspection results promptly and in writing to Contractor and Architect.

F. Remove and replace work that does not comply with specified requirements.

G. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.5 PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.
   1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.

C. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

D. Repair blow-holes at welds with 18 gage plates welded in place. Replace entire sections of deck where holes cannot be satisfactorily repaired.

3.6 HANGERS FOR MISCELLANEOUS EQUIPMENT

A. Do not attach hangers for ductwork, mechanical piping, or ceilings directly to metal deck.

END OF SECTION

SECTION 05 40 00

COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Load-bearing wall framing.
2. Exterior non-load-bearing wall framing.
3. Floor joist framing.
4. Roof rafter framing.
5. Ceiling joist framing.
6. Soffit framing.
7. Any other cold-formed framing system noted on Structural Contract Drawings.

B. Related Requirements:
1. Section 042133 – Brick Masonry
2. Section 053100 – Steel Decking
3. Section 055000 – Metal Fabrications
4. Section 092116.23 – Gypsum Board Shaft Wall Assemblies
5. Section 092216 – Non-Structural Metal Framing

1.3 SUBMITTALS

A. Product Data: For each type of cold-formed steel framing product and accessory indicated on the Contract Drawings, provide the following:
1. Section Properties: Submit section properties, material strengths and ASTM specification compliance verification for each size member, strap or brace of each gage used.
2. Connections: Submit manufacturer's data for each type of manufactured connector, screw, or fastener verifying conformance with the Contract Drawings.

B. Shop Drawings: Show layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
1. Submit shop drawings and calculation electronically in PDF format via email for review by the Structural Engineer-of-Record. The Structural Engineer-of-Record will review the shop drawings and forward stamped electronic documents to the contractor through the Architect via email. The contractor shall be responsible for transmitting the reviewed set to the fabricator for corrections. The printing of shop drawings as required for review is considered a reimbursable expense and will be billed at cost.
2. Only complete shop drawing submittals will be reviewed. Shop drawings not in compliance with the Submittal portion of this document will be rejected. Time required by Wallace Engineering Structural Consultants, Inc. to review shop drawing submittals a

second or third time will be billed to the General Contractor at Wallace Engineering Structural Consultants, Inc. hourly rates.

3. For cold-formed steel framing indicated to comply with design loads, include complete structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation and licensed in the state where the project is located. Design calculations will be reviewed by the Engineer-of-Record.

C. Qualification Data: For testing agency.

D. Welding certificates.

E. Product Test Reports: For each listed product, for tests performed by a qualified testing agency.
   1. Steel sheet.
   2. Expansion anchors.
   3. Powder-actuated anchors.
   4. Mechanical fasteners.
   5. Adhesive anchors.
   6. Vertical deflection clips.
   7. Horizontal drift deflection clips
   8. Miscellaneous structural clips and accessories.

F. Research Reports: For non-standard cold-formed steel framing, from ICC-ES.

1.4 QUALITY ASSURANCE

A. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified professional engineer licensed in the state where the project is located.

B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of cold-formed steel framing that are similar to those indicated on this Project in material, design and extent.

C. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM E 329 for testing indicated.

D. Product Tests: Mill certificates or data from a qualified independent testing agency, or in-house testing with calibrated test equipment indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

E. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. AWS D1.1, "Structural Welding Code - Steel."
   2. AWS D1.3, "Structural Welding Code - Sheet Steel."

F. Fire-Test-Response Characteristics: Where indicated, provide cold-formed steel framing identical to that of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

G. Comply with current AISI Specifications and Standards.

H. Preinstallation Conference: Conduct conference at Project site.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling.

B. During construction, adequately distribute all loads applied to framing members so as not to exceed the carrying capacity of any one member.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. AllSteel & Gypsum Products, Inc.
2. California Expanded Metal Products Company.
3. ClarkDietrich Building Systems, Inc.
4. Consolidated Fabricators Corp.; Building Products Division.
5. Craco Mfg., Inc.
6. Custom Stud Inc.
7. Design Shapes in Steel.
8. Formetal Co. Inc. (The).
9. MarinoWARE.
10. Nuconsteel; a Nucor Company.
11. Olmar Supply, Inc.
12. Quail Run Building Materials, Inc.
13. SCAFCO Corporation.
14. Southeastern Stud & Components, Inc.
15. State Building Products, Inc.
16. Steel Construction Systems.
17. Steel Network, Inc. (The).
18. Steel Structural Systems.
19. Steeler, Inc.
20. Super Stud Building Products, Inc.
21. Telling Industries, LLC.
22. United Metal Products, Inc.
23. United Steel Manufacturing.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cold-formed steel framing.

B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.
1. Design Loads: As indicated on Contract Drawings.
2. Deflection Limits: Design framing systems to withstand design loads with deflections not exceeding the following limits:
    a. Exterior Load-Bearing Wall Framing – Horizontal deflections:
        1) Masonry Veneer: l/600 of the wall height.
        2) Brittle Finishes: l/360 of the wall height.
        3) Flexible Finishes: l/240 of the wall height.
    b. Interior Load-Bearing Wall Framing – Horizontal deflections under a minimum horizontal load of 5 lbf/sq. ft.:

1) Masonry Veneer: l/600 of the wall height.
2) Brittle Finishes: l/360 of the wall height.
3) Flexible Finishes: l/240 of the wall height.

c. Exterior Non-Load-Bearing Framing – Horizontal deflections:
1) Masonry Veneer: l/600 of the wall height.
2) Brittle Finishes: l/360 of the wall height.
3) Flexible Finishes: l/240 of the wall height.

d. Floor Joist Framing: Vertical deflection of 1/360 for live loads and l/240 for total loads of the span.

e. Roof Rafter Framing: Vertical deflection of 1/360 for live loads and l/240 for total loads of the span.

f. Ceiling Joist Framing: Vertical deflection of 1/360 of the span for live loads and 1/240 for total loads of the span.

3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.

4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
a. Roof Framing: Downward movement of 3/4 inch and upward movement of 1/2 inch, unless noted otherwise on Contract Documents.
b. Floor Framing: Downward movement of 3/4 inch, unless noted otherwise on Contract Documents.

5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

C. Comply with current AISI Specifications and Standards, unless more stringent requirements are indicated.

D. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.3 COLD-FORMED STEEL FRAMING, GENERAL

A. Manufacturing Standard: All cold form framing shall be equivalent to SSMA (Steel Stud Manufacturers Association) published standards and installation recommendations, which will be used as a quality standard reference in the event the Contractor furnishes materials in which the submitted manufacturer does not have a published installation manual.

B. Steel Sheet: ASTM A 1003, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
1. Grade: ST33H or ST50H as indicated or as required by structural performance
2. Coating: G60.

C. Steel Sheet for Vertical Deflection Clips: ASTM A 653, structural steel, zinc coated, of grade and coating as follows:
1. Grade: 50, Class 1.
2. Coating: G90.

2.4 LOAD-BEARING WALL FRAMING

A. Steel Studs: The physical and structural properties listed by SSMA shall be the minimum permitted. Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: 0.0329 inch or as indicated on Contract Drawings.
   2. Minimum Flange Width: 1-5/8 inches.
   3. Minimum Lip Width: 1/2 inch.

B. Steel Track: The physical and structural properties listed by SSMA shall be the minimum permitted. Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, and as follows:
   1. Minimum Base-Metal Thickness: 0.0329 inch or as indicated on Contract Drawings, but shall match wall stud thickness when heavier than 0.0329 inch.
   2. Minimum Flange Width: 1-1/4 inches.

C. Steel Box or Back-to-Back Headers: The physical and structural properties listed by SSMA shall be the minimum permitted. Manufacturer's standard C-shapes used to form header beams, of web depths indicated, unpunched, with stiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: 0.0329 inch or as indicated on Contract Drawings.
   2. Minimum Flange Width: 1-5/8 inches.
   3. Minimum Lip Width: 1/2 inch.

2.5 EXTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: The physical and structural properties listed by SSMA shall be the minimum permitted. Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: 0.0329 inch or as indicated on Contract Drawings.
   2. Minimum Flange Width: 1-5/8 inches.
   3. Minimum Lip Length: 1/2 inch.

B. Steel Track: The physical and structural properties listed by SSMA shall be the minimum permitted. Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: 0.0329 inch or as indicated on Contract Drawings, but shall match wall stud thickness when heavier than 0.0329 inch.
   2. Minimum Flange Width: 1-1/4 inches.

C. Vertical Deflection Clips: Manufacturer's standard bypass and head clips as noted on Contract Drawings, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. AllSteel & Gypsum Products, Inc.
      b. ClarkDietrich Building Systems, Inc.
      c. MarinoWARE.
      d. SCAFCO Corporation.
      e. Steel Network, Inc. (The).
      f. Steeler, Inc.

D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track as noted on the Contract Drawings; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inch or as indicated on Contract Drawings.
2. Minimum Flange Width: 3/4 inch plus the design gap.
3. Row of bridging to be located 12 inches from top of studs.

E. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.
   1. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
      a. Minimum Base-Metal Thickness: 0.0428 inch or as indicated on Contract Drawings.
      b. Minimum Flange Width: 3/4 inch plus the design gap.
   2. Inner Track: Of web depth indicated, and as follows:
      a. Minimum Base-Metal Thickness: 0.0329 inch or as indicated on Contract Drawings.
      b. Minimum Flange Width: Equal to sum of outer deflection track flange width plus 1 inch.

F. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

2.6 FLOOR JOIST FRAMING

A. Steel Joists: The physical and structural properties listed by SSMA shall be the minimum permitted. Manufacturer's standard C-shaped steel joists, of web depths indicated, unpunched, with stiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: 0.0428 inch or as indicated on Contract Drawings.
   2. Minimum Flange Width: 1-5/8 inches.
   3. Minimum Li p Width: 1/2 inch.

B. Steel Joist Track: The physical and structural properties listed by SSMA shall be the minimum permitted. Manufacturer's standard U-shaped steel joist track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: 0.0428 inch, or as indicated on Contract Drawings, but shall match wall stud thickness when heavier than 0.0428 inch.
   2. Minimum Flange Width: 1-1/4 inches.

2.7 ROOF-RAFTER FRAMING

A. Steel Rafters: The physical and structural properties listed by SSMA shall be the minimum permitted. Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: 0.0428 inch or as indicated on Contract Drawings.
   2. Minimum Flange Width: 1-5/8 inches.
   3. Minimum Lip Width: 1/2 inch.

B. Built-Up Members: The physical and structural properties listed by SSMA shall be the minimum permitted. Built-up members of manufacturer’s C-shaped steel section, with stiffened flanges,

nested into a U-shaped steel section joist track, with unstiffened flanges; unpunched; of web depths as indicated on the Contract Drawings; and as follows.

1. Minimum Base-Metal Thickness: 0.0428 inches, or as indicated on Contract Drawings.
2. Minimum Flange Width: 1-5/8 inches.
3. Minimum Lip Width: 1/2 inch.

2.8 CEILING JOIST FRAMING

A. Steel Ceiling Joists: The physical and structural properties listed by SSMA shall be the minimum permitted. Manufacturer's standard C-shaped steel sections, of web depths indicated, punched with standard holes, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0329 inch or as indicated on Contract Drawings.
2. Minimum Flange Width: 1-5/8 inches.
3. Minimum Lip Width: 1/2 inch.

2.9 SOFFIT FRAMING

A. Exterior Soffit Frame: The physical and structural properties listed by SSMA shall be the minimum permitted. Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0329 inch or as indicated on Contract Drawings.
2. Minimum Flange Width: 1-5/8 inches.
3. Minimum Lip Width: 1/2 inch.

2.10 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:

1. Supplementary framing.
2. Bracing, bridging, and solid blocking.
3. Web stiffeners.
4. Anchor clips.
5. End clips.
6. Foundation clips.
7. Gusset plates.
8. Stud kickers and knee braces.
9. Joist hangers and end closures.
10. Hole reinforcing plates.
11. Backer plates.

2.11 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36, zinc coated by hot-dip process according to ASTM A 123.

B. Unheaded Anchor Rods: **ASTM F 1554, Grade 36**.

1. Configuration: Straight.
2. Nuts: ASTM A 563 heavy-hex carbon steel.
3. Plate Washers: ASTM A 36 carbon steel.
4. Washers: ASTM F 436, Type 1, hardened carbon steel.
5. Finish: Plain, except where indicated to be galvanized.

C. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency.

D. Powder-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.

E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
   1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

F. Welding Electrodes: Comply with AWS standards.

2.12 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: ASTM A 780.

B. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

C. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107, with fluid consistency and 30-minute working time.

D. Shims: Load bearing, high-density multimonomer plastic, and nonleaching; or of cold-formed steel of same grade and coating as framing members supported by shims.

E. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.13 FABRICATION

A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
   1. Fabricate framing assemblies using jigs or templates.
   2. Cut framing members by sawing or shearing; do not torch cut.
   3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
      a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
      b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by no fewer than three exposed screw threads.
   4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.
   5. Do not begin fabrication of work prior to receiving approval of shop drawings and calculations. Fabricate per manufacturer’s current printed instructions.

6. Shop Fabrication: Fabricate items in shop to greatest extent possible so as to minimize field assembly of units at project site. Clearly mark units for assembly and coordinated installation.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.

C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.

B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that are required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

C. Install load bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch to ensure a uniform bearing surface on supporting concrete or masonry construction.

D. Install sealer gaskets at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed steel framing according to AISI S200 and to manufacturer's written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.

1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.

D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
   1. Cut framing members by sawing or shearing; do not torch cut.
   2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
      a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
      b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.

H. Install insulation, specified in Section 072100 "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

J. All structural joists and studs shall have a minimum of 10 inches of unpunched steel at bearing or support points.

K. Erection Tolerances: Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
   1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.4 LOAD-BEARING WALL INSTALLATION

A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacings as follows:
   1. Maximum Anchor Spacing: 24 inches, or as shown on Contract Drawings.

B. Squarely seat studs against top and bottom tracks with gap not exceeding of 1/8 inch between the end of wall framing member and the web of track. Fasten both flanges of studs to top and bottom tracks. Space studs as follows:
   1. Maximum Stud Spacing: 16 inches, or as indicated on Contract Drawings.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar configurations.

D. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.

E. Align floor and roof framing over studs according to AISI S200, Section C1. Where framing cannot be aligned, continuously reinforce track to transfer loads.

F. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure as indicated on Contract Drawings.

G. Install headers over wall openings wider than stud spacing. Locate headers above openings as indicated on Contract Drawings or Shop Drawings. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.
   1. Frame wall openings with not less than a double stud at each jamb of frame as indicated on Contract Drawings or Shop Drawings. Fasten jamb members together to uniformly distribute loads.
   2. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.

H. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.
   1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.

I. Install horizontal bridging in stud system, spaced vertically 48 inches on center or as indicated on Contract Drawings or Shop Drawings. Fasten at each stud intersection. Gypsum wallboard shall not be considered as bridging.
   1. Bridging:
      a. Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs with a minimum of two screws into each flange of the clip angle for framing members up to 6 inches deep.
      b. Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
      c. Proprietary bridging bars installed according to manufacturer's written instructions.

J. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.

B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:
   1. Stud Spacing: As indicated on Contract Drawings or Shop Drawings.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
   1. Install single deep-leg deflection tracks and anchor to building structure.
   2. Install double deep-leg deflection tracks and anchor outer track to building structure.
   3. Connect vertical deflection clips to bypassing and infill studs and anchor to building structure.
   4. Connect drift clips to cold-formed metal framing and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Contract Drawings or Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.
   1. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.
      a. Install solid blocking at 96-inch centers.
   2. Bridging:
      a. Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
      b. Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
      c. Proprietary bridging bars installed according to manufacturer's written instructions.

F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.6 JOIST INSTALLATION

A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Contract Drawings or Shop Drawings.

B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.
   1. Install joists over supporting frame with a minimum end bearing of 1-1/2 inches.
   2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections as indicated on Shop Drawings.
   3. Splices in joists are not permitted.
   4. Joist webs shall not be in direct contact with rim track webs.

C. Space joists not more than 2 inches from abutting walls, and as follows:
   1. Joist Spacing: As indicated on Contract Drawings or Shop Drawings.

D. Frame openings with built-up joist headers consisting of joist and joist track, or another combination of connected joists if indicated.

E. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement, or as indicated on Contract Drawings or Shop Drawings.
   1. Install web stiffeners to transfer axial loads of walls above.

F. Install bridging at intervals indicated on the Contract Drawings or Shop Drawings. Fasten bridging at each joist intersection as follows:
   1. Bridging:
      a. Joist-track solid blocking of width and thickness indicated, secured to joist webs.

b. Combination of flat, taut, steel sheet straps of width and thickness indicated and joist-track solid blocking of width and thickness indicated. Fasten flat straps to bottom flange of joists and secure solid blocking to joist webs.

G. Secure joists to load-bearing interior walls to prevent lateral movement of bottom flange.

H. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

3.7 FIELD QUALITY CONTROL

A. Testing: Contractor will retain a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor, owner and Architect.

D. Remove and replace work where test results indicate that it does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.8 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 074113
METAL ROOF PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal roof panel system of preformed steel panels.

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 E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2023.

C. ASTM E1592 - Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference; 2005 (Reapproved 2017).

1.03 SUBMITTALS

A. See Section 013000 - 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.
   1. Show work to be field-fabricated or field-assembled.

D. Verification Samples: For each roofing system specified, submit samples of minimum size 12 inches (305 mm) square, representing actual roofing metal, thickness, profile, color, and texture.
   1. Include typical panel joint in sample.

E. Test Reports: Indicate compliance of metal roofing system to specified requirements.

F. Warranty: Submit specified manufacturer's warranty and ensure that forms have been completed in Owner's name and are registered with manufacturer.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section and with at least three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. See Section 017419 - Construction Waste Management and Disposal for packaging waste requirements.

B. Provide strippable plastic protection on prefinished roofing panels for removal after installation.

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

1.06 FIELD CONDITIONS

A. Do not install metal roof panels, eave protection membrane, underlayment, or _____ when surface, ambient air, or wind chill temperatures are below 45 degrees F (7 degrees C).

1.07 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Finish Warranty: Provide 5-year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or

flaking. Complete forms in Owner's name and register with warrantor.

C. Special Warranty: Provide 2-year warranty for weathertightness of roofing system, including agreement to repair or replace metal roof panels that fail to keep out water commencing on the Date of Substantial Completion. Complete forms in Owner's name and register with warrantor.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Structural Metal Roof Panel Manufacturers:
   1. Match Existing.
   2. Substitutions: See Section 016000 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

A. Metal Roof Panels: Provide complete roofing assemblies, including roof panels, clips, fasteners, connectors, and miscellaneous accessories, tested for compliance with the following minimum standards:
   1. Structural Design Criteria: Provide panel assemblies designed to safely support design loads at support spacing indicated, with deflection not to exceed L/180 of span length(L) when tested in accordance with ASTM E1592.
   2. Overall: Complete weathertight system tested and approved in accordance with ASTM E1592.
   3. Thermal Movement: Design system to accommodate without deformation anticipated thermal movement over ambient temperature range of 100 degrees F (56 degrees C).

2.03 METAL ROOF PANELS

A. 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. Metal Panels: Factory-formed panels with factory-applied finish.
   1. Texture: Smooth.
   2. Length: Full length of roof slope, without lapped horizontal joints.
   3. Width: Maximum panel coverage of 24 inches (610 mm).

2.04 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.

2.05 FABRICATION

A. Panels: Provide factory or field 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.

2.06 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 metal surfaces having minimum total dry film thickness (DFT) of 0.9 mil, 0.0009 inch (0.023 mm); color and gloss as selected by Architect from manufacturer’s standard line.

2.07 ACCESSORIES

A. Miscellaneous Sheet Metal Items: Provide flashings, gutters, downspouts, trim, moldings, closure strips, preformed crickets, caps, and equipment curbs 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, polyurethane, or silyl-terminated polyether/polyurethane.
   2. Concealed Sealant: Non-curing butyl sealant or tape sealant.
   3. Seam Sealant: Factory-applied, non-skinning, non-drying type.

D. Underlayment: Self-adhering polymer modified sheet; 20 mil (0.51 mm) total thickness; with strippable siliconized release film on bottom side and slip resistant and UV-stable facing on top side.
   1. Water Vapor Permeance: 30 perm (1716 ng/(Pa s sq m)), maximum, when tested in accordance with ASTM E96/E96M, Desiccant Method A.

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. 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.

B. Remove protective film from surface of roof panels immediately prior to installation; strip film carefully to avoid damage to prefinished surfaces.

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 metal roof panel manufacturer's instructions and recommendations, as applicable to specific project conditions; securely anchor components of roofing system in place 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 required, use methods that will not distort panel profiles. Use of torches for field cutting is prohibited.

B. Accessories: Install necessary components that are required for complete roofing assembly, including flashings, gutters, downspouts, trim, moldings, closure strips, preformed crickets, caps, equipment curbs, rib closures, ridge closures, and similar roof accessory items.

C. Roof Panels: Install metal roof panels in accordance with manufacturer's installation instructions, minimizing transverse joints except at junction with penetrations.

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 076200
SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fabricated sheet metal items, including flashings, counterflashings, gutters, downspouts, and sheet metal roofing.

B. Sealants for joints within sheet metal fabrications.

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 C920 - Standard Specification for Elastomeric Joint Sealants; 2018.

D. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007 (Reapproved 2018).

E. CDA A4050 - Copper in Architecture - Handbook; current edition.

F. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

1.04 QUALITY ASSURANCE

A. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements and standard details, except as otherwise indicated.

B. Fabricator and Installer Qualifications: Company specializing in sheet metal work with 5 years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. See Section 017419 - Construction Waste Management and Disposal for packaging waste requirements.

B. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

C. Prevent contact with materials that could cause discoloration or staining.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Sheet Metal Flashing and Trim:
   1. Match Existing.
   2. Substitutions: See Section 016000 - Product Requirements.

2.02 SHEET MATERIALS

A. Pre-Finished Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24-gauge, 0.0239-inch (0.61 mm) thick base metal, shop pre-coated with PVDF coating.
   1. Polyvinylidene Fluoride (PVDF) Coating: Superior performing organic powder coating, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system.

2.03 FABRICATION

A. Form sections true to shape, accurate in size, square, and free from distortion or defects.

B. Form pieces in longest possible lengths.

C. Hem exposed edges on underside 1/2 inch (13 mm); miter and seam corners.

D. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.

E. Fabricate corners from one piece with minimum 18-inch (450 mm) long legs; seam for rigidity, seal with sealant.

F. Fabricate flashings to allow toe to extend 2 inches (50 mm) over roofing gravel. Return and brake edges.

2.04 GUTTERS AND DOWNSPOUTS

A. Gutters: SMACNA (ASMM) Rectangular profile.

B. Downspouts: Rectangular profile.

C. Gutters and Downspouts: Size for rainfall intensity determined by a storm occurrence of 1 in 10 years in accordance with SMACNA (ASMM).

D. Accessories: Profiled to suit gutters and downspouts.
   1. Anchorage Devices: In accordance with SMACNA (ASMM) requirements.
   2. Gutter Supports: Brackets.
   3. Downspout Supports: Brackets.

E. Seal metal joints.

2.05 FLASHING

A. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for conduits and facade materials to be installed.

2.06 ACCESSORIES

A. Fasteners: Galvanized steel, with soft neoprene washers.

B. Primer Type: Zinc chromate.

C. Concealed Sealants: Non-curing butyl sealant.

D. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; color to match adjacent material.

E. Asphalt Roof Cement: ASTM D4586/D4586M, Type I, asbestos-free.

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. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil, 0.015 inch (0.38 mm).

3.03 INSTALLATION

A. Comply with drawing details.

B. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted..

C. Apply plastic cement compound between metal flashings and felt flashings.

D. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.

E. Secure gutters and downspouts in place with concealed fasteners.

3.04 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements for field inspection requirements.

B. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.

END OF SECTION

This page intentionally left blank

SECTION 079200
JOINT SEALANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nonsag gunnable joint sealants.

B. Joint backings and accessories.

C. Owner-provided field quality control.

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 C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints; 2019 (Reapproved 2020).

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Submit manufacturer's technical datasheets for each product to be used; include 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. Backing material recommended by sealant manufacturer.
   4. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
   5. Substrates the product should not be used on.

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. Samples for Verification: Where custom sealant color is specified, obtain directions from Architect and submit at least two physical samples for verification of color of each required sealant.

E. Preconstruction Laboratory Test Reports: Submit at least four weeks prior to start of installation.

F. Preinstallation Field Adhesion Test Plan: Submit at least two weeks prior to start of installation.

G. Field Quality Control Plan: Submit at least two weeks prior to start of installation.

H. Preinstallation Field Adhesion Test Reports: Submit filled out Preinstallation Field Adhesion Test Reports log within 10 days after completion of tests; include bagged test samples and photographic records.

I. 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.

J. Executed warranty.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

B. Installer Qualifications: Company specializing in performing the work of this section and with at least three years of documented experience.

C. 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. Allow sufficient time for testing to avoid delaying the work.
   4. Deliver sufficient samples to manufacturer for testing.
   5. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.

D. Preinstallation Field Adhesion Test Plan: Include destructive field adhesion testing of one sample of each combination of sealant type and substrate, except interior acrylic latex sealants, and include the following for each tested sample.
   1. Identification of testing agency.
   2. Preinstallation Field Adhesion Test Log Form: Include the following data fields, with known information filled out.
      a. Test date.
      b. Copy of test method documents.
      c. Age of sealant upon date of testing.
      d. Test results, modeled after the sample form in the test method document.
      e. Indicate use of photographic record of test.

E. Owner will employ an independent testing agency to perform the field quality control inspection and testing as referenced in PART 3 of this section and as follows, to prepare and submit the field quality control plan and log, and to provide recommendations of remedies in the case of failure.
   1. Contractor shall cooperate with testing agency and repair failures discovered and destructive test location damage.

F. Field Quality Control Plan:
   1. Field Quality Control Log Form: Show same data fields as on Preinstallation Field Adhesion Test Log, with known information filled out and lines for multiple tests per sealant/substrate combinations; include visual inspection and specified field testing; allow for possibility that more tests than minimum specified may be necessary.

G. 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. When performing destructive tests, also inspect the opened joint for proper installation characteristics recommended by manufacturer, and report any deficiencies.
   5. Deliver the samples removed during destructive tests in separate sealed plastic bags, identified with project, location, test date, and test results, to Owner.
   6. 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.

H. Destructive Field Adhesion Test: Test for adhesion in accordance with ASTM C1521, using Destructive Tail Procedure.
   1. Sample: At least 18 inches (457 mm) long.
   2. Minimum Elongation Without Adhesive Failure: Consider the tail at rest, not under any elongation stress; multiply the stated movement capability of the sealant in percent by two; then multiply 1 inch (25.4 mm) by that percentage; if adhesion failure occurs before the 1-

inch mark is that distance from the substrate, the test has failed.

3. If either adhesive or cohesive failure occurs before minimum elongation, take necessary measures to correct conditions and retest; record each modification to products or installation procedures.

1.05 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Manufacturer Warranty: Provide 2-year manufacturer warranty for installed sealants and accessories that fail to achieve a watertight seal, exhibit loss of adhesion or cohesion, or do not cure. Complete forms in Owner's name and register with manufacturer.

C. Extended Correction Period: Correct defective work within 2-year period commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Nonsag Sealants:
   1. Bostik Inc; _____: www.bostik-us.com/#sle.
   2. Dow; _____: www.dow.com/#sle.
   3. Hilti, Inc; _____: www.hilti.com/#sle.
   4. Pecora Corporation; _____: www.pecora.com/#sle.
   5. Sika Corporation; _____: www.usa.sika.com/#sle.
   6. Specified Technologies Inc; _____: www.stifirestop.com/#sle.
   7. Tremco Commercial Sealants & Waterproofing; ____: www.tremcosealants.com/#sle.

2.02 JOINT SEALANT APPLICATIONS

A. Scope:
   1. Exterior Joints:
      a. Seal the following joints:
         1) Joints between doors, windows, and other frames or adjacent construction.
         2) Joints between different exposed materials.
   2. Interior Joints:
      a. Do not seal gaps and openings in gypsum board and suspended ceilings
      b. Seal the following joints:
         1) Joints between door frames and window frames and adjacent construction.
   3. Do Not Seal:
      a. Intentional weep holes in masonry.
      b. Joints where sealant installation is specified in other sections.

2.03 JOINT SEALANTS - GENERAL

A. Colors: As indicated on drawings.

2.04 NONSAG JOINT SEALANTS

A. Nonstaining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
   1. Movement Capability: Plus and minus ____ percent, minimum.
   2. Nonstaining to Porous Stone: Nonstaining 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. Color: To be selected by Architect from manufacturer's standard range.

B. Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Uses M and A; single component, mildew resistant; not expected to withstand continuous water immersion or traffic.
   1. Color: White.

C. Polymer Sealant: ASTM C920; single component, cured sealant is paintable and mold/mildew resistant, low odor and VOC, and ultraviolet (UV) resistant.
   1. Color: White.

D. Nonsag Traffic-Grade Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multi-component; explicitly approved by manufacturer for continuous water immersion and traffic without the necessity to recess sealant below traffic surface.
   1. Movement Capability: Plus and minus 25 percent, minimum.
   2. Hardness Range: 20 to 30, Shore A, when tested in accordance with ASTM C661.
   3. Color: Match adjacent finished surfaces.

E. Type ___ - Acrylic Emulsion Latex: Water-based; ASTM C834, single component, nonstaining, nonbleeding, nonsagging; not intended for exterior use.
   1. Color: To be selected by Architect from manufacturer's standard range.
   2. Grade: ASTM C834; Grade 0 Degrees F (Minus 18 Degrees C).

2.05 ACCESSORIES

A. Sealant Backing Materials, General: Materials placed in joint before applying sealants; assists sealant performance and service life by developing optimum sealant profile and preventing three-sided adhesion; type and size recommended by sealant manufacturer for compatibility with sealant, substrate, and application.

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. Preinstallation Adhesion Testing: Install a sample for each test location indicated in the test plan.
   1. Test each sample as specified in PART 1 under QUALITY ASSURANCE article.
   2. Notify Architect of date and time that tests will be performed, at least seven days in advance.
   3. Record each test on Preinstallation Adhesion Test Log as indicated.
   4. If any sample fails, review products and installation procedures, consult manufacturer, or take other measures that are necessary to ensure adhesion; retest in a different location; if unable to obtain satisfactory adhesion, report to Architect.
   5. After completion of tests, remove remaining sample material and prepare joints for new sealant installation.

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.

3.03 INSTALLATION

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

B. Provide joint sealant installations complying with ASTM C1193.

C. Install bond breaker backing tape where backer rod cannot be used.

D. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.

E. 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.

F. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

3.04 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements for additional requirements.

B. Owner will employ an independent testing agency to perform field quality control inspection and testing as specified in PART 1 under QUALITY ASSURANCE article.

C. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.

END OF SECTION

This page intentionally left blank

SECTION 081113
HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Non-fire-rated hollow metal doors and frames.

B. Hollow metal frames for wood doors.

1.02 RELATED REQUIREMENTS

A. Section 087100 - Door Hardware.

1.03 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

B. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2023.

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

D. 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; 2023, with Editorial Revision.

E. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.

F. BHMA A156.115 - Hardware Preparation in Steel Doors and Frames; 2016.

G. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

H. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames; 2002.

I. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2011.

J. NAAMM HMMA 840 - Guide Specifications For Receipt, Storage and Installation of Hollow Metal Doors and Frames; 2017.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/guidelines.

C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.

D. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

C. Maintain at project site copies of reference standards relating to installation of products specified.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.

B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Hollow Metal Doors and Frames:
   1. Ceco Door, an Assa Abloy Group company; _____: www.assaabloydss.com/#sle.
   2. Curries, an Assa Abloy Group company; _____: www.assaabloydss.com/#sle.
   3. Republic Doors, an Allegion brand; ____: www.republicdoor.com/#sle.
   4. Steelcraft, an Allegion brand; ____: www.allegion.com/#sle.
   5. Substitutions: See Section 016000 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

A. Requirements for Hollow Metal Doors and Frames:
   1. Steel Sheet: Comply with one or more of the following requirements; galvannealed steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
   2. Accessibility: Comply with ICC A117.1 and ADA Standards.
   3. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
   4. Zinc Coating for Typical Interior and/or Exterior Locations: Provide metal components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvannealed) by the hot-dip process in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness, unless noted otherwise for specific hollow metal doors and frames.

B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.03 HOLLOW METAL DOORS

2.04 HOLLOW METAL FRAMES

A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.

B. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.
   1. Frame Metal Thickness: 18 gauge, 0.042 inch (1.0 mm), minimum.
   2. Frame Finish: Factory primed and field finished.

2.05 ACCESSORIES

A. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.

B. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Verify that finished walls are in plane to ensure proper door alignment.

3.02 INSTALLATION

A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.

B. Coordinate frame anchor placement with wall construction.

C. Install door hardware as specified in Section 087100.

D. Coordinate installation of electrical connections to electrical hardware items.

3.03 TOLERANCES

A. Maximum Diagonal Distortion: 1/16 inch (1.6 mm) measured with straight edge, corner to corner.

3.04 ADJUSTING

A. Adjust for smooth and balanced door movement.

3.05 SCHEDULE

A. Refer to Door and Frame Schedule on the drawings.

END OF SECTION

This page intentionally left blank

SECTION 081416
FLUSH WOOD DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Flush wood doors; flush configuration; non-rated.

1.02 RELATED REQUIREMENTS

A. Section 081113 - Hollow Metal Doors and Frames.

1.03 REFERENCE STANDARDS

A. AWI (QCP) - Quality Certification Program; Current Edition.

B. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).

C. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.

D. WDMA I.S. 1A - Interior Architectural Wood Flush Doors; 2021, with Errata (2022).

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.

C. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.
   1. Provide information as required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).

D. Samples: Submit two samples of door veneer, in size illustrating wood grain, stain color, and sheen.

E. Certificate: Submit labels and certificates required by quality assurance and quality control programs.

F. Manufacturer's Installation Instructions: Indicate special installation instructions.

G. Warranty, executed in Owner's name.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with not less than three years of documented experience.
   1. Company with at least one project within past five years with value of woodwork within at least 20 percent of cost of woodwork for this project.
   2. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.

B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.

C. Woodwork Quality Assurance Program:
   1. Comply with AWI (QCP) woodwork association quality assurance service/program in accordance with requirements for work specified in this section; www.awiqcp.org/#sle.
   2. Provide labels indicating that the installed work complies with AWI/AWMAC/WI (AWS) requirements for grade or grades specified.
   3. Provide designated labels on shop drawings as required by quality assurance program.
   4. Provide designated labels on installed products as required by quality assurance program.
   5. Submit documentation upon completion of installation that verifies this work is in compliance with specified requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Package, deliver and store doors in accordance with specified quality standard.

B. Accept doors on site in manufacturer's packaging, and inspect for damage.

C. Protect doors with resilient packaging sealed with heat shrunk plastic; do not store in damp or wet areas or areas where sunlight might bleach veneer; seal top and bottom edges with tinted sealer if stored more than one week, and break seal on site to permit ventilation.

1.07 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Manufacturer Warranty: Provide manufacturer's warranty on interior doors for the life of the installation. Complete forms in Owner's name and register with manufacturer.
   1. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Wood Veneer Faced Doors:
   1. Masonite Architectural; Aspiro Select Wood Veneer Doors: www.architectural.masonite.com/#sle.
   2. VT Industries, Inc; ____: www.vtindustries.com/#sle.
   3. Substitutions: See Section 016000 - Product Requirements.

2.02 DOORS AND PANELS

A. Doors: See drawings for locations and additional requirements.
   1. Quality Standard: Custom Grade, Heavy Duty performance, in accordance with AWI/AWMAC/WI (AWS), unless noted otherwise.
   2. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.

B. Interior Doors: 1-3/4 inches (44 mm) thick unless otherwise indicated; flush construction.
   1. Provide solid core doors at each location.
   2. Wood veneer facing with factory transparent finish as indicated on drawings.

2.03 DOOR AND PANEL CORES

A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated.

2.04 DOOR FACINGS

A. Veneer Facing for Transparent Finish: Species as specified above, veneer grade in accordance with quality standard indicated, plain sliced (flat cut), with book match between leaves of veneer, running match of spliced veneer leaves assembled on door or panel face.
   1. Vertical Edges: Any option allowed by quality standard for grade.

2.05 DOOR CONSTRUCTION

A. Fabricate doors in accordance with door quality standard specified.

B. Cores Constructed with stiles and rails:
   1. Provide solid blocks at lock edge for hardware reinforcement.

C. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.

D. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.

E. Provide edge clearances in accordance with the quality standard specified.

2.06 FINISHES - WOOD VENEER DOORS

A. Finish work in accordance with AWI/AWMAC/WI (AWS), Section 5 - Finishing for grade specified and as follows:

B. Finish work in accordance with WDMA I.S. 1A for grade specified and as follows:
   1. Transparent:
      a. System - TR-2, Catalyzed Lacquer.
      b. Stain: As selected by Architect.

c. Sheen: Flat.

C. Factory finish doors in accordance with approved sample.

D. Seal door top edge with color sealer to match door facing.

2.07 ACCESSORIES

A. Hollow Metal Door Frames: See Section 081113.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.02 INSTALLATION

A. Install doors in accordance with manufacturer's instructions and specified quality standard.

B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.

C. Use machine tools to cut or drill for hardware.

D. Coordinate installation of doors with installation of frames and hardware.

3.03 TOLERANCES

A. Comply with specified quality standard for fit and clearance tolerances.

B. Comply with specified quality standard for telegraphing, warp, and squareness.

3.04 ADJUSTING

A. Adjust doors for smooth and balanced door movement.

B. Adjust closers for full closure.

3.05 SCHEDULE

A. See Door and Frame Schedule on Drawings.

END OF SECTION

This page intentionally left blank

SECTION 084313
ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Aluminum-framed storefront, with vision glass.

B. Aluminum doors and frames.

C. Weatherstripping.

1.02 RELATED REQUIREMENTS

A. Section 087100 - Door Hardware: Hardware items other than specified in this section.

B. Section 088000 - Glazing: Glass and glazing accessories.

1.03 REFERENCE STANDARDS

A. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site; 2015.

B. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems; 2015.

C. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document); 2015.

D. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.

E. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

F. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.

G. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.

H. 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).

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with installation of other components that comprise the exterior enclosure.

B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, and internal drainage details.

C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.

D. Samples: Submit two samples in size illustrating finished aluminum surface, glass, glazing materials.

E. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.

F. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.
   1. Provide certified glass products through ANSI accredited certifications that include plant audits and independent laboratory performance testing.
      a. Insulating Glass Certification Council (IGCC).
      b. Safety Glazing Certification Council (SGCC).

B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Handle products of this section in accordance with AAMA CW-10.

B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.08 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F (5 degrees C). Maintain this minimum temperature during and 48 hours after installation.

1.09 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Correct defective Work within a five year period after Date of Substantial Completion.

C. Provide five year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.

D. Provide five year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Aluminum-Framed Storefronts:
   1. Kawneer North America; _____: www.kawneer.com/#sle.
   2. Oldcastle BuildingEnvelope; _____: www.oldcastlebe.com/#sle.
   3. YKK AP America, Inc; _____: www.ykkap.com/commercial/#sle.
   4. Substitutions: See Section 016000 - Product Requirements.

2.02 BASIS OF DESIGN -- FRAMING FOR INSULATING GLAZING

A. Front-Set Style, Thermally-Broken:
   1. Basis of Design: Match Existing.

B. Other Manufacturers: Provide either the product identified as "Basis of Design" or an equivalent product of another manufacturer.

2.03 BASIS OF DESIGN -- SWINGING DOORS

A. Entrance Doors, Various Stile Widths:
   1. Basis of Design: Same as Frame Manufacturer.

2.04 ALUMINUM-FRAMED STOREFRONT

A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
   1. Finish: Superior performing organic coatings.
      a. Factory finish all surfaces that will be exposed in completed assemblies.
      b. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.
   2. Finish Color: As selected by Architect from manufacturer's standard line.

3. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
4. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
5. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
6. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F (95 degrees C) over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
7. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
8. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.

B. Performance Requirements
1. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
a. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
2. Air Leakage: 0.06 cfm/sq ft (0.3 L/sec sq m) maximum leakage of storefront wall area when tested in accordance with ASTM E283/E283M at 1.57 psf (75 Pa) pressure difference.

2.05 COMPONENTS

A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
1. Glazing Stops: Flush.

B. Glazing: See Section 088000.

C. Swing Doors: Glazed aluminum.
1. Finish: Same as storefront.

2.06 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).

B. Fasteners: Stainless steel.

C. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

D. Glazing Accessories: See Section 088000.

2.07 FINISHES

A. High Performance Organic Coating: AAMA 2604; multiple coats, thermally cured fluoropolymer system.

2.08 HARDWARE

A. For each door, include weatherstripping, sill sweep strip, and threshold.

B. Other Door Hardware: See Section 087100.

C. Weatherstripping: Wool pile, continuous and replaceable; provide on all doors.

D. Sill Sweep Strips: Resilient seal type, retracting, of neoprene; provide on all doors.

E. Threshold: Extruded aluminum, one piece per door opening, ribbed surface; provide on all doors.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other work.

B. Verify that storefront wall openings and adjoining water-resistive and/or air barrier seal materials are ready to receive work of this section.

3.02 INSTALLATION

A. Install wall system in accordance with manufacturer's instructions.

B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

C. Provide alignment attachments and shims to permanently fasten system to building structure.

D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

E. Provide thermal isolation where components penetrate or disrupt building insulation.

F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.

G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.

H. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

I. Set thresholds in bed of sealant and secure.

J. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES

A. Maximum Variation from Plumb: 0.06 inch per 3 feet (1.5 mm per m) non-cumulative or 0.06 inch per 10 feet (1.5 mm per 3 m), whichever is less.

B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch (0.8 mm).

3.04 FIELD QUALITY CONTROL

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

B. See Section 014000 - Quality Requirements for general testing and inspection requirements.

C. Water-Spray Test: Provide water spray quality test of installed storefront components in accordance with AAMA 501.2 during construction process and before installation of interior finishes.

1. Perform a minimum of two tests in each designated area as indicated on drawings.
2. Conduct tests in each area prior to 10 percent and 50 percent completion of this work.

D. Repair or replace storefront components that have failed designated field testing, and retest to verify performance complies with specified requirements.

3.05 ADJUSTING

A. Adjust operating hardware and sash for smooth operation.

3.06 CLEANING

A. Remove protective material from pre-finished aluminum surfaces.

B. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.

3.07 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

SECTION 087100
DOOR HARDWARE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Hardware for wood and aluminum doors.

B. Electrically operated and controlled hardware.

C. Weatherstripping and gasketing.

1.02 RELATED REQUIREMENTS

A. Section 081416 - Flush Wood Doors.

1.03 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

B. BHMA (CPD) - Certified Products Directory; Current Edition.

C. BHMA A156.1 - Standard for Butts and Hinges; 2021.

D. BHMA A156.2 - Bored and Preassembled Locks and Latches; 2022.

E. BHMA A156.4 - Door Closers and Pivots; 2024.

F. BHMA A156.6 - Standard for Architectural Door Trim; 2021.

G. BHMA A156.16 - Standard for Auxiliary Hardware; 2023.

H. BHMA A156.22 - Standard for Gasketing; 2021.

I. BHMA A156.115W - Hardware Preparation in Wood Doors with Wood or Steel Frames; 2006.

J. DHI (H&S) - Sequence and Format for the Hardware Schedule; 2019.

K. DHI WDHS.3 - Recommended Locations for Architectural Hardware for Flush Wood Doors; 1993; also in WDHS-1/WDHS-5 Series, 1996.

L. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

M. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

N. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the manufacture, fabrication, and installation of products that door hardware is installed on.

B. Keying Requirements Meeting:
   1. Owner will schedule meeting at project site prior to Contractor occupancy.
   2. Attendance Required:
      a. Contractor.
      b. Owner.
      c. Architect.
      d. Installer's Architectural Hardware Consultant (AHC).
      e. Hardware Installer.
      f. Owner's Security Consultant.
   3. Agenda:
      a. Establish keying requirements.
      b. Verify locksets and locking hardware are functionally correct for project requirements.
   4. Incorporate "Keying Requirements Meeting" decisions into keying submittal upon review of door hardware keying system including, but not limited to, the following:
      a. Access control requirements.
   5. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

6. Deliver established keying requirements to manufacturers.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Manufacturer's catalog literature for each type of hardware, marked to clearly show products to be furnished for this project, and includes construction details, material descriptions, finishes, and dimensions and profiles of individual components.

C. Shop Drawings - Door Hardware Schedule: Submit detailed listing that includes each item of hardware to be installed on each door. Use door numbering scheme as included in Contract Documents.
   1. Prepared by or under supervision of Architectural Hardware Consultant (AHC).
   2. Comply with DHI (H&S) using door numbers and hardware set numbers as indicated in construction documents.
   3. List groups and suffixes in proper sequence.
   4. Provide complete description for each door listed.
   5. Provide manufacturer name, product names, and catalog numbers; include functions, types, styles, sizes and finishes of each item.
   6. Include account of abbreviations and symbols used in schedule.

D. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

E. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified for commercial door hardware with at least three years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Package hardware items individually; label and identify each package with door opening code to match door hardware schedule.

1.08 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Manufacturer's Warranty: Provide warranty against defects in material and workmanship for period indicated. Complete forms in Owner's name and register with manufacturer.
   1. Closers: Five years, minimum.
   2. Locksets and Cylinders: Three years, minimum.
   3. Other Hardware: Two years, minimum.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Provide specified door hardware as required to make doors fully functional, compliant with applicable codes, and secure to extent indicated.

B. Provide individual items of single type, of same model, and by same manufacturer.

C. Provide door hardware products that comply with the following requirements:
   1. Applicable provisions of federal, state, and local codes.
   2. Accessibility: ADA Standards and ICC A117.1.
   3. Applicable provisions of NFPA 101.
   4. Listed and certified compliant with specified standards by BHMA (CPD).
   5. Hardware Preparation for Wood Doors with Wood or Steel Frames: BHMA A156.115W.
   6. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified.

D. Lock Function: Provide lock and latch function numbers and descriptions of manufacturer's series. See Door Hardware Schedule.

E. Fasteners:
   1. Provide fasteners of proper type, size, quantity, and finish that comply with commercially recognized standards for proposed applications.
      a. Aluminum fasteners are not permitted.
      b. Provide phillips flat-head screws with heads finished to match door surface hardware unless otherwise indicated.

2.02 HINGES

A. Hinges: Comply with BHMA A156.1, Grade 1.
   1. Provide hinges on every swinging door.
   2. Provide following quantity of butt hinges for each door:

2.03 LOCK CYLINDERS

A. Lock Cylinders: Provide key access on outside of each lock, unless otherwise indicated.
   1. Provide cylinders from same manufacturer as locking device.
   2. Provide cams and/or tailpieces as required for locking devices.

2.04 CYLINDRICAL LOCKS

A. Cylindrical Locks (Bored): Comply with BHMA A156.2, Grade 1, 4000 Series.
   1. Bored Hole: 2-1/8 inch (54 mm) diameter.
   2. Latchbolt Throw: 1/2 inch (12.7 mm), minimum.
   3. Backset: 2-3/4 inch (70 mm) unless otherwise indicated.
   4. Strikes: Provide manufacturer's standard strike for each latchset or lockset with strike box and curved lip extending to protect frame in compliance with indicated requirements.
      a. Finish: To match lock or latch.

2.05 DOOR PULLS AND PUSH PLATES

A. Door Pulls and Push Plates: Comply with BHMA A156.6.
   1. Pull Type: Straight, unless otherwise indicated.
   2. Push Plate Type: Flat, with square corners, unless otherwise indicated.
      a. Edges: Beveled, unless otherwise indicated.
   3. Material: Aluminum, unless otherwise indicated.

2.06 CLOSERS

A. Closers: Comply with BHMA A156.4, Grade 1.
   1. Type: Surface mounted to door.
   2. Provide door closer on each exterior door.

2.07 PROTECTION PLATES

A. Protection Plates: Comply with BHMA A156.6.

B. Edges: Beveled, on four sides unless otherwise indicated.

C. Fasteners: Countersunk screw fasteners.

2.08 KICK PLATES

A. Kick Plates: Provide along bottom edge of push side of every door with closer, except aluminum storefront and glass entry doors, unless otherwise indicated.
   1. Size: 8 inch (203 mm) high by 2 inch (51 mm) less door width (LDW) on push side of door.

2.09 FLOOR STOPS

A. Floor Stops: Comply with BHMA A156.16, Grade 1 and Resilient Material Retention Test as described in this standard.
   1. Type: Manual hold-open, with pencil floor stop.
   2. Material: Aluminum housing with rubber insert.

2.10 WALL STOPS

A. Wall Stops: Comply with BHMA A156.16, Grade 1 and Resilient Material Retention Test as described in this standard.
   1. Type: Bumper, concave, wall stop.
   2. Material: Aluminum housing with rubber insert.

2.11 WEATHERSTRIPPING AND GASKETING

A. Weatherstripping and Gasketing: Comply with BHMA A156.22.
   1. Head and Jamb Type: Adjustable.
   2. Door Sweep Type: Encased in retainer.
   3. Material: Aluminum, with brush weatherstripping.

2.12 SILENCERS

A. Silencers: Provide at equal locations on door frame to mute sound of door's impact upon closing.
   1. Single Door: Provide three on strike jamb of frame.
   2. Pair of Doors: Provide two on head of frame, one for each door at latch side.
   3. Material: Rubber, gray color.

2.13 FINISHES

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that doors and frames are ready to receive this work; labeled, fire-rated doors and frames are properly installed, and dimensions are as indicated on shop drawings.

3.02 INSTALLATION

A. Install hardware in accordance with manufacturer's instructions and applicable codes.

B. Use templates provided by hardware item manufacturer.

C. Door Hardware Mounting Heights: Distance from finished floor to center line of hardware item. As indicated in following list; unless noted otherwise in Door Hardware Schedule or on drawings.
   1. For Wood Doors: Install in compliance with DHI WDHS.3 recommendations.
   2. Flush Wood Doors: See Section 081416.
   3. Mounting heights in compliance with ADA Standards:
      a. Locksets: 40-5/16 inch (1024 mm).
      b. Push Plates/Pull Bars: 42 inch (1067 mm).

D. Set exterior door thresholds with full-width bead of elastomeric sealant at each point of contact with floor providing a continuous weather seal; anchor thresholds with stainless steel countersunk screws.

3.03 ADJUSTING

A. Adjust work under provisions of Section 017000 - Execution and Closeout Requirements.

B. Adjust hardware for smooth operation.

C. Adjust gasketing for complete, continuous seal; replace if unable to make complete seal.

3.04 CLEANING

A. Clean finished hardware in accordance with manufacturer's written instructions after final adjustments have been made.

B. Clean adjacent surfaces soiled by hardware installation.

C. Replace items that cannot be cleaned to manufacturer's level of finish quality at no additional cost.

D. See Section 017419 - Construction Waste Management and Disposal for additional requirements.

3.05 PROTECTION

A. Protect finished Work under provisions of Section 017000 - Execution and Closeout Requirements.

B. Do not permit adjacent work to damage hardware or finish.

END OF SECTION

This page intentionally left blank

SECTION 088000
GLAZING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Insulating glass units.

B. Glazing compounds.

1.02 REFERENCE STANDARDS

A. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015 (Reaffirmed 2020).

B. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2019).

C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.

D. ASTM C1036 - Standard Specification for Flat Glass; 2021.

E. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.

F. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).

G. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass; 2021a.

H. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2016.

I. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2019.

J. GANA (GM) - GANA Glazing Manual; 2022.

K. GANA (SM) - GANA Sealant Manual; 2008.

L. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

M. IGMA TB-3001 - Guidelines for Sloped Glazing; 2001.

N. NFRC 100 - Procedure for Determining Fenestration Product U-factors; 2023.

O. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence; 2023.

P. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems; 2023.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data on Insulating Glass Unit Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.

C. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.

D. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.04 QUALITY ASSURANCE

A. Perform Work in accordance with GANA (GM) for glazing installation methods. Maintain one copy on site.

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

1. Provide certified glass products through ANSI accredited certifications that include plant audits and independent laboratory performance testing.
    a. Insulating Glass Certification Council (IGCC).
    b. Safety Glazing Certification Council (SGCC).

C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.

1.05 FIELD CONDITIONS

A. Do not install glazing when ambient temperature is less than 40 degrees F (4 degrees C).

B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.06 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Insulating Glass Units: Provide a five (5) year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including providing products to replace failed units.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES

A. Provide type and thickness of exterior glazing assemblies to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of glass.
    1. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
    2. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.
    3. Glass thicknesses listed are minimum.

B. Weather-Resistive Barrier Seals: Provide completed assemblies that maintain continuity of building enclosure water-resistive barrier, vapor retarder, and/or air barrier.
    1. In conjunction with weather barrier related materials described in other sections, as follows:

C. Thermal and Optical Performance: Provide exterior glazing products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:
    1. Center of Glass U-Value: Comply with NFRC 100 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
    2. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with NFRC 200 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
    3. Solar Optical Properties: Comply with NFRC 300 test method.

2.02 GLASS MATERIALS

A. Float Glass: Provide float glass based glazing unless otherwise indicated.
    1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality - Q3.

2.03 INSULATING GLASS UNITS

A. Manufacturers:
    1. Guardian Glass, LLC; _____: www.guardianglass.com/#sle.
    2. Pilkington North America Inc; _____: www.pilkington.com/na/#sle.Pilkington North America Inc; _____: www.pilkington.com/na/#sle.
    3. Viracon, Apogee Enterprises, Inc; _____: www.viracon.com/#sle.
    4. Vitro Architectural Glass (formerly PPG Glass); _____: www.vitroglazings.com/#sle.
    5. Substitutions: See Section 016000 - Product Requirements.

B. Insulating Glass Units: Types as indicated.
    1. Durability: Certified by an independent testing agency to comply with ASTM E2190.

2. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; coated overhead glass, Kind CO; or coated spandrel glass, Kind CS.
3. Warm-Edge Spacers: Low-conductivity thermoplastic with desiccant warm-edge technology design.
    a. Spacer Width: As required for specified insulating glass unit.
    b. Spacer Height: Manufacturer's standard.
4. Spacer Color: Black.
5. Edge Seal:
    a. Color: Black.
6. Purge interpane space with dry air, hermetically sealed.

C. Insulating Glass Units: Vision glass, double glazed.
1. Applications: Exterior glazing unless otherwise indicated.
2. Space between lites filled with air.
3. Outboard Lite: Annealed float glass, 1/4 inch (6.4 mm) thick, minimum.
    a. Tint: Clear.
4. Warm-edge spacer.
5. Inboard Lite: Annealed float glass, 1/4 inch (6.4 mm) thick, minimum.
    a. Tint: Clear.
6. Total Thickness: 1 inch (25.4 mm).
7. Thermal Transmittance (U-Value), Summer - Center of Glass: _____, nominal.

2.04 GLAZING COMPOUNDS

A. Polyurethane Sealant: Single component, chemical curing, nonstaining, nonbleeding; ASTM C920 Type S, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 20 to 35; color as selected.

B. Type GC-5 - Silicone Sealant: Single component; neutral curing; capable of water immersion without loss of properties; nonbleeding, nonstaining; ASTM C920 Type S, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 15 to 25; _____ color.

2.05 ACCESSORIES

A. Setting Blocks: Silicone, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot (25 mm for each square meter) of glazing or minimum 4 inch (100 mm) by width of glazing rabbet space minus 1/16 inch (1.5 mm) by height to suit glazing method and pane weight and area.

B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Continuous by one half the height of the glazing stop by thickness to suit application, self adhesive on one face.

C. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound with integral resilient spacer rod applicable to application indicated; 5 to 30 cured Shore A durometer hardness; coiled on release paper; black color.
1. Width: As required for application.
2. Thickness: As required for application.
3. Spacer Rod Diameter: As required for application.

2.06 SOURCE QUALITY CONTROL

A. See Section 014000 - Quality Requirements for additional requirements.

B. Provide shop inspection and testing for glass.

PART 3 EXECUTION

3.01 VERIFICATION OF CONDITIONS

A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.

B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.

3.02 PREPARATION

A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.

B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

3.03 INSTALLATION, GENERAL

A. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.

3.04 INSTALLATION - WET GLAZING METHOD (SEALANT AND SEALANT)

A. Application - Exterior Glazed: Set glazing infills from the exterior of the building.

B. Place setting blocks at 1/4 points and install glazing pane or unit.

C. Install removable stops with glazing centered in space by inserting spacer shims both sides at 24 inch (610 mm) intervals, 1/4 inch (6.4 mm) below sight line.

D. Fill gaps between glazing and stops with _____ type sealant to depth of bite on glazing, but not more than 3/8 inch (9 mm) below sight line to ensure full contact with glazing and continue the air and vapor seal.

E. Apply sealant to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

3.05 FIELD QUALITY CONTROL

A. Glass and Glazing product manufacturers to provide field surveillance of the installation of their products.

B. Monitor and report installation procedures and unacceptable conditions.

3.06 CLEANING

A. See Section 017419 - Construction Waste Management and Disposal, for additional requirements.

B. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.

C. Remove nonpermanent labels immediately after glazing installation is complete.

D. Clean glass and adjacent surfaces after sealants are fully cured.

E. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

3.07 PROTECTION

A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.

B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

END OF SECTION

SECTION 092116
GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal stud wall framing.

B. Cementitious backing board.

C. Gypsum wallboard.

D. Joint treatment and accessories.

1.02 RELATED REQUIREMENTS

A. Section 092216 - Non-Structural Metal Framing.

1.03 REFERENCE STANDARDS

A. AISI S100 - North American Specification for the Design of Cold-Formed Steel Structural Members; 2016, with Supplement (2020).

B. AISI S201 - North American Standard for Cold-Formed Steel Framing - Product Data; 2017.

C. AISI S220 - North American Standard for Cold-Formed Steel Nonstructural Framing; 2020.

D. AISI S240 - North American Standard for Cold-Formed Steel Structural Framing; 2015, with Errata (2020).

E. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2023.

F. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 2023.

G. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

H. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members; 2015.

I. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories; 2020.

J. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2017 (Reapproved 2022).

K. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.

L. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2023.

M. 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.

N. 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.

O. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base; 2019.

P. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel; 2018.

Q. ASTM C1325 - Standard Specification for Fiber-Mat Reinforced Cementitious Backer Units; 2022, with Editorial Revision (2023).

R. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.

S. ASTM C1658/C1658M - Standard Specification for Glass Mat Gypsum Panels; 2019, with Editorial Revision (2020).

T. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.

U. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems; 2015 (Reapproved 2019).

V. GA-216 - Application and Finishing of Gypsum Panel Products; 2021.

W. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

X. UL (FRD) - Fire Resistance Directory; Current Edition.

Y. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

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

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data:
   1. Provide data on metal framing, gypsum board, accessories, and joint finishing system.
   2. Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Member of Steel Stud Manufacturers Association (SSMA): www.ssma.com/#sle.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLIES

A. Provide completed assemblies complying with ASTM C840 and GA-216.
   1. See PART 3 for finishing requirements.

B. Grid Suspension Systems: Provide grid suspension systems in accordance with ASTM C840 and GA-216 complying with the following:
   1. ICC-ES Evaluation Report No. _____.

2.02 METAL FRAMING MATERIALS

A. Material and Product Requirements Criteria: AISI S201.

B. Steel Sheet: ASTM A1003/A1003M, subject to the ductility limitations indicated in AISI S220 or equivalent.
   1. Structural Grade: As required to meet design criteria.
   2. Corrosion Protection Coating Designation: G40, or equivalent in accordance with AISI S220.

C. Nonstructural Steel Framing for Application of Gypsum Board: See Section 092216.

D. Nonstructural Framing System Components: AISI S220; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 5 psf (L/120 at 240 Pa).
   1. Studs: C-shaped with knurled or embossed faces.
   2. Runners: U shaped, sized to match studs.

E. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection and prevent rotation of studs while maintaining structural performance of partition.

1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI S100.
2. Material: ASTM A653/A653M steel sheet, SS Grade 50/340, with G60/Z180 hot-dipped galvanized coating.

F. Grid Suspension Systems: Steel grid system of main tees and support bars connected to structure using hanging wire.

2.03 BOARD MATERIALS

A. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
2. Glass mat faced gypsum panels, as defined in ASTM C1658/C1658M, suitable for paint finish, of the same core type and thickness may be substituted for paper-faced board.
3. Thickness:
a. Vertical Surfaces: 5/8 inch (16 mm).
b. Ceilings: 5/8 inch (16 mm).

B. Backing Board For Wet Areas:
1. Application: Surfaces behind tile in wet areas.
2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
3. ANSI Cement-Based Board: Non-gypsum-based; aggregated Portland cement panels with glass fiber mesh embedded in front and back surfaces complying with ANSI A118.9 or ASTM C1325.
a. Thickness: 5/8 inch (16 mm).
4. Glass Mat Faced Board: Coated glass mat water-resistant gypsum backing panel as defined in ASTM C1178/C1178M.
a. Regular Type: Thickness 5/8 inch (16 mm).

C. Ceiling Board: Special sag resistant gypsum ceiling board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
1. Application: Ceilings, unless otherwise indicated.
2. Thickness: 5/8 inch (16 mm).
3. Edges: Tapered.

2.04 GYPSUM BOARD ACCESSORIES

A. Finishing Accessories: ASTM C1047, extruded aluminum alloy (6063 T5) or galvanized steel sheet ASTM A924/A924M G90, unless noted otherwise.
1. Types: As detailed or required for finished appearance.

B. Beads, Joint Accessories, and Other Trim: ASTM C1047, galvanized steel or rolled zinc, unless noted otherwise.
1. Expansion Joints:
a. Type: V-shaped metal with factory-installed protective tape.

C. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
1. Fiberglass Tape: 2 inch (50 mm) wide, coated glass fiber tape for joints and corners, except as otherwise indicated.
2. Paper Tape: 2 inch (50 mm) wide, creased paper tape for joints and corners, except as otherwise indicated.
3. Joint Compound: Setting type, field-mixed.

D. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inches (0.84 mm) in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion-resistant.

E. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch (0.84 to 2.84 mm) in Thickness: ASTM C954; steel drill screws, corrosion-resistant.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

3.02 FRAMING INSTALLATION

A. Metal Framing: Install in accordance with ASTM C1007AISI S220 and manufacturer's instructions.

B. Studs: Space studs at 16 inches on center (at 406 mm on center).
   1. Extend partition framing to structure where indicated and to ceiling in other locations.
   2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
   3. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.

3.03 BOARD INSTALLATION

A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.

B. Single-Layer Nonrated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.

C. Exposed Gypsum Board in Interior Wet Areas: Seal joints, cut edges, and holes with water-resistant sealant.

D. Cementitious Backing Board: Install over steel framing members and plywood substrate where indicated, in accordance with ANSI A108.11 and manufacturer's instructions.

E. Installation on Metal Framing: Use screws for attachment of gypsum board.

3.04 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.

B. Corner Beads: Install at external corners, using longest practical lengths.

3.05 JOINT TREATMENT

A. Glass Mat Faced Gypsum Board and Exterior Glass Mat Faced Sheathing: Use fiberglass joint tape, embed and finish with setting type joint compound.

B. Paper Faced Gypsum Board: Use paper joint tape, embed with drying type joint compound and finish with drying type joint compound.

C. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
   1. Level 5: Walls and ceilings to receive semi-gloss or gloss paint finish and other areas specifically indicated.
   2. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
   3. Level 1: Fire-resistance-rated wall areas above finished ceilings, whether or not accessible in the completed construction.

D. 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 (0.8 mm).

E. Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.

F. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

3.06 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet (3 mm in 3 m) in any direction.

3.07 CLEANING

A. See Section 017000 - Execution and Closeout Requirements for additional requirements.

3.08 PROTECTION

A. Protect installed gypsum board assemblies from subsequent construction operations.

END OF SECTION

This page intentionally left blank

SECTION 095100
ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Suspended metal grid ceiling system.

B. Acoustical units.

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 C635/C635M - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2022.

C. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2019.

D. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2022.

E. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2023.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.

B. Do not install acoustical units until after interior wet work is dry.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data on suspension system components and acoustical units.

C. Samples: Submit two samples in size illustrating material and finish of acoustical units.

D. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.
   2. Extra Acoustical Units: Quantity equal to 5 percent of total installed.

1.05 QUALITY ASSURANCE

A. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

B. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.06 FIELD CONDITIONS

A. Maintain uniform temperature of minimum 60 degrees F (16 degrees C), and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

PART 2 PRODUCTS

2.01 ACOUSTICAL UNITS

A. Acoustical Units - General: ASTM E1264, Class A.

B. Acoustical Panels: Painted mineral fiber, with the following characteristics:
   1. Classification: ASTM E1264 Type III.
   2. Size: 24 by 24 inches (610 by 610 mm).
   3. Thickness: 3/4 inch (19 mm).
   4. Panel Edge: Square.

5. Suspension System: Exposed grid.

2.02 SUSPENSION SYSTEM(S)

A. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, hold down clips, stabilizer bars, clips, and splices as required.
   1. Materials:
      a. Steel Grid: ASTM A653/A653M, G30 coating, unless otherwise indicated.

B. Exposed Suspension System: Hot-dipped galvanized steel grid with steel cap.
   1. Structural Classification: Intermediate-duty, when tested in accordance with ASTM C635/C635M.
   2. Profile: Tee; 15/16 inch (24 mm) face width.
   3. Finish: Baked enamel.
   4. Color: White.

2.03 ACCESSORIES

A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.

B. Hanger Wire: 12 gauge, 0.08 inch (2 mm) galvanized steel wire.

C. Perimeter Moldings: Same metal and finish as grid.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that layout of hangers will not interfere with other work.

3.02 PREPARATION

A. Install after major above-ceiling work is complete.

B. Coordinate the location of hangers with other work.

3.03 INSTALLATION - SUSPENSION SYSTEM

A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions and as supplemented in this section.

B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.

C. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
   1. Use longest practical lengths.

D. Suspension System, Non-Seismic: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.

E. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.

F. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.

G. Support fixture loads using supplementary hangers located within 6 inches (152 mm) of each corner, or support components independently.

H. Do not eccentrically load system or induce rotation of runners.

3.04 INSTALLATION - ACOUSTICAL UNITS

A. Install acoustical units in accordance with manufacturer's instructions.

B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.

C. Fit border trim neatly against abutting surfaces.

D. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.

E. Cutting Acoustical Units:
   1. Make field cut edges of same profile as factory edges.

3.05 TOLERANCES

A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet (3 mm in 3 m).

B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

3.06 CLEANING

A. See Section 017000 - Execution and Closeout Requirements for additional requirements.

B. Clean surfaces.

C. Replace damaged or abraded components.

END OF SECTION

This page intentionally left blank

SECTION 096500
RESILIENT FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Resilient tile flooring.

B. Resilient base.

C. Installation accessories.

1.02 REFERENCE STANDARDS

A. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2022.

B. ASTM F1700 - Standard Specification for Solid Vinyl Floor Tile; 2020.

C. ASTM F1861 - Standard Specification for Resilient Wall Base; 2021.

D. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2023.

E. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.

1.03 SUBMITTALS

A. See Section 013000 - 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. Verification Samples: Submit two samples, in size illustrating color and pattern for each resilient flooring product specified.

D. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.

E. Certification: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of subfloor is acceptable.

F. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.
   2. Extra Flooring Material: 5 percent of each type and color.
   3. Extra Wall Base: One full coil of each type and color.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing specified flooring with minimum three years documented experience.

B. Installer Qualifications: Company specializing in installing specified flooring with minimum three 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 (13 degrees C) and 90 degrees F (72 degrees C).

D. 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 (21 degrees C) to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F (13 degrees C).

PART 2 PRODUCTS

2.01 TILE FLOORING

A. Vinyl Tile: Solid vinyl with color and pattern throughout thickness.
   1. Minimum Requirements: Comply with ASTM F1700, of Class corresponding to type specified.
   2. Total Thickness: 0.125 inch (3 mm).

2.02 RESILIENT BASE

A. Resilient Base: ASTM F1861, Type TS, rubber, vulcanized thermoset; style as scheduled.
   1. Height: 4 inches (100 mm).
   2. Thickness: 0.125 inch (3.2 mm).
   3. Finish: Satin.

2.03 ACCESSORIES

A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.

B. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.

C. Adhesive for Vinyl Flooring:

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.

B. 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.

C. Cementitious Subfloor Surfaces: Verify that substrates are ready for resilient flooring installation by testing for moisture and alkalinity (pH).
   1. Test as Follows:
      a. Alkalinity (pH): ASTM F710.
      b. Internal Relative Humidity: ASTM F2170.
      c. Moisture Vapor Emission: ASTM F1869.
   2. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.

3.02 PREPARATION

A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.

B. Remove subfloor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with subfloor filler to achieve smooth, flat, hard surface.

C. Prohibit traffic until filler is fully cured.

D. Clean substrate.

3.03 INSTALLATION - GENERAL

A. Starting installation constitutes acceptance of subfloor conditions.

B. Install in accordance with manufacturer's written instructions.

C. Adhesive-Applied Installation:
   1. Spread only enough adhesive to permit installation of materials before initial set.
   2. Fit joints and butt seams tightly.

3. Set flooring in place, press with heavy roller to attain full adhesion.

D. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
   1. Metal Strips: Attach to substrate before installation of flooring using stainless steel screws.

E. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

3.04 INSTALLATION - TILE FLOORING

A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.

3.05 INSTALLATION - RESILIENT BASE

A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches (45 mm) between joints.

B. Miter internal corners. At external corners, use premolded units. At exposed ends, use premolded units.

C. Install base on solid backing. Bond tightly to wall and floor surfaces.

3.06 CLEANING

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

B. Clean in accordance with manufacturer's written instructions.

3.07 PROTECTION

A. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION

This page intentionally left blank

SECTION 096700
FLUID-APPLIED FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fluid-applied flooring and base.

1.02 REFERENCE STANDARDS

A. ANSI/ESD STM7.1 - The Protection of Electrostatic Discharge Susceptible Items Flooring Systems Resistive Characterization; 2021.

B. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2022.

C. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2023.

D. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.

E. ICRI 310.2R - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair; 2013.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns and colors available; and _____.

C. Samples: Submit two samples, in size illustrating color and pattern for each floor material for each color specified.

D. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.

E. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention, and application rate for each coat.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.
   2. Extra Top Coat Materials: 2 gallons (8 liters).

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Applicator Qualifications: Company specializing in performing the work of this section.

C. Supervisor Qualifications: Trained by product manufacturer , under direct full time supervision of manufacturer's own foreman.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store resin materials in a dry, secure area.

B. Store materials for three days prior to installation in area of installation to achieve temperature stability.

1.06 FIELD CONDITIONS

A. Maintain minimum temperature in storage area of 55 degrees F (13 degrees C).

B. Store materials in area of installation for minimum period of 24 hours prior to installation.

C. Maintain ambient temperature required by manufacturer 72 hours prior to, during, and 24 hours after installation of materials.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fluid-Applied Flooring:
   1. Stonhard.
   2. Substitutions: See Section 016000 - Product Requirements.

2.02 FLUID-APPLIED FLOORING SYSTEMS

A. Fluid-Applied Flooring: Epoxy, with aggregate.
   1. Texture: Smooth.
   2. Sheen: High gloss.
   3. Color: As selected by Architect.
   4. Products:
      a. Stonhard; Stoncrete EFX: www.stonhard.com/#sle.
      b. Substitutions: See Section 016000 - Product Requirements.

2.03 ACCESSORIES

A. Base Caps: Zinc with projecting base of 1/8 inch (3 mm); color as selected.

B. Subfloor Filler: Type recommended by fluid-applied flooring manufacturer.

C. Primer: Type recommended by fluid-applied flooring manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive flooring.

B. 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 flooring.

C. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of materials to subfloor surfaces.

D. Cementitious Subfloor Surfaces: Verify that substrates are ready for fluid-applied flooring installation by testing for moisture and alkalinity (pH).
   1. Test as Follows:
      a. Alkalinity (pH): ASTM F710.
      b. Internal Relative Humidity: ASTM F2170.
      c. Moisture Vapor Emission: ASTM F1869.
   2. Obtain instructions if test results are not within limits recommended by fluid-applied flooring manufacturer.

3.02 PREPARATION

A. Remove subfloor ridges and bumps. Fill low spots, cracks, joints, holes, and other defects with subfloor filler.

B. Prepare concrete surfaces according to ICRI 310.2R, CSP 3.

C. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Grind irregularities above the surface level. Prohibit traffic until filler is cured.

D. Vacuum clean substrate.

E. Apply primer to surfaces required by flooring manufacturer.

3.03 INSTALLATION - ACCESSORIES

A. Install cant strips at base of walls where flooring is to be extended up wall as base.

B. Install terminating cap strip at top of base; attach securely to wall substrate.

3.04 INSTALLATION - FLOORING

A. Apply in accordance with manufacturer's instructions.

B. Apply each coat to minimum thickness required by manufacturer.

C. Finish to smooth level surface.

3.05 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Test installed floor surface in accordance with ANSI/ESD STM7.1 .

3.06 PROTECTION

A. Prohibit traffic on floor finish for 48 hours after installation.

B. Barricade area to protect flooring until fully cured.

END OF SECTION

This page intentionally left blank

SECTION 097200
WALL COVERINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation and prime painting.

B. Wall covering and borders.

1.02 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on wall covering and adhesive.

C. Samples: Submit two samples of wall covering, in size illustrating color, finish, and texture.

D. Manufacturer's Installation Instructions: Indicate special procedures.

E. Maintenance Data: Submit data on cleaning, touch-up, and repair of covered surfaces.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.
   2. Extra Wall Covering Materials: One full sheet of each color and pattern of wall covering; store where directed.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Protect packaged adhesive from temperature cycling and cold temperatures.

1.05 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the adhesive or wall covering product manufacturer.

B. Maintain these conditions 24 hours before, during, and after installation of adhesive and wall covering.

C. Provide lighting level of 80 ft candles (860 lx) measured mid-height at substrate surfaces.

PART 2 PRODUCTS

2.01 WALL COVERINGS

A. Wall Covering: Rigid vinyl panel.
   1. Panel Size: 4 feet by 8 feet (1219 mm by 2438 mm).
   2. Rigid Vinyl Thickness: 30 mils (0.030 inch) (0.76 mm).
   3. Panel Edge Treatment: Square.
   4. Trim: Manufacturer's standard trim shapes; vinyl, match face panel color.
   5. Color: As Indicated.
   6. Surface Texture: As Indicated.
   7. Manufacturers:
      a. InProCorp.
      b. Substitutions: See Section 016000 - Product Requirements.

B. Substrate Filler: As recommended by adhesive and wall covering manufacturers; compatible with substrate.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are prime painted and ready to receive work, and comply with requirements of wall covering manufacturer.

B. Verify flatness tolerance of surfaces does not vary more than 1/8 inch in 10 feet (3 mm in 3 m) nor vary at a rate greater than 1/16 inch/ft (1.5 mm/300 mm).

3.02 PREPARATION

A. Fill cracks in substrate and smooth irregularities with filler; sand smooth.

B. Wash impervious surfaces with tetra-sodium phosphate, rinse and neutralize; wipe dry.

C. Surface Appurtenances: Remove or mask electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.

D. Vacuum clean surfaces free of loose particles.

3.03 INSTALLATION

A. Apply adhesive and wall covering in accordance with manufacturer's instructions.

B. Apply wall covering smooth, without wrinkles, gaps or overlaps. Eliminate air pockets and ensure full bond to substrate surface.

C. Butt edges tightly.

D. Horizontal seams are not acceptable.

E. Do not seam within 2 inches (50 mm) of internal corners or within 6 inches (150 mm) of external corners.

F. Install wall covering before installation of bases and items attached to or spaced slightly from wall surface.

G. Remove excess adhesive while wet from seam before proceeding to next wall covering sheet. Wipe clean with dry cloth.

3.04 CLEANING

A. Clean wall coverings of excess adhesive, dust, dirt, and other contaminants.

B. Reinstall wall plates and accessories removed prior to work of this section.

3.05 PROTECTION

A. Do not permit construction activities at or near finished wall covering areas.

END OF SECTION

SECTION 099123
INTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints.

C. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.

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. Floors, unless specifically indicated.
   6. Glass.
   7. Concealed pipes, ducts, and conduits.

1.02 REFERENCE STANDARDS

A. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.

1.03 SUBMITTALS

A. See Section 013000 - 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 products to be used in project; include description of each system.

C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches (216 by 279 mm) in size, illustrating range of colors available for each finishing product specified.
   1. Where sheen is specified, submit samples in only that sheen.

D. Manufacturer's Instructions: Indicate special surface preparation procedures.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.
   2. Extra Paint and Finish Materials: 1 gal (4 L) of each color; from the same product run, store where directed.
   3. Label each container with color in addition to the manufacturer's label.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum 5 years documented experience.

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 (7 degrees C) and a maximum of 90 degrees F (32 degrees C), 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 (3 degrees C) above the dew point, or to damp or wet surfaces.

D. Minimum Application Temperatures for Paints: 50 degrees F (10 degrees C) for interiors unless required otherwise by manufacturer's instructions.

E. Provide lighting level of 80 fc (860 lux) 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. Paints:
1. Behr Paint Company: www.behr.com/#sle.
2. Dunn-Edwards Corporation; _____: www.dunnedwards.com/#sle.
3. PPG Paints: www.ppgpaints.com/#sle.
4. Sherwin-Williams Company: www.sherwin-williams.com/#sle.

C. Primer Sealers: Same manufacturer as top coats.

D. Substitutions: See Section 016000 - Product Requirements.

2.02 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready-mixed, unless intended to be a field-catalyzed paint.
1. 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.
2. Supply each paint material in quantity required to complete entire project's work from a single production run.
3. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

B. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.

C. Colors: As indicated on drawings.

2.03 PAINT SYSTEMS - INTERIOR

A. Medium Duty Door/Trim: For surfaces subject to frequent contact by occupants, including metals:
1. Medium duty applications include door frames.
2. Two top coats and one coat primer.
3. Top Coat(s): Interior Light Industrial Coating, Water Based; MPI #151, 153, or 154.
4. Top Coat Sheen:
   a. Semi-Gloss: MPI gloss level 5; use this sheen at door frames and hollow metal doors.

B. Medium Duty Vertical and Overhead: Including gypsum board.
1. Two top coats and one coat primer.
2. Top Coat(s): Interior Alkyd, Water Based; MPI #157, 167, 168, or 169.

3. Top Coat Sheen:
    a. Semi-Gloss: MPI gloss level 5; use this sheen at hollow metal doors and frames.
4. Primer: As recommended by top coat manufacturer for specific substrate.

2.04 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. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

C. Test shop-applied primer for compatibility with subsequent cover materials.

D. 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.

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 mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

D. Seal surfaces that might cause bleed through or staining of topcoat.

E. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.

F. 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 CLEANING

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

3.05 PROTECTION

A. Protect finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION

This page intentionally left blank

SECTION 104400
FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fire extinguishers.

B. Fire extinguisher cabinets.

C. Accessories.

1.02 REFERENCE STANDARDS

A. FM (AG) - FM Approval Guide; Current Edition.

B. NFPA 10 - Standard for Portable Fire Extinguishers; 2022.

C. UL (DIR) - Online Certifications Directory; Current Edition.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide extinguisher operational features.

C. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.

1.04 FIELD CONDITIONS

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

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fire Extinguishers:
   1. Kidde, a unit of United Technologies Corp; _____: www.kidde.com/#sle.
   2. Potter-Roemer; _____: www.potterroemer.com/#sle.
   3. Larsen's Manufacturing Co; _____: www.larsensmfg.com/#sle.
   4. Substitutions: See Section 016000 - Product Requirements.

B. Fire Extinguisher Cabinets and Accessories:
   1. Kidde, a unit of United Technologies Corp; _____: www.kidde.com/#sle.
   2. Larsen's Manufacturing Co; _____: www.larsensmfg.com/#sle.
   3. Potter-Roemer; _____: www.potterroemer.com/#sle.
   4. Substitutions: See Section 016000 - 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 FM (AG) for purpose specified and as indicated.

2.03 FIRE EXTINGUISHER CABINETS

A. Cabinet Construction: Non-fire rated.
   1. Formed primed steel sheet; 0.036 inch (0.9 mm) thick base metal.

B. Cabinet Configuration: Semi-recessed type.
   1. Size to accommodate accessories.
   2. Projected Trim: Returned to wall surface.
   3. Provide cabinet enclosure with right angle inside corners and seams, and with formed perimeter trim and door stiles.

C. Door: 0.036 inch (0.9 mm) metal thickness, reinforced for flatness and rigidity with nylon catch. Hinge doors for 180 degree opening with two butt hinges.

D. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.

E. Fabrication: Weld, fill, and grind components smooth.

F. Finish of Cabinet Interior: White colored enamel.

2.04 ACCESSORIES

A. Lettering: “FIRE EXTINGUISHER” decal, or vinyl self-adhering, prespaced black lettering in accordance with authorities having jurisdiction (AHJ).

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify rough openings for cabinet are correctly sized and located.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Secure rigidly in place.

3.03 MAINTENANCE

A. See Section 017000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.

B. Provide a separate maintenance contract for specified maintenance service.

END OF SECTION

SECTION 22 01 00

GENERAL PLUMBING PROVISIONS

PART 1 GENERAL

1.1 WORK INCLUDED

A. The work covered by Division 22 sections consist of furnishing all labor, equipment, appliances and material for the heating, air conditioning, piping and plumbing systems in strict accordance with Codes, Specifications and the applicable drawings and subject to the terms and conditions of the contract. Include all appurtenances necessary to the proper operation of the systems and equipment specified.

B. General Contractor shall install all concrete pads and bases required for installing mechanical equipment. Mechanical Contractor is responsible for the exact sizes required, location of anchor bolts, etc.

C. Some equipment may be furnished by other divisions. Mechanical Contractor is responsible to check the drawings and specifications for equipment that will be furnished by others. Furnish the supplies (hot and cold water cut-offs), traps, drains, controls, gas piping, pressure reducing valves, etc., on all equipment furnished by other divisions.

D. General Contractor shall furnish and install all ceiling access panels required to service mechanical equipment, valves and controls above gyp board or hidden spline ceilings.

E. General Contractor shall provide all site drive, sidewalk and other surfaced areas saw cutting and repairs back to preexisting conditions for the required mechanical piping. Mechanical Contractor shall provide the trenching, bedding and backfill required for the pipe installation.

1.2 RELATED SECTIONS

A. The General Conditions and Division 1, General Requirements, as bound in the specification preamble, apply to all work under Division 22. Carefully note its contents in performance of the work.

B. The Architectural, Mechanical, Electrical, and Structural plans and Specifications, including Information to Bidders and other pertinent documents issued by the Engineer are a part of this Specifications and the accompanying mechanical plans. Comply with them in every respect. Examine all the above carefully. Failure to comply does not relieve the Contractor of responsibility nor may it be used as a basis for additional compensation due to omission of architectural, electrical and structural details from the mechanical drawings.

C. All electrical power wiring is specified under Division 26 of the Specifications. Mechanical Contractor shall furnish all motor starters required for the control and protection of all motors furnished for the Division 22.

D. All concrete pads and bases required for installing mechanical equipment are specified in another section of the Specifications. Advise the General Contractor as to the exact sizes

required, location of anchor bolts, etc.

E. Paint all mechanical equipment piping, supports and other exposed material. Do not paint equipment supplied with painted finish, such as the main mechanical equipment unless damaged during handling and installation. In such cases, use touch-up paint of the same type and color as original paint. Conform to requirements in other sections of the Specifications and match wall finish to the room in which installed.

1.3 CODES, FEES AND LATERAL COSTS

A. Comply with all applicable codes, specifications, local ordinances, industry standards, utility company regulations, and the applicable requirements of the following latest nationally accepted codes and standards:

1. Ochelata, Oklahoma City Building Code.
2. Oklahoma State Mechanical Code.
3. Oklahoma State Plumbing Code.
4. Oklahoma Energy Code.
5. IBC - International Building Code.
6. IFC - International Fire Code; latest accepted edition.
7. IGC - International Gas Code; latest accepted edition.
8. IPC - International Plumbing Code; latest accepted edition.
9. IMC - International Mechanical Code; latest accepted edition.
10. IECC - International Energy Conservation Code; latest accepted edition.
11. AMCA - Air Moving & Conditioning Association.
12. ASA - American Standards Association.
13. ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers.
14. ASME - American Society of Mechanical Engineers.
15. ASTM - American Society of Testing Materials.
16. AWWA - American Water Works Association.
17. NBS - National Bureau of Standards.
18. NEMA - National Electrical Manufacturers Association.
19. NFPA - National Fire Protection Association.

20. SMACNA - Sheet Metal & Air Conditioning Contractors' National Association.

21. UL - Underwriters' Laboratories, Inc.

22. AGA - American Gas Association.

23. OSHA - Occupational Safety and Hazard Association.

24. AABC - Associated Air Balance Councils.

25. NEBB - National Environmental Balancing Bureau.

B. Comply with State of Oklahoma adopted ADA Accessible Guidelines in regard to accessible or handicapped features.

C. In case of difference between building codes, Specifications, state Laws, local ordinances, industry standards and utility company regulations and the Contract Documents, the most stringent governs. Promptly notify the Engineer in writing of any such difference.

D. Remove any work installed that does not comply with the requirements of the applicable building codes, state laws, local ordinances, industry standards, or utility company regulations, correct the deficiencies, and reinstall all work at no cost to the Owner.

E. The mechanical drawings show the general arrangement of all piping, equipment and appurtenances. Follow as closely as actual building construction and the work of other trades will permit. Final layout will be governed by actual field conditions with all measurements verified at the site. Conform to the requirements shown on all of the drawings. General and structural drawings take precedence over mechanical drawings. Because of the small scale of the mechanical drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. Investigate the existing and finish conditions affecting the work and arrange the work accordingly, providing such fittings, valves and accessories as may be required to meet such conditions. Contractor shall verify that all equipment, ducts, pipes and all other components will fit in the space provided before fabrication or ordering.

F. Obtain any and all required permits in connection with this work under the Contract and pay any and all fees in connection therewith. Arrange with the serving utility companies for the connections to all utilities and pay all charges for same including inspection fees and meters if required. Refundable deposits will be paid by the Owner.

G. Mechanical Contractor shall provide and install, where applicable, seismic restraints for all piping and duct systems per the latest accepted Building Code.

1.4 GUARANTEE

A. Furnish a written certificate guaranteeing all materials, equipment and labor furnished to be free of all defects for a period of one (1) year from and after the date of final acceptance of the work by the Owner and further guarantee to replace such work without charges if any defects appear within the stipulated guaranty period.

1.5 SOIL CONDITIONS

A. The Specifications and the drawings in no way imply the conditions of the soil to be encountered. When excavating may be required in execution of the work, this Contractor agrees that he has informed himself regarding conditions affecting the work.

1.6 INSPECTION OF PREMISES

A. Before submitting a bid, visit the site of the proposed job and determine the conditions relating to this work.

1.7 UTILITIES, LOCATIONS AND ELEVATIONS

A. Locations and elevations of the various utilities included within the scope of this work have been obtained from substantially reliable sources and are offered as a general guide only, without guarantee as to accuracy. Verify the location and elevation of all utilities and their relation to the work before entering into a contract.

B. Identify outdoor underground lines with continuous strip of plastic utility marker tape at regular intervals (maximum of 10 feet) "Caution (state utility) pipe below". Install one foot directly above pipe before backfilling to grade.

1.8 EXISTING BUILDING AND EXISTING MECHANICAL EQUIPMENT

A. Visit the existing building and become thoroughly acquainted with the existing mechanical systems and utilities in order to determine all of the work that will be necessary to carry out the intent of the plans and specifications.

B. If it is necessary, in any way, to interfere with normal operations of the existing utilities in order to carry out the work, give notice and obtain written approval from the Owner before the work is started.

C. The work involved in this project requires the Contractor to work inside of an existing building. Interruption of the regular routine of the building by the Contractor must be kept to a minimum.

1.9 EQUIPMENT NOT SPECIFIED UNDER DIVISION 22

A. Equipment which requires plumbing and other mechanical connections may be specified in another division of this Specification. Under these conditions, provide necessary utilities including waste, water and natural gas.

B. Rough-in work from approved shop drawings only.

PART 2 PRODUCTS

2.1 EQUIPMENT AND MATERIALS

A. Provide new materials bearing the manufacturer's name, trade name and the UL label in every case where a standard has been established for the particular material. Furnish the standard

product of a manufacturer regularly engaged in the production of the required type of equipment. Provide the manufacturer's latest approved design.

B. Deliver equipment and materials to the site and store in original containers, suitably sheltered from the elements, but readily accessible for inspection by the Engineer until installed. Store all items subject to moisture damage (such as controls) in dry, heated spaces.

C. Provide equipment and materials of the same general type and of the same make throughout the work to provide uniform appearance, operation and maintenance.

D. Tightly cover equipment and protect against dirt, water and chemical or mechanical injury and theft. At the completion of the work, clean fixtures, equipment and materials and polish thoroughly. Turn over to the Owner in a condition satisfactory to the Engineer. Repair damage or defects developing before acceptance of the work at no expense to the Owner.

E. Insure that items to be furnished fit the space available. Make necessary field measurements to ascertain space requirements, including those for connections. Furnish and install such sizes and shapes of equipment that the final installation suits the true intent and meaning of the drawings and Specifications.

F. Follow manufacturer's directions completely in the delivery, storage, protection and installation of all equipment and materials. Promptly notify the Engineer in writing of any conflicts between any requirements of the Contract Documents and the manufacturers' directions. Obtain the Engineer's written instruction before proceeding with the work. Replace any work that does not comply with the manufacturers' directions or such written instructions from the Engineer, at no cost to the Owner.

G. Support all products by service organizations with adequate spare parts inventory and personnel located reasonably close to the site.

H. Where multiple units of the same type or class of products are required, provide all units of the same manufacturer.

2.2 EQUIPMENT ACCESSORIES

A. Furnish and install all equipment, accessories, connections and incidental items necessary to fully complete all work, ready for use, occupancy and operation by the Owner.

B. Where equipment requiring different arrangement or connections from those shown is provided, install the equipment to operate properly and in harmony with the intent of the drawings and Specifications.

C. Support, plumb, rigid and true to line, all work and equipment furnished. Study thoroughly all general, structural, electrical and mechanical drawings, shop drawings and catalog data to determine how equipment, fixtures, piping, ductwork, etc., are to be supported, mounted or suspended and provide extra steel bolts, inserts, pipe stands, brackets and accessories for proper supports whether or not shown on the drawings. When directed, submit drawings showing supports.

D. If accessories are required to complete the work and meet the intent of the specification, it is the responsibility of the Contractor to provide such accessories.

2.3 MATERIAL AND EQUIPMENT SCHEDULE

A. Submit to the Engineer as soon as practical, six (6) complete sets of the schedule of materials and equipment proposed for the installation, or electronic submittals as detailed below. Include manufacturers' names, catalog data, diagrams, drawings and other descriptive data and submit under one cover with an index sheet in front.

1. If Electronic files are submitted, a complete set of the schedule of materials and equipment proposed for the installation shall be included. Include manufacturers' names, catalog data, diagrams, drawings and other descriptive data. All information shall be submitted electronically in "pdf" format, and shall be separated into electronic "pdf" files according to the corresponding specification section (i.e. "22 10 06 - Plumbing Specialties.pdf"). Unless incomplete submittals are authorized by the project engineer, all Division 22 submittals shall be electronically sent at one time. Without authorization, incomplete submittals shall be rejected.

B. Provide written certification that shop drawings are in accordance with the specifications and are dimensionally correct with reference to available space.

C. All submittals will be reviewed a maximum of two (2) times. The cost of additional submittal reviews beyond those two specified will be charged to the Contractor.

D. Shop drawings for the Engineer's files are required on the following items:

1. Plumbing fixtures and floor sinks.

2. Water balance certification.

3. Piping materials including valves.

4. Piping insulation materials.

5. Complete mechanical equipment electrical data and wiring details.

2.4 EQUIPMENT AND MATERIAL SUBSTITUTIONS

A. It is the responsibility of the Contractor to investigate any desired substitutions for specified equipment prior to submission of his bid. The Mechanical Contractor shall be responsible for any changes required in mechanical, electrical, structural or vibration isolation systems and shall bear all cost for those changes whether the substitute equipment is named by manufacturer in the specifications or is submitted to the Architect for "or equal" consideration. All changes shall be accomplished in a manner acceptable to the Architect per Section 01 60 00 at no additional cost to the Owner.

B. In order to obtain prior approval on equipment or material not specified in Division 22 Specifications or Equipment Schedules, Mechanical Contractor MUST submit to the Engineer

any proposed equipment or material ten (10) working days prior to the bid date.

C. If ANY substitute equipment is submitted to Engineer for approval, without said equipment having been pre-approved, the entire submittal will be rejected for resubmittal.

D. Any equipment manufacturers which are a subsidiary to the listed acceptable manufacturers are not considered equal. Therefore, it is the responsibility of the Contractor and equipment supplier to obtain prior approval as described in paragraph 2.4, this Section.

PART 3 EXECUTION

3.1 COORDINATION OF WORK

A. Compare the mechanical drawings and Specifications with the drawings and Specifications for other trades and report any discrepancies between them to the Engineer and obtain from him written instruction for changes necessary in the mechanical work. Install the mechanical work in cooperation with other trades installing inter-related work. Before installation, make proper provisions to avoid interferences in a manner approved by the Engineer. Make all changes required in the work caused either by neglect or existing field conditions at no cost to the Owner.

B. It is the responsibility of the General Contractor, Mechanical Contractor, Electrical Contractor and Sprinkler Contractor to coordinate installation of all equipment. Equipment installed prior to proper coordination, which interferes with the harmony and intent of the specifications and drawings, will be removed and reinstalled at the cost of the responsible Contractor.

C. Furnish anchor bolts, sleeves, inserts and supports required for the mechanical work. Locate anchor bolts, sleeves, inserts and supports as directed by the trade requiring them and insure that they are properly installed.

D. Adjust locations of pipes, ducts, equipment fixtures, etc., to accommodate the work and for interferences anticipated and encountered. Determine the exact route and location of each pipe and duct prior to fabrication.

1. New work and remodeled areas are to interface with existing facility services. Contractor to familiarize himself with the extent of the work prior to submitting his bid. Failure to gain familiarity will not be grounds for additional compensation.

2. Provide right-of-way to lines that pitch over those that do not pitch. For example, Plumbing drains normally have right-of-way. Lines whose elevations cannot be changed have the right-of-way over lines whose elevations can be changed.

3. Make offsets, transitions and changes in direction in pipes and ducts as required to maintain proper head room and pitch.

E. Install all mechanical work to permit removal without damage to other parts, to coils, fan shafts and wheels, filters, belt guards, sheaves and drives and all other parts requiring periodic replacement or maintenance. Arrange pipes, ducts and equipment to permit ready access to valves, cocks, traps, starters, motors, control components and to clear the openings of

swinging and overhead doors and of access panels.

3.2 CHLORINATION OF DOMESTIC WATER LINES

A. After the hot and cold water systems are complete, all fixtures connected, the system flushed out completely and the shut-off valve to the water main closed, fill the system with a solution containing 50 parts per million of available chlorine. Allow the solution to stand six (6) hours before flushing and returning to service.

B. Then fill the system with a solution containing 100 parts per million of available chlorine. Allow this solution to stand two (2) hours before flushing and returning to service.

C. Notify the Owner twenty-four hours prior to test so his representative can witness test. Obtain chemical analysis of the domestic water lines after chlorination from a Certified Chemist and submit the results of these tests to the Engineer and Owner.

3.3 RECORD DRAWINGS

A. Maintain record drawings showing exact locations and sizes, as actually installed, of piping, drains, cleanouts, ductwork, controls and equipment as specified herein. Deliver to the Owner/Architect upon completion and acceptance of the work, one (1) complete set of contract drawings marked to indicate all deviations from intended installation.

3.4 CUTTING AND PATCHING

A. The General Contractor shall be responsible for all required Building cutting, patching, etc., incidental to this work and shall make all required repairs thereafter to the satisfaction of the Engineer. Do not cut into any major structural element, beam or column without the written approval of the Engineer.

B. The General Contractor shall cut, patch, repair and/or replace pavements, sidewalks, roads and curbs as required to permit the installation of the plumbing work and pay all expenses incurred for this work.

C. Openings in fire or smoke barriers for air handling ductwork or air movement shall be protected in accordance with NFPA 90A and 90B and the Standard Mechanical Code.

D. Pipes, conduits, cables, wires, air ducts, pneumatic tubes and ducts and similar handling service equipment that pass through fire or smoke barriers shall be protected in accordance with NFPA 101 by the plumbing contractor.

E. All fire stopping assemblies must be UL approved assemblies.

3.5 EXCAVATION AND TRENCHING FOR PIPING

A. Excavate to the depths indicated on the Drawings or as required to provide adequate slope and burial depth. Excavated materials not required or suitable for backfill or fill shall be removed from the site. Do such grading as is necessary to prevent surface water from flowing into trenches or other excavations. Water accumulating therein shall be removed by pumping or

by other method. Sheeting and shoring shall be installed as may be necessary for protection of the work and for safety of personnel. Excavation shall be by open cut except that short sections of a trench may be tunneled if the pipe can be safely and properly installed and backfill can be properly tamped in such tunnel sections.

B. Trench Excavation: Grade bottom of trenches to provide uniform bearing and support for each section of pipe on undisturbed soil. Where rock is encountered excavate to a minimum overdepth of 4" below trench depths indicated on the Drawings or specified. Overdepth in rock excavation and unauthorized overdepths shall be backfilled. Whenever wet or otherwise unstable soil incapable of properly supporting the pipe is encountered such soil shall be removed and the trench backfilled to proper grade as hereinafter specified.

C. Depth of Cover: Trenches shall be of depth that will provide three feet (3') minimum cover for domestic water, fire lines, sanitary and storm sewers from existing grade or from indicated finish grade, whichever is lower, unless otherwise specifically shown.

D. Utilities Locating: Locate existing utility lines prior to beginning any excavation

E. Protection of Existing Utilities: Existing utility lines to be retained that are shown on the Drawings or the locations of which are made known to the Contractor prior to excavation, as well as all utility lines uncovered during excavation operations, shall be protected from damage during excavation and backfilling, and if damaged, shall be repaired by the Contractor, at his expense.

F. Trenches shall not be backfilled until required pressure and other tests have been performed and until the utilities systems as installed conform to requirements of Drawings and Specifications.

G. Backfill trenches with excavated materials consisting of earth, sandy clay, sand, gravel, soft shale or other approved materials, free from clods of earth or stones 2-1/2" maximum dimension, deposited in 6" layers and compacted to 95% Standard Proctor Compaction Test of the maximum laboratory density determined in accordance with ASTM D698, Moisture-Density Relation of Soils. If fills fail to meet the specified densities, the Contractor shall remove and re-compact the fill until specified densities are achieved. Compaction test shall be performed for each fifty linear feet of trench.

H. Provide a 4-inch thick (minimum) layer of 3/4-inch No. 4 gravel aggregate bedding beneath all buried piping. Bedding shall be compacted and leveled to provide sloping required.

I. Tests for displacement of sewers: After the trench has been backfilled to 2 feet or more above the pipe, if the pipe shows poor alignment, displaced pipe, or any other defects, such defects shall be remedied by the Contractor at his expense.

3.6 EQUIPMENT START-UP AND TESTING

A. Instruct the Owner's operating personnel during start-up and separate operating tests of each major item of equipment. During the operating tests, prove the operation of each item of equipment to the satisfaction of the Engineer. Give at least seven (7) days notice to the

Engineer of equipment start-up and operating tests.

3.7 CATALOG DATA FOR OWNER

A. Provide, in looseleaf binders, two (2) sets of a compilation of catalog data of each manufactured item of equipment used in the mechanical work and present this compilation to the Owner/Architect for transmittal to the Owner before final payment is made. Include descriptive data and printed installation, operating and maintenance instructions for each item of equipment. Provide a complete double index as follows:

1. Listing of products alphabetically by name.

2. Listing the names of manufacturers whose products have been incorporated in the work alphabetically together with their addresses and the names and addresses of the local sales representatives.

3. Certificates of Final Inspections.

4. Complete spare parts data with current prices and supply sources.

5. Extended warranties.

B. Deliver to the Owner all special tools, lubricants, extra materials and any other products necessary for the proper operation and maintenance of the mechanical and plumbing systems.

C. Provide project record documents indicating all changes from contract documents made during construction.

D. Submit all Certificates of Final Inspections from the Administrative Authorities.

E. Submit TAB reports on approved forms. Final TAB report submittals shall include all required rebalances if any are required.

F. Submit to the Engineer as soon as practical, electronic closeout documents as detailed below.

1. Include manufacturers' names, catalog data, diagrams, drawings and other descriptive data and submit under one cover with an index sheet in front.All information shall be submitted electronically in "pdf" format, and shall be separated into electronic "pdf" files.

3.8 INSTRUCTION OF OWNER'S REPRESENTATIVE

A. Instruct the representative of the Owner in the proper operation and maintenance of all elements of the mechanical system.

3.9 PROTECTIVE COATINGS

A. Paint exterior surfaces of steel piping run in or through concrete floor fill, under tile floors or underground, and aluminum surfaces in contact with masonry, with one coat of acid resisting bituminous base paint.

3.10 TEST AND ACCEPTANCE

A. Water Piping System: Test with water at 100 psi for one (1) hour or with available city water pressure for twenty-four (24) hours to prove tight and free from leaks.

B. Plumbing and Drainage System: Test the new system humidity and drain piping with water and prove tight. Test system with 10 feet of water for 24 hour period. Air test is not permitted.

3.11 NOISE CONTROL

A. It is intended that the mechanical systems as installed under this contract be free from objectionable noise when the system is operating. The system shall operate at noise levels below criteria recommended for the application by ASHRAE. Provide vibration isolation accessories and isolate equipment, pipeline, ductwork, etc., as required so as to insure an acceptable noise level in all of the mechanical systems.

3.12 CLEANING AND ADJUSTING

A. Do not allow waste material and rubbish to accumulate in or above the premises. After completion of this work, remove rubbish, tools, scaffolding and surplus materials from and about the building and leave all work clean and ready for use. Clean all equipment, pipes, valves and fittings of grease, metal cuttings and sludge. Repair any stoppage, discoloration or other damage to parts of the building, its finish or furnishings due to failure to properly clean the mechanical systems, without additional cost to the Owner. Adjust all automatic control devices for proper operation.

3.13 SYSTEM OPERATING TESTS

A. After the successful completion of all equipment start-up and test requirements, perform the following tests on the complete mechanical systems:

1. First Operating Test by Contractor: Prove the operation of the mechanical systems and of each individual item in the systems. Give at least 10 days prior notice to the Engineer of such tests. Adjust and set proper quantities to all items and equipment. Should any item of the systems fail to perform in an approved manner, repeat this test until approved by the Engineer. During this test, balance circulation of heating and cooling water to balancing cocks, valves, thermostats and similar Items to insure that the mechanical systems perform as intended.

2. Checking by Owner and Engineer: Following the successful completion of first operating tests by the Contractor, the Owner and the Engineer have the privilege of making such tests as they may desire during a period of three weeks to ascertain in detail if any corrections are to be made to the system. At the end of the testing by the Owner and the Engineer, the Engineer may direct the Contractor in writing to make such corrections to the systems as are within the scope of the contract.

3. Contractor's Corrections to Systems: Make all required corrections to the systems and notify the Engineer in wiring that the corrections outlined have been completed. Give at

least seven (7) days notice of a final three-day operating test.

4. Three-Day Operating Test: Perform an operating test to the satisfaction of the Engineer for a period of three (3) days. Should any element of the systems not perform properly, make all required corrections and repeat the test until successfully performed.

    a. Submit the Form of Record proposed by the Contractor for the recording of all measurements to the Engineer for approval at least two weeks before the approved form will be required by the Contractor.

    b. Measurements: Make the following measurements at two-hour intervals (5 measurements per 8-hour day) during the three-day operating test.

        1. Electrical: Running amperes and voltage of each motor 3/4 horsepower or larger.

        2. Air temperatures in each heated or air conditioned space and outdoor temperatures.

    c. Instruments: Provide all instruments, materials and labor to perform the tests and to obtain and record the measurements specified herein, including the furnishing of all required record forms as approved by the Engineer. Submit for the Engineer's approval, complete shop drawings or catalog data for all instruments to be used for the three day operating test and obtain approval at least two weeks before the instruments will be required for test measurements.

    d. Report: Submit four (4) copies of a written report of the three-day operating test on the approved Form of Record to the Engineer for approval and subsequent transmittal to the Owner.

3.14 ACCESS PANELS

A. Provide access panels as required in all walls, ceilings and ductwork to service and have access to all valves, and other operating parts. For all ceiling and wall access doors that are required in gypsum board and plaster, provide minimum 24" x 24", unless due to structural restraints the access door can be reduced to a minimum of 18" x18", Milcor type appropriate for the construction involved.

3.15 DEMOLITION

A. There are areas in the existing building in which demolition will have to be performed due to the requirements for remodeling. The demolition work involved is not fully described herein; however, the information given on the electrical and mechanical drawings and the information set out in the specifications will substantially serve to inform the mechanical Contractor as to the full extent of the demolition required.

B. Contractor should visit job site to verify extent of demolition required to complete project.

C. It is the intent of this Specification that all required demolition work be fully and completely performed and all work be accomplished in a neat and workmanlike manner.

D. Remove all existing piping, fittings, heating, cooling, ventilation equipment that is required to accomplish the remodel work. All existing utilities that are disconnected shall be capped recessed in walls and floors. Contractor shall be responsible for visiting building and determining the extent of the demolition work. Contractor shall provide any necessary temporary piping required to keep existing building utilities (water, gas and sewer) in operation until new construction is completed to the extent that the new utilities can be reconnected.

E. All rubbish, debris and expendable items resulting from demolition work shall be removed from the premises as it accumulates and disposed of at an off-site location by the Contractor.

3.16 SALVAGE

A. Except as otherwise specified herein, or noted on drawings, the Contractor shall receive title to all building materials indicated to be demolished or removed which are not specifically designated as being retained by the Owner, said title to vest in the Contractor immediately upon receipt of Work Order. All salvage materials removed shall be taken from the premises promptly, as the storage of salvage materials on the site will not be permitted. Bidders shall take into account the salvage value to them of materials removed and such value shall be reflected in the bids.

B. All items of usable equipment shall remain the property of the Owner. All such items of equipment which are to be removed and which are not to be reused shall be stored on the premises by the Contractor as directed by the Owner.

C. Usable items shall be determined by the Owner and shall include existing heating and cooling pumps and other equipment so designated as "usable" by the Owner.

3.17 FINALLY

A. It is the intention that this specification shall provide a complete installation except as herein before specifically excepted. All accessory construction and apparatus necessary or advantageous in the operation and testing of the work shall be included. The omission of specific reference to any part of the work necessary for such complete installation shall not be interpreted as relieving this Contractor from furnishing and installing such parts.

END OF SECTION

SECTION 22 05 53

IDENTIFICATION FOR PLUMBING PIPING & EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Pipe Markers.

D. Ceiling tacks.

1.2 REFERENCE STANDARDS

A. ASME A13.1 - Scheme for the Identification of Piping Systems; The American Society of Mechanical Engineers; 2007.

B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2013.

1.3 SUBMITTALS

A. See Section 22 01 00 - General Plumbing Provisions for submittal procedures.

B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.

C. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number. Valve locations with tag numbers shall also be indicated on "as-built" drawings.

D. Product Data: Provide manufacturers catalog literature for each product required.

E. Manufacturer's Installation Instructions: Indicate special procedures, and installation.

F. Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS

2.1 PLUMBING COMPONENT IDENTIFICATION GUIDELINE

A. Pipe Markers: 3/4 inch diameter and higher.

2.2 IDENTIFICATION APPLICATIONS

A. Instrumentation: Tags.

B. Piping: Pipe markers.

C. Valves: Tags and ceiling tacks where located above lay-in ceiling.

2.3 NAMEPLATES

A. Manufacturers:

1. Kolbi Pipe Marker Co.

2. Seton Identification Products.

3. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

B. Description: Laminated three-layer plastic with engraved letters.

1. Letter Color: White.

2. Letter Height: 1/4 inch.

3. Background Color: Black.

4. Plastic: Conform to ASTM D709.

2.4 TAGS

A. Manufacturers:

1. Advanced Graphic Engraving.

2. Brady Corporation.

3. Kolbi Pipe Marker Co.

4. Seton Identification Products.

5. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

B. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter.

C. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.

D. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame. Valve tag chart should should indicate valve size, valve model and valve location. Valve locations with tag numbers shall also be indicated on "as-built" drawings.

2.5 PIPE MARKERS

A. Manufacturers:

1. Brady Corporation.

2. Kolbi Pipe Marker Co.

3. MIFAB, Inc.

4. Seton Identification Products.

5. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

B. Comply with ASME A13.1.

C. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

D. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

E. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

F. Color code as follows:

1. Potable, Cooling, Boiler, Feed, Other Water: Green with white letters.

2. Fire Quenching Fluids: Red with white letters.

3. Combustible Fluids: Brown with white letters.

2.6 CEILING TACKS

A. Manufacturers:

1. Craftmark.

2. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

B. Description: Steel with 3/4 inch diameter color coded head.

C. Color code as follows:

1. Plumbing Valves: Green.

PART 3 EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

A. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Install tags with corrosion resistant chain.

C. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

D. Install metallic detection tape located approximately 12 inches above pipe, where in ground utility lines are buried outside building footprint. Tape shall be continuous and be marked, indicating utility type (ie. water, sewer, gas, electric, etc).

E. Use tags on piping 3/4 inch diameter and smaller.

1. Identify service, flow direction, and pressure.

2. Install in clear view and align with axis of piping.

3. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

F. Locate ceiling tacks to locate valves above lay-in panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION

SECTION 22 07 19

PIPING INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Flexible elastomeric cellular insulation.

B. Piping insulation.

C. Jackets and accessories.

1.2 RELATED REQUIREMENTS

A. Section 22 10 05 - Plumbing Piping: Placement of hangers and hanger inserts.

1.3 REFERENCE STANDARDS

A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.

C. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019, with Editorial Revision (2023).

D. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2019).

E. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement; 2007 (Reapproved 2019).

F. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.

G. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation; 2017 (Reapproved 2023).

H. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2023.

I. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2013).

J. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2023.

K. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association; 2006.

1.4 SUBMITTALS

A. See Section 22 01 00 - General Plumbing Provisions, for submittal procedures.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than five years of documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum five years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

B. Deliver material to job site in original non-broken factory packaging, labeled with manufacturer's density and thickness.

1.7 FIELD CONDITIONS

A. Maintain ambient conditions required by manufacturers of each product.

B. Maintain temperature before, during, and after installation for minimum of 24 hours.

C. Perform work at ambient and equipment temperature as recommended by the adhesive manufacturer.

PART 2 PRODUCTS

2.1 REQUIREMENTS FOR ALL PRODUCTS OF THIS SECTION

A. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84, NFPA 255, or UL 723.

2.2 GLASS FIBER

A. Manufacturers:

1. Knauf Insulation.

2. Johns Manville Corporation.

3. Owens Corning Corp.

4. CertainTeed Corporation.

5. Armstrong World Industries, Inc.

6. Rubatex Corp.

7. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

B. Insulation: ASTM C547 ; semi-rigid, noncombustible, end grain adhered to jacket.

1. 'K' value: ASTM C177, 0.24 at 75 degrees F.

2. Maximum service temperature: 650 degrees F.

3. Maximum moisture absorption: 0.2 percent by volume.

C. Vapor Barrier Jacket: White Kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches.

D. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

E. Vapor Barrier Lap Adhesive:

1. Compatible with insulation.

F. Insulating Cement/Mastic:

1. ASTM C195; hydraulic setting on mineral wool.

G. Fibrous Glass Fabric:

1. Cloth: Untreated; 9 oz/sq yd weight.

2. Blanket: 1.0 lb/cu ft density.

3. Weave: 5x5.

H. Indoor Vapor Barrier Finish:

1. Cloth: Untreated; 9 oz/sq yd weight.

2. Vinyl emulsion type acrylic, compatible with insulation, white color.

I. Outdoor Vapor Barrier Mastic:

1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

J. Outdoor Breather Mastic:

1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

K. Insulating Cement:

1. ASTM C449/C449M.

2.3 CELLULAR GLASS

A. Manufacturers:

1. Pittsburgh Corning Corporation.

2. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

B. Insulation: ASTM C 552.

1. 'K' value: 0.37 at 100 degrees F.

2. Service Temperature: Up to 900 degrees F.

3. Water Vapor Permeability: 0.005 perm inch.

4. Water Absorption: 0.2 percent by volume, maximum.

2.4 HYDROUS CALCIUM SILICATE

A. Manufacturers:

1. Johns Manville Corporation.

2. PABCO.

3. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

B. Insulation: ASTM C533 and ASTM C795; rigid molded, asbestos free, gold color.

1. 'K' value: 2 and C518; 0.40 at 300 degrees F, when tested in accordance with 2 or 1.

C. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

D. Insulating Cement:

1. ASTM C449/C449M.

2.5 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Manufacturer:

1. Armacell International.

2. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534 Grade 2; use molded tubular material wherever possible.

1. 'K' value: ASTM C 177; 0.27 at 75 degrees F.

2. Maximum Moisture Absorption - Pipe Insulation: 3.5 percent, by weight, when tested in accordance with ASTM D 1056.

3. Maximum Moisture Absorption - Sheets: 6.0 percent, by weight, when tested in accordance with ASTM D 1056.

4. Water Vapor Permeability: 0.20 perm-inches, when tested in accordance with ASTM E 96.

C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

1. Air dried, contact adhesive, compatible with insulation.

2.6 JACKETS

A. PVC Plastic.

1. Manufacturers:

a. Johns Manville Corporation.

b. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

2. Jacket: One piece molded type fitting covers and sheet material, off-white color.

a. Minimum Service Temperature: 0 degrees F.

b. Maximum Service Temperature: 150 degrees F.

c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.

d. Thickness: 15 mil.

e. Connections: Pressure sensitive color matching vinyl tape.

3. Covering Adhesive Mastic:

a. Compatible with insulation.

B. Canvas Jacket: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire retardant lagging adhesive.

1. Lagging Adhesive:

a. Compatible with insulation.

C. Aluminum Jacket: ASTM B209 (ASTM B209M) formed aluminum sheet.

1. Thickness: 0.016 inch sheet.

2. Finish: Embossed.

3. Joining: Longitudinal slip joints and 2 inch laps.

4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.

5. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that piping has been tested before applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

C. Repair all insulation that is damaged during construction using the same materials.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. Exposed Piping: Locate insulation and cover seams in least visible locations.

D. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints.

E. Glass fiber insulated pipes conveying fluids below ambient temperature:

1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.

2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.

F. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

G. Inserts and Shields:

1. Application: Piping 1 inch diameter or larger.

2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.

3. Insert location: Between support shield and piping and under the finish jacket.

4. Insert configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.

5. Insert material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

H. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions.

I. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces: Finish with PVC jacket and fitting covers.

J. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with PVC jacket and fitting covers.

K. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

L. Buried Piping: Provide factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with one mil thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.

3.3 SCHEDULES

A. Plumbing Systems:

1. Domestic Hot Water Supply:

a. Glass Fiber Insulation:

1. Pipe Size Range: 2 inch and under: 1 inch thickness.

2. Pipe Size Range: 2-1/2 inch and larger: 1-1/2 inch thickness.

3. Thickness: 1/2 inch (in interior walls).

2. Domestic Cold Water Supply:

a. Glass Fiber Insulation:

1. Pipe Size Range: 2 inch and under: 1 inch thickness.

2. Pipe Size Range: 2-1/2 inch and larger: 1 inch thickness.

3. Thickness: 1/2 inch (in interior walls).

3. Sanitary Piping Above Ceilings:

    a. Glass Fiber Insulation:

        1. Pipe Size Range: all sizes.

        2. Thickness: 1 inch.

B. Cooling Systems:

1. Condensate Drains from Cooling Coils: 1/2 inch thickness; cellular insulation.

2. Refrigerant Suction: 3/4 inch thickness; cellular insulation.

3. Refrigerant Hot Gas: 3/4 inch thickness; cellular insulation.

END OF SECTION

SECTION 22 10 05

PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pipe, pipe fittings, valves, and connections for piping systems.

1. Sanitary sewer.
2. Domestic water.
3. Gas.
4. Flanges, unions, and couplings.
5. Valves.
6. Flow controls.
7. Check.
8. Water pressure reducing valves.
9. Relief valves.
10. Strainers.

1.2 RELATED REQUIREMENTS

A. Section 22 01 00 - General Plumbing Provisions.

B. Section 22 05 53 - Identification for Plumbing Piping & Equipment.

C. Section 22 07 19 - Piping Insulation.

1.3 REFERENCE STANDARDS

A. ANSI Z21.22 - American National Standard for Relief Valves for Hot Water Supply Systems; 2015 (Reaffirmed 2020).

B. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2021.

C. ASME B16.4 - Gray Iron Threaded Fittings: Classes 125 and 250; 2021.

D. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.

E. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes; 2018.

F. ASME B31.9 - Building Services Piping; 2020.

G. ASME BPVC-IV - Boiler and Pressure Vessel Code, Section IV - Rules for Construction of Heating Boilers; 2023.

H. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.

I. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings; 2021.

J. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2023a.

K. ASTM B32 - Standard Specification for Solder Metal; 2020.

L. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes; 2020.

M. ASTM B68/B68M - Standard Specification for Seamless Copper Tube, Bright Annealed; 2019.

N. ASTM C4 - Standard Specification for Clay Drain Tile and Perforated Clay Drain Tile; 2004 (Reapproved 2014).

O. ASTM C14 - Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe; 2015.

P. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings; 2020a.

Q. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications; latest accepted edition.

R. ASTM D2513 - Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings; 2020.

S. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems; 2020.

T. ASTM D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings; 2020.

U. ASTM D2680 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping; 2020.

V. ASTM D2683 - Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing; 2020.

W. ASTM D2846/D2846M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems; 2019a.

X. ASTM D2855 - Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and

Piping Components with Tapered Sockets; 2020.

Y. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2023.

Z. ASTM D3517 - Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pressure Pipe; 2019.

AA. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers; 1992 (Reapproved 2008).

BB. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; 2018.

CC. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings; 2021.

DD. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast; 2023.

EE. AWWA C901 - Polyethylene (PE) Pressure Pipe and Tubing, 3/4 In. (19 mm) Through 3 In. (76 mm), for Water Service; 2020.

FF. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2021.

GG. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2020.

HH. MSS SP-67 - Butterfly Valves; 2022.

II. MSS SP-71 - Gray Iron Swing Check Valves, Flanged and Threaded Ends; 2018.

JJ. MSS SP-78 - Gray Iron Plug Valves, Flanged and Threaded Ends; 2011.

KK. MSS SP-80 - Bronze Gate, Globe, Angle, and Check Valves; 2019.

LL. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010, with Errata .

MM. NFPA 54 - National Fuel Gas Code; National Fire Protection Association; 2012.

1.4 SUBMITTALS

A. See Section 22 01 00 - General Plumbing Provisions, for submittal procedures.

B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

C. Project Record Documents: Record actual locations of valves.

1.5 QUALITY ASSURANCE

A. Perform work in accordance with applicable codes.

B. Perform Work in accordance with Oklahoma, city of Ochelata, Oklahoma standards.

C. Valves: Manufacturer's name and pressure rating marked on valve body.

D. Welding Materials and Procedures: Conform to ASME (BPV IX) and applicable state labor regulations.

E. Welder Qualifications: Certified in accordance with ASME (BPV IX).

F. Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

1.6 REGULATORY REQUIREMENTS

A. Perform Work in accordance with State of Oklahoma, and city of Ochelata plumbing code.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.8 FIELD CONDITIONS

A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.1 SANITARY SEWER PIPING, ABOVE GRADE

A. Cast Iron Pipe: ASTM A74, service weight.

1. Fittings: Cast iron.

2. Joint Seals: ASTM C 564 neoprene gaskets.

B. Cast Iron Pipe: CISPI 301, hubless, service weight.

1. Fittings: Cast iron.

2. Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.

C. PVC Pipe: ASTM D2665.

1. Fittings: PVC.

2. Joints: Solvent welded, with ASTM D2564 solvent cement.

D. In Fire-rated Walls:

1. Cast iron.

a. Fittings: Cast iron.

E. In Plenum-rated Areas:

1. Cast iron.

a. Fittings: Cast iron.

2.2 WATER PIPING, ABOVE GRADE

A. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), Drawn (H).

1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.

2. Joints: ASTM B32, alloy Sn95 solder or mechanical press-fit couplings.

2.3 NATURAL GAS PIPING, BURIED BEYOND 5 FEET OF BUILDING

A. Steel Pipe: ASTM A53/A53M Schedule 40 black.

1. Fittings: ASTM A234/A234M, wrought steel welding type, with AWWA C105/A21.5 polyethylene jacket or double layer, half-lapped 10 mil polyethylene tape.

2. Joints: ASME B31.1, welded.

B. Polyethylene Pipe: ASTM D2513, SDR 11.

1. Fittings: ASTM D2683 or ASTM D2513 socket type.

2. Joints: Fusion welded.

2.4 NATURAL GAS PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Steel Pipe: ASTM A53/A53M Schedule 40 black.

1. Fittings: ASTM A 234/A 234M, forged steel welding type.

2. Joints: ASME B31.1, welded.

3. Jacket: AWWA C105/A21.5 polyethylene jacket or double layer, half-lapped 10 mil polyethylene tape.

2.5 NATURAL GAS PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53/A53M Schedule 40 black.

1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M, wrought steel welding type.

2. Fittings: ASME B16.3, malleable iron, or ASTM A 234/A 234M, forged steel welding type.

3. Joints: NFPA 54, threaded or welded to ASME B31.1.

2.6 FLANGES, UNIONS, AND COUPLINGS

A. Unions for Pipe Sizes 3 Inches and Under:

1. Ferrous pipe: Class 150 malleable iron threaded unions.

2. Copper tube and pipe: Class 150 bronze unions with soldered joints.

B. Flanges for Pipe Size Over 1 Inch:

1. Ferrous pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.

2. Copper tube and pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.

C. Grooved and Shouldered Pipe End Couplings:

1. Housing: Malleable iron clamps to engage and lock, designed to permit some angular deflection, contraction, and expansion; steel bolts, nuts, and washers; galvanized for galvanized pipe.

2. Sealing gasket: "C" shape composition sealing gasket.

D. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.7 MECHANICALLY FORMED TEE FITTINGS

A. Mechanically extracted outlets shall have a height not less than three times the thickness of the branch tube wall.

B. Branch tubes shall not restrict the flow in the main tube. Mechanical Contractor shall insure the branch tube penetration into the collar is of the correct depth.

C. Mechanically formed tee fittings shall be cleaned and brazed with filler material conforming to AWS A5.8.

2.8 PRESS FITTINGS

A. Fittings shall comply with NSF 61, CSA, UPC and be approved by the local jurisdiction. Wrot copper press fittings shall be made from commercially pure copper mill products per ASTM B 75 Alloy C12200. Cast copper alloy press fittings shall be made from materials with a minimum of 78% copper and a maximum of 15% zinc. The press fittings connections shall

be compatible with seamless K, L or M copper tube made to ASTM B 88. Fittings shall have a maximum non-shock working pressure of 200 PSI between the temperatures of -20°F and +250°F. Elastomeric seals shall be made of EPDM material, and the fittings shall be manufactured with an inboard bead design. All fittings shall be installed in accordance with the manufacturer's installation instructions and according to local plumbing and mechanical codes. The press-to-connect joint shall be made with pressing tools and jaw sets recommended and authorized by press fitting manufacturer.

2.9 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with MSS SP-58.

B. Plumbing Piping - Drain, Waste, and Vent:

1. Conform to ASME B31.9.

2. Hangers for Pipe Sizes 1/2 Inch to 1-1/2 Inches: Carbon steel, adjustable swivel, split ring.

3. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.

4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

5. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.

6. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.

7. Vertical Support: Steel riser clamp.

8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

9. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

C. Plumbing Piping - Water:

1. Conform to ASME B31.9.

2. Hangers for Pipe Sizes 1/2 Inch to 1-1/2 Inches: Carbon steel, adjustable swivel, split ring.

3. Hangers for Cold Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.

4. Hangers for Hot Pipe Sizes 2 Inches to 4 Inches: Carbon steel, adjustable, clevis.

5. Hangers for Hot Pipe Sizes 6 Inches and Over: Adjustable steel yoke, cast iron pipe roll, double hanger.

6. Multiple or Trapeze Hangers: Steel channels with welded supports or spacers and hanger rods.

7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 Inches and Over: Steel channels with welded supports or spacers and hanger rods, cast iron roll.

8. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.

9. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.

10. Vertical Support: Steel riser clamp.

11. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

12. Floor Support for Hot Pipe Sizes to 4 Inches: Cast iron adjustable pipe saddle, locknut, nipple, floor flange, and concrete pier or steel support.

13. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

2.10 GATE VALVES

A. Manufacturers:

1. Conbraco Industries.

2. Nibco, Inc.

3. Milwaukee Valve Company.

4. Crane Co.

5. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

B. Up To and Including 2 1/2 Inches:

1. MSS SP-80, Class 125, bronze body, bronze trim, rising stem, handwheel, inside screw, solid wedge disc, solder or threaded ends.

C. 3 Inches and Larger:

1. MSS SP-70, Class 125, iron body, bronze trim, outside screw and yoke, handwheel, solid wedge disc, flanged ends. Provide chain wheel operators for valves 6 inches and larger mounted over 8 feet above floor.

2.11 GLOBE VALVES

A. Manufacturers:

1. Conbraco Industries.

2. Nibco, Inc.

3. Milwaukee Valve Company.

4. Crane Co.

5. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

B. Up To and Including 2 1/2 Inches:

1. MSS SP-80, Class 125, bronze body, bronze trim, handwheel, bronze disc, solder or threaded ends.

C. 3 Inches and Larger:

1. MSS SP-85, Class 125, iron body, bronze trim, handwheel, outside screw and yoke, renewable bronze plug-type disc, renewable seat, flanged ends. Provide chain-wheel operators for valves 6 inches and larger mounted over 8 feet above floor.

2.12 BALL VALVES

A. Manufacturers:

1. Conbraco Industries.

2. Nibco, Inc.

3. Milwaukee Valve Company.

4. Crane Co.

B. Construction, 4 Inches and Smaller: MSS SP-110, Class 150, 400 psi CWP, bronze, two piece body, chrome plated brass ball, regular port, teflon seats and stuffing box ring, blow-out proof stem, lever handle, threaded ends with union.

2.13 PLUG VALVES

A. Manufacturers:

1. Conbraco Industries.

2. Nibco, Inc.

3. Milwaukee Valve Company.

4. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

B. Construction 2-1/2 Inches and Larger: 1, 250 psi CWP, cast iron body and plug, pressure lubricated, teflon or Buna N packing, flanged or grooved ends. Provide lever operator with set screw.

2.14 BUTTERFLY VALVES

A. Manufacturers:

1. Hammond Valve.

2. Crane Co.

3. Milwaukee Valve Company.

4. Stockham.

5. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

B. Construction 1-1/2 Inches and Larger: MSS SP-67, 200 psi CWP, cast or ductile iron body, elastomer coated ductile iron disc, resilient replaceable EPDM seat, wafer ends, extended neck, 10 position lever handle.

C. Provide gear operators for valves 6 inches and larger, and chain-wheel operators for valves mounted over 8 feet above floor.

2.15 FLOW CONTROLS

A. Manufacturers:

1. ITT Bell & Gossett.

2. Griswold Controls.

3. Taco, Inc.

4. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

B. Construction: Class 125, Brass or bronze body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet , blowdown/backflush drain.

C. Calibration: Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3.5 psi psi.

2.16 SWING CHECK VALVES

A. Manufacturers:

1. Hammond Valve.

2. Nibco, Inc.

3. Milwaukee Valve Company.

4. Crane Co.

5. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

B. Up to 2 Inches:

1. 1, Class 125, bronze body and cap, bronze swing disc with rubber seat, solder or threaded ends.

C. Over 2 Inches:

1. 1, Class 125, iron body, bronze swing disc, renewable disc seal and seat, flanged or grooved ends.

2.17 SPRING LOADED CHECK VALVES

A. Manufacturers:

1. Hammond Valve.

2. Crane Co.

3. Milwaukee Valve Company.

4. Stockham.

5. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

B. Class 125, iron body, bronze trim, stainless steel springs, bronze disc, Buna N seals, wafer style ends.

2.18 WATER PRESSURE REDUCING VALVES

A. Manufacturers:

1. Amtrol Inc.

2. Cla-Val Co.

3. Watts Regulator Company.

4. Spence Engineering Co.

5. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

B. Up to 2 Inches:

1. MSS SP-80, bronze body, stainless steel and thermoplastic internal parts, fabric reinforced diaphragm, strainer, threaded single union ends.

C. Over 2 Inches:

1. MSS SP-85, cast iron body, bronze fitted, elastomeric diaphragm and seat disc, flanged.

2.19 RELIEF VALVES

A. Pressure Relief:

1. Manufacturers:

a. Cla-Val Co.

b. Henry Technologies.

c. Watts Regulator Company.

d. Spence Engineering Co.

e. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

2. AGA Z21.22 certified, bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, temperature relief maximum 210 degrees F, capacity ASME (BPV IV) certified and labelled.

B. Temperature and Pressure Relief:

1. Manufacturers:

a. Cla-Val Co.

b. Henry Technologies.

c. Watts Regulator Company.

d. Spence Engineering Co.

e. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

2. AGA Z21.22 certified, bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, temperature relief maximum 210 degrees F, capacity ASME (BPV IV) certified and labelled.

2.20 STRAINERS

A. Manufacturers:

1. Armstrong International, Inc.

2. Green Country Filtration.

3. WEAMCO.

4. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

B. Size 1-1/2 inch to 4 inch:

1. Class 125, flanged iron body, Y pattern with 1/16 inch stainless steel perforated screen.

C. Size 5 inch and Larger:

1. Class 125, flanged iron body, basket pattern with 1/8 inch stainless steel perforated screen.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

D. Install piping to maintain headroom, conserve space, and not interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 22 07 19.

H. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors.

I. Establish elevations of buried piping outside the building to ensure not less than 3 ft of cover.

J. Install vent piping penetrating roofed areas to maintain integrity of roof assembly.

K. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

L. Provide support for utility meters in accordance with requirements of utility companies.

M. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting.

N. Install bell and spigot pipe with bell end upstream.

O. Install valves with stems upright or horizontal, not inverted.

P. Pipe vents from gas pressure reducing valves to outdoors and terminate in weather proof hood.

Q. Install water piping to ASME B31.9.

R. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.

S. Sleeve pipes passing through partitions, walls and floors.

T. Inserts:

1. Provide inserts for placement in concrete formwork.

2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.

4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

U. Pipe Hangers and Supports:

1. Install in accordance with ASME B31.9.

2. Support horizontal piping as scheduled.

3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.

4. Place hangers within 12 inches of each horizontal elbow.

5. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.

6. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.

7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

8. Provide copper plated hangers and supports for copper piping.

9. Provide hangers adjacent to motor driven equipment with vibration isolation.

10. Support cast iron drainage piping at every joint.

V. Where water pressure within the building exceeds 75 psi static, install an approved water-pressure reducing valve conforming to ASSE 1003 with strainer to reduce the building pressure to 75 psi static or less.

3.4 APPLICATION

A. Use grooved mechanical couplings and fasteners only in accessible locations.

B. Install unions downstream of valves and at equipment or apparatus connections.

C. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.

D. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

E. Install ball valves for throttling, bypass, or manual flow control services.

F. Provide lug end butterfly valves adjacent to equipment when provided to isolate equipment.

G. Provide spring loaded check valves on discharge of water pumps.

H. Provide ball valves in natural gas systems for shut-off service.

I. Provide flow controls in water recirculating systems where indicated.

J. All sanitary waste and vent pipe installed above grade in fire-rated walls, fire-rated plenum spaces or return air plenums shall be cast iron.

3.5 TOLERANCES

A. Drainage Piping: Maintain invert elevations within 1/4 inch vertically of location indicated on drawings. Slope to drain at minimum of 1/4 inch per foot slope for pipes 3 inch and smaller and 1/8 inch per foot slope for pipes larger than 3 inch.

B. Contractor must maintain inverts as indicated on the drawings. The contractor shall employ the latest precision technology available to insure the accuracy of the installation. If the contractor is unable to maintain, the contractor should notify the engineer IMMEDIATELY to obtain direction.

C. Water Piping: Slope at minimum of 1/32 inch per foot and arrange to drain at low points.

3.6 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Disinfect water distribution system in accordance with Oklahoma state and local codes.

B. Prior to starting work, verify system is complete, flushed and clean.

C. Ensure Ph of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).

D. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.

E. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.

F. Maintain disinfectant in system for 24 hours.

G. If final disinfectant residual tests less than 25 mg/L, repeat treatment.

H. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.

I. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

3.7 SERVICE CONNECTIONS

A. Provide new sanitary sewer services. Before commencing work check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.

B. Connection of dissimilar pipe materials shall be made with the specified adapter couplings.

C. Sewers shall be encased or cradled in concrete where shown on the plans or as directed by the Engineer. Unless otherwise noted on the plans, concrete encasement shall encircle the pipe and shall be a minimum thickness of four inches.

D. Contractor shall connect to existing gas service in accordance with the requirements of local gas service official and all applicable municipal and state regulations. All gas piping shall conform to and be tested in accordance with the local gas company and the Standard Gas Code. Gas piping shall have cathodic protection and all piping subject to natural gas pressure over 15 ounces must be welded. Any charge made by the gas company for placing the valves, piping, and connection to service main shall be borne by this contractor. See plans for extent of piping.

E. This Contractor shall extend the system of gas piping, to the various outlets as indicated on plans, complete with stop ball valves, drip pockets, valves and other accessories that may be required to give proper and adequate service.

F. Provide gas ball valves in final connection to all equipment. Unions will not be permitted, except in final connections to equipment. Proper reducing fittings shall be used. Bushings will not be accepted. Gas piping in building shall be standard weight schedule 40 black steel pipe with malleable fittings, unless contractor wishes to weld all joints. Welded rod shall be of same material as piping. No. 22 bronze welding will be permitted.

G. All underground gas service exterior to the building (5 psi or less) shall be a polyethylene plastic pipe manufactured in accordance with ASTM No. D-2517 or D-2513 and shall be indicated on the pipe. Gas piping shall be laid at least 36" below grade at all points. Provide a #12 THN copper wire in trench with pipe and leave both ends exposed for future accessibility.

H. All gas piping in ground, including service, shall be checked with a "Holiday" detector to assure that the coating is free of holes, voids, contamination, cracks, etc. This test shall be performed after the completion of joint and finish coating and touch-up. This test shall be conducted in the presence of the Owner's inspector and performed by experienced personnel.

I. For corrosion protection, all underground and exposed exterior steel pipe and fittings must be coated and wrapped.

J. Test all gas piping operating at 6 oz. with air pump and mercury gauge to pressure that will maintain 25 psig for 20 minutes and inspected by gas service official.

K. All gas piping operating at more than 1 psig shall be tested at 100 psig for steel and 50 psig for plastic, for a minimum of 15 minutes and inspected by gas service official.

L. The pressure regulator at the building shall be sized, and approved by gas service official.

M. All above ground piping shall be rigid steel pipe designated for natural gas use. Pipe shall be painted with a rust inhibiting primer and a final coat the color of which shall be determined by governing regulations or as directed by the Engineer if no governing regulations exist regarding finish color.

N. All gas piping systems within a building and other above ground gas piping shall be electrically continuous and bonded to a grounded electrode as defined in NFPA 70.

O. Medium and high pressure gas regulators installed in the medium and high pressure gas lines (2 psi or greater) shall comply with the following provisions:

1. Shall be suitable for the inlet and outlet gas pressure.

2. Shall comply with Code and gas official requirements.

3. Shall be accessible for servicing.

4. Shall be vented to outdoors when located indoors.

5. Shall be installed in the gas piping system so that it cannot be concealed by building construction.

P. Provide a listed shut off valve immediately ahead of and immediately behind each medium pressure regulator.

Q. Underground gas piping shall be installed in a separate ditch.

3.8 SCHEDULES

A. Pipe Hanger Spacing:

1. Metal Piping:

a. Pipe size: 1/2 inches to 1-1/4 inches:

1. Maximum hanger spacing: 8 ft.

2. Hanger rod diameter: 1/4 inch.

b. Pipe size: 1-1/2 inches to 2 inches:

1. Maximum hanger spacing: 8 ft.
2. Hanger rod diameter: 1/4 inch.

c. Pipe size: 2-1/2 inches to 3 inches:
1. Maximum hanger spacing: 8 ft.
2. Hanger rod diameter: 3/8 inch.

d. Pipe size: 4 inches to 6 inches:
1. Maximum hanger spacing: 8 ft.
2. Hanger rod diameter: 3/8 inch.

e. Pipe size: 8 inches to 12 inches:
1. Maximum hanger spacing: 10 ft.
2. Hanger rod diameter: 1/2 inch.

f. Pipe size: 14 inches and Over:
1. Maximum hanger spacing: 10 ft.
2. Hanger rod diameter: 7/8 inch..

2. Plastic Piping:
a. All sizes:
1. Maximum hanger spacing: 6 ft.
2. Hanger rod diameter: 3/8 inch.

END OF SECTION

SECTION 22 10 06

PLUMBING SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Floor Sink.s

B. Cleanouts.

C. Water hammer arrestors.

D. Thermostatic mixing valves.

1.2 RELATED REQUIREMENTS

A. Section 22 10 05 - Plumbing Piping.

B. Section 22 40 00 - Plumbing Fixtures.

1.3 REFERENCE STANDARDS

1.4 SUBMITTALS

A. See Section 22 01 00 - General Plumbing Provisions, for submittal procedures.

B. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.

C. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.

D. Manufacturer's Instructions: Indicate Manufacturer's Installation Instructions: Indicate assembly and support requirements.

E. Project Record Documents: Record actual locations of equipment and cleanouts _____.

F. Operation Data: Indicate frequency of treatment required for interceptors.

G. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. Extra Loose Keys for Outside Hose Bibbs: Four.

I. Product Data: Manufacturer’s standard data sheets describing components including materials, dimensions, relationship to adjacent construction, and attachments.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than five years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept specialties on site in original factory packaging. Inspect for damage.

PART 2 PRODUCTS

2.1 DRAINS

A. Manufacturers:

1. Josam Company.
2. Jay R. Smith Manufacturing Company.
3. Zurn Industries, Inc.
4. Wade Tyler Pipe.
5. MIFAB, Inc.
6. Watts Water Technologies.
7. Striem, Edwardsville, KS USA
8. Schier Products Company, Edwardsville, KS USA
9. Substitutions: See Section 22 10 00 - General Plumbing Provisions.

B. Floor Sink:

1. Square lacquered cast iron body with integral seepage pan, epoxy coated interior, aluminum dome strainer, clamp collar, sediment bucket; and nickel bronze frame; half grate.

2.2 CLEANOUTS

A. Manufacturers:

1. Jay R. Smith Manufacturing Company.
2. Josam Company.
3. Ward Manufacturing, Inc.
4. Zurn Industries, Inc.
5. Wade Tyler Pipe.

6. Watts Water Technologies.

7. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

B. Cleanouts at Exterior Surfaced Areas:

1. Round cast nickel bronze access frame and non-skid cover.

C. Cleanouts at Exterior Unsurfaced Areas:

1. Line type with lacquered cast iron body and round epoxy coated gasketed tractor-type cover.

2.3 WATER HAMMER ARRESTORS

A. Manufacturers:

1. Jay R. Smith Manufacturing Company.

2. Watts Regulator Company.

3. Zurn Industries, Inc.

4. Wade Tyler Pipe.

5. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

B. Water Hammer Arrestors:

1. Stainless steel construction, bellows type sized in accordance with PDI-WH 201, precharged suitable for operation in temperature range -100 to 300 degrees F and maximum 250 psi working pressure.

2.4 MIXING VALVES

A. Thermostatic Mixing Valves:

1. Manufacturers:

a. ESBE.

b. Leonard Valve Company.

c. Honeywell Water Controls.

d. Powers Process Controls.

e. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

2. Valve: Chrome plated cast brass body, stainless steel or copper alloy bellows, integral temperature adjustment.

3. Accessories:

a. Check valve on inlets.

b. Volume control shut-off valve on outlet.

c. Stem thermometer on outlet.

d. Strainer stop checks on inlets.

4. Cabinet: 16 gage stainless steel, for surface mounting with keyed lock.

B. Pressure Balanced Mixing Valves:

1. Manufacturers:

a. Delta Faucet Company.

b. H.G. Specialties.

c. Powers Process Controls.

d. Taconova.

e. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

2. Valve: Chrome plated cast brass body, stainless steel cylinder, integral temperature adjustment.

3. Accessories:

a. Volume control shut-off valve on outlet.

b. Stem thermometer on outlet.

c. Strainer stop checks on inlets.

d. Cabinet: 16 gage stainless steel, for surface mounting with keyed lock.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Extend cleanouts to finished wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.

C. Encase exterior cleanouts in concrete flush with grade. Refer to plans for detail.

D. Install approved potable water protection devices on plumbing lines where contamination of domestic water may occur; janitor rooms, flush valves, interior and exterior hose bibbs.

E. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to lavatories,, .

F. Install components in accordance with manufacture's instructions and approved product data submittals.

END OF SECTION

SECTION 22 10 08

PLUMBING SOLDER

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Lead-free plumbing solder.

1.2 RELATED SECTIONS

A. Section 22 10 05 - Plumbing Piping.

B. Section 22 40 00 - Plumbing Fixtures.

1.3 REFERENCES

A. ASTM B 32 - Standard Specification for Solder Metal; 1996.

B. NSF 61 - Drinking Water System Components - Health Effects; 2002 (ANSI/NSF 61).

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: The Harris Products Group

B. Substitutions: See Section 22 01 00 - General Plumbing Provisions for equipment and material substitutions.

C. Provide all plumbing solder from a single manufacturer.

2.2 MATERIALS

A. Plumbing Solder: Sterling® solder or equal, ASTM B 32, Alloy Grade TC; 95 percent tin, 4.85 percent copper, 0.15 percent selenium.

1. Certified to comply with NSF 61.

2. Melting Temperature: 410 degrees F.

3. Tensile Strength: 7,130 psi.

4. Shear Strength: 5,979 psi.

5. Elongation Percent: 19.1.

6. Brinell Hardness: 15.1.

7. Burst Strength: 5,800 psi.

8. Pressure/Temperature Test Data on Copper Tube Assemblies comprised of 3 inch, 2 inch, 1 inch, 3/4 inch, and 1/2 inch Tubing with a Reducing Tee:

    a. No leaks at 70 degrees F., 200 psi, held for 2 minutes.

    b. No leaks at 180 degrees F., 200 psi, held for 2 minutes.

    c. No leaks at 70 degrees F., 2,000 psi, held for 5 minutes.

B. No lead in plumbing solder.

PART 3 EXECUTION

3.1 INSTALLATION

A. Apply plumbing solder in accordance with manufacturer's recommendations.

END OF SECTION

SECTION 22 40 00

PLUMBING FIXTURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Water closets.

1.2 RELATED REQUIREMENTS

A. Section 22 10 05 - Plumbing Piping.

B. Section 22 10 06 - Plumbing Specialties.

C. Division 26 - Equipment wiring, electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

A. Comply with State of Oklahoma adopted ADA Accessible Guidelines in regard to accessible or handicapped features.

B. ASME A112.6.1M - Floor-Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use; 1997 (Reaffirmed 2017).

C. ASME A112.18.1 - Plumbing Supply Fittings; 2018, with Errata.

1.4 SUBMITTALS

A. Section 22 01 00 - General Plumbing Provisions: Procedures for submittals.

B. Product Data: Provide catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.

C. Manufacturer's Instructions: Indicate installation methods and procedures.

D. Maintenance Data: Include fixture trim exploded view and replacement parts lists.

E. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

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

1.6 REGULATORY REQUIREMENTS

A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Accept fixtures on site in factory packaging. Inspect for damage.

B. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

1.8 WARRANTY

A. Provide five year manufacturer warranty for drinking fountain.

B. All warranties to begin at Date of Substantial Completion as accepted by the Owner.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Potable Water Systems: Provide plumbing fittings and faucets that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

2.2 LAVATORIES

A. Lavatory Manufacturers:

1. American Standard Inc.

2. Zurn Industries, Inc.

3. Kohler Company.

4. Sloan.

5. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

B. Vitreous China Wall Hung Basin:

1. ASME A112.19.2; vitreous china wall hung lavatory, with 4 inch high back, rectangular basin with front overflow.

a. Drilling Centers: 4 inch.

C. Supply Faucet Manufacturers:

1. Sloan Valve Company.

2. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

D. Supply Faucet: ASME A112.18.1; chrome plated combination supply fitting with open grid strainer, water economy aerator with maximum flow of 0.5 gallon per minute (low-flow), single lever handle.

E. Accessories:

1. Chrome plated 17 gage brass P-trap with clean-out plug and arm with escutcheon.
2. Offset waste with plug and strainer where required.
3. Wheel handle stops.
4. Rigid supplies.
5. Carrier:
    a. Manufacturers:
        1. JOSAM Company.
        2. Sloan Valve Company.
        3. Zurn Industries, Inc.
        4. Watts Water Technologies.
        5. Substitutions: See Section 22 01 00 - General Plumbing Provisions.
    b. ASME A112.6.1M; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, concealed arm supports, bearing plate and studs.

F. All lavatory faucets shall be listed to ASSE 1070 for temperature and pressure protection with a maximum control flow of 0.5 gpm (2.2 lpm). Faucet shall feature a single cartridge design for ease of repair and maintenance and shall provide an approach temperature of no greater than 5ºF (3°C). Faucet shall include integral check valves to prevent cross flow and shall be in compliance with the American with Disabilities Act (ADA). Faucet shall feature ceramic disc mixing and shall be constructed using Lead Free material.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.

B. Verify that electric power is available and of the correct characteristics.

C. Confirm that millwork is constructed with adequate provision for the installation of counter top lavatories and sinks.

3.2 PREPARATION

A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.3 INSTALLATION

A. Install each fixture with trap, easily removable for servicing and cleaning.

B. Provide chrome plated rigid supplies to fixtures with hand wheel stops, reducers, and escutcheons.

C. Install components level and plumb.

D. Install and secure fixtures in place with wall carriers and bolts.

E. Seal fixtures to wall and floor surfaces with sealant as specified in Section 07 92 00, color to match fixture

F. Install handicap valve handles to the accessible side.

G. Provide HandiLav or approved equal molded trap and supply insulation kit for all exposed drain and supply handicap lavatories.

H. Install a check valve in the hot and cold water supply lines at every service sink.

3.4 INTERFACE WITH WORK OF OTHER SECTIONS

A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

3.5 ADJUSTING

A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.6 CLEANING

A. Clean plumbing fixtures and equipment.

3.7 PROTECTION

A. Protect installed products from damage due to subsequent construction operations.

B. Repair or replace damaged products before Date of Substantial Completion.

3.8 SCHEDULES

A. Fixture Heights: Install fixtures to heights above finished floor as indicated.

1. Lavatory:

a. Standard: 31 inches to top of basin rim.

b. Accessible: 34 inches maximum to top of basin rim.

c. Youth: Refer to Architectural Plans.

B. Minimum fixture rough-in sizes or as required for particular fixtures.

1. Lavatory:

a. Hot Water: 1/2 Inch.

b. Cold Water: 1/2 Inch.

c. Waste: 1-1/2 Inch.

d. Vent: 1-1/4 Inch.

END OF SECTION

SECTION 23 01 00

GENERAL HVAC PROVISIONS

PART 1 GENERAL

1.1 WORK INCLUDED

A. The work covered by Division 23 sections consist of furnishing all labor, equipment, appliances and material for the heating, air conditioning, piping and plumbing systems in strict accordance with Codes, Specifications and the applicable drawings and subject to the terms and conditions of the contract. Include all appurtenances necessary to the proper operation of the systems and equipment specified.

B. General Contractor shall install all concrete pads and bases required for installing mechanical equipment. Mechanical Contractor is responsible for the exact sizes required, location of anchor bolts, etc.

C. Mechanical Contractor shall furnish and install roof-mounted air handler and exhaust fan bases and shall be the manufacturer's base.

D. Some equipment may be furnished by other divisions. Mechanical Contractor is responsible to check the drawings and specifications for equipment that will be furnished by the Owner. Furnish the duct, insulation, controls, etc., on all equipment furnished by other divisions.

E. General Contractor shall furnish and install all ceiling access panels required to service mechanical equipment, valves and controls above gyp board or hidden spline ceilings.

1.2 RELATED SECTIONS

A. The General Conditions and Division 1, General Requirements, as bound in the specification preamble, apply to all work under Division 23. Carefully note its contents in performance of the work.

B. The Architectural, Plumbing, Electrical, and Structural plans and Specifications, including Information to Bidders and other pertinent documents issued by the Engineer are a part of this Specifications and the accompanying mechanical plans. Comply with them in every respect. Examine all the above carefully. Failure to comply does not relieve the Contractor of responsibility nor may it be used as a basis for additional compensation due to omission of architectural, electrical and structural details from the mechanical drawings.

C. All electrical power wiring is specified under Division 26 of the Specifications. Mechanical Contractor shall furnish all motor starters required for the control and protection of all motors furnished for the Division 23. Provide and install all automatic temperature and interlock wiring required for controlling mechanical equipment furnished under Division 23, in compliance with Division 26 of the Project Manual.

D. All concrete pads and bases required for installing mechanical equipment are specified in another section of the Specifications. Advise the General Contractor as to the exact sizes

required, location of anchor bolts, etc.

E. Paint all roof top mechanical equipment ducts, supports and other exposed material. Do not paint indoor equipment supplied with painted finish, such as the main mechanical equipment unless damaged during handling and installation. In such cases, use touch-up paint of the same type and color as original paint. Conform to requirements in other sections of the Specifications and match wall finish to the room in which installed.

1.3 CODES, FEES AND LATERAL COSTS

A. Comply with all applicable codes, specifications, local ordinances, industry standards, utility company regulations, and the applicable requirements of the following latest nationally accepted codes and standards:

1. Ochelata, Oklahoma City Building Code.
2. Oklahoma State Mechanical Code; latest accepted edition.
3. Oklahoma State Plumbing Code; latest accepted edition.
4. Oklahoma Energy Code; latest accepted edition.
5. IBC - International Building Code; latest accepted edition.
6. IFC - International Fire Code; latest accepted edition.
7. IGC - International Gas Code; latest accepted edition.
8. IMC - International Mechanical Code; latest accepted edition.
9. IPC - International Plumbing Code; latest accepted edition.
10. IECC - International Energy Conservation Code
11. AMCA - Air Moving & Conditioning Association.
12. ASA - American Standards Association.
13. ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers.
14. ASME - American Society of Mechanical Engineers.
15. ASTM - American Society of Testing Materials.
16. AWWA - American Water Works Association.
17. NBS - National Bureau of Standards.
18. NEMA - National Electrical Manufacturers Association.
19. NFPA - National Fire Protection Association.

20. SMACNA - Sheet Metal & Air Conditioning Contractors' National Association.

21. UL - Underwriters' Laboratories, Inc.

22. AGA - American Gas Association.

23. OSHA - Occupational Safety and Hazard Association.

24. AABC - Associated Air Balance Councils

25. NEBB - National Environmental Balancing Bureau

B. Comply with State of Oklahoma adopted ADA Accessible Guidelines in regard to accessible or handicapped features.

C. In case of difference between building codes, Specifications, state Laws, local ordinances, industry standards and utility company regulations and the Contract Documents, the most stringent governs. Promptly notify the Engineer in writing of any such difference.

D. Remove any work installed that does not comply with the requirements of the applicable building codes, state laws, local ordinances, industry standards, or utility company regulations, correct the deficiencies, and reinstall all work at no cost to the Owner.

E. The mechanical drawings show the general arrangement of all piping, equipment and appurtenances. Follow as closely as actual building construction and the work of other trades will permit. Final layout will be governed by actual field conditions with all measurements verified at the site. Conform to the requirements shown on all of the drawings. General and structural drawings take precedence over mechanical drawings. Because of the small scale of the mechanical drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. Investigate the existing and finish conditions affecting the work and arrange the work accordingly, providing such fittings, valves and accessories as may be required to meet such conditions. Contractor shall verify that all equipment, ducts, pipes and all other components will fit in the space provided before fabrication or ordering.

F. Obtain any and all required permits in connection with this work under the Contract and pay any and all fees in connection therewith. Arrange with the serving utility companies for the connections to all utilities and pay all charges for same including inspection fees and meters if required. Refundable deposits will be paid by the Owner.

1.4 GUARANTEE

A. Furnish a written certificate guaranteeing all materials, equipment and labor furnished to be free of all defects for a period of one (1) year from and after the date of final acceptance of the work by the Owner and further guarantee to replace such work without charges if any defects appear within the stipulated guaranty period.

1.5 SOIL CONDITIONS

A. The Specifications and the drawings in no way imply the conditions of the soil to be encountered. When excavating may be required in execution of the work, this Contractor agrees that he has informed himself regarding conditions affecting the work.

1.6 INSPECTION OF PREMISES

A. Before submitting a bid, visit the site of the proposed job and determine the conditions relating to this work.

1.7 UTILITIES, LOCATIONS AND ELEVATIONS

A. Locations and elevations of the various utilities included within the scope of this work have been obtained from substantially reliable sources and are offered as a general guide only, without guarantee as to accuracy. Verify the location and elevation of all utilities and their relation to the work before entering into a contract.

1.8 EXISTING BUILDING AND EXISTING MECHANICAL EQUIPMENT

A. Visit the existing building and become thoroughly acquainted with the existing physical plant, mechanical systems and utilities in order to determine all of the work that will be necessary to carry out the intent of the plans and specifications.

B. If it is necessary, in any way, to interfere with normal operations of the existing utilities in order to carry out the work, give notice and obtain written approval from the Owner before the work is started.

1.9 EQUIPMENT NOT SPECIFIED UNDER DIVISION 23

A. Equipment which requires plumbing and other mechanical connections may be specified in another division of this Specification. Under these conditions, provide necessary utilities including waste, water, natural gas, duct, insulation and controls.

B. Rough-in work from approved shop drawings only.

PART 2 PRODUCTS

2.1 EQUIPMENT AND MATERIALS

A. Provide new materials bearing the manufacturer's name, trade name and the UL label in every case where a standard has been established for the particular material. Furnish the standard product of a manufacturer regularly engaged in the production of the required type of equipment. Provide the manufacturer's latest approved design.

B. Deliver equipment and materials to the site and store in original containers, suitably sheltered from the elements, but readily accessible for inspection by the Engineer until installed. Store all items subject to moisture damage (such as controls) in dry, heated spaces.

C. Provide equipment and materials of the same general type and of the same make throughout the work to provide uniform appearance, operation and maintenance.

D. Tightly cover equipment and protect against dirt, water and chemical or mechanical injury and theft. At the completion of the work, clean fixtures, equipment and materials and polish thoroughly. Turn over to the Owner in a condition satisfactory to the Engineer. Repair damage or defects developing before acceptance of the work at no expense to the Owner.

E. Insure that items to be furnished fit the space available. Make necessary field measurements to ascertain space requirements, including those for connections. Furnish and install such sizes and shapes of equipment that the final installation suits the true intent and meaning of the drawings and Specifications.

F. Follow manufacturer's directions completely in the delivery, storage, protection and installation of all equipment and materials. Promptly notify the Engineer in writing of any conflicts between any requirements of the Contract Documents and the manufacturers' directions. Obtain the Engineer's written instruction before proceeding with the work. Replace any work that does not comply with the manufacturers' directions or such written instructions from the Engineer, at no cost to the Owner.

G. Support all products by service organizations with adequate spare parts inventory and personnel located reasonably close to the site.

H. Where multiple units of the same type or class of products are required, provide all units of the same manufacturer.

2.2 EQUIPMENT ACCESSORIES

A. Furnish and install all equipment, accessories, connections and incidental items necessary to fully complete all work, ready for use, occupancy and operation by the Owner.

B. Where equipment requiring different arrangement or connections from those shown is provided, install the equipment to operate properly and in harmony with the intent of the drawings and Specifications.

C. Support, plumb, rigid and true to line, all work and equipment furnished. Study thoroughly all general, structural, electrical, fire suppression and mechanical drawings, shop drawings and catalog data to determine how equipment, fixtures, piping, ductwork, etc., are to be supported, mounted or suspended and provide extra steel bolts, inserts, pipe stands, brackets and accessories for proper supports whether or not shown on the drawings. When directed, submit drawings showing supports.

D. If accessories are required to complete the work and meet the intent of the specification, it is the responsibility of the Contractor to provide such accessories.

2.3 MATERIAL AND EQUIPMENT SCHEDULE

A. Submit to the Engineer as soon as practical, six (6) complete sets of the schedule of materials and equipment proposed for the installation, or electronic submittals as detailed below.

Include manufacturers' names, catalog data, diagrams, drawings and other descriptive data and submit under one cover with an index sheet in front.

1. If Electronic files are submitted, a complete set of the schedule of materials and equipment proposed for the installation shall be included. Include manufacturers' names, catalog data, diagrams, drawings and other descriptive data. All information shall be submitted electronically in "pdf" format, and shall be separated into electronic "pdf" files according to the corresponding specification section (i.e. "23 40 00 - Air Cleaning Devices.pdf"). Unless incomplete submittals are authorized by the project engineer, all Division 23 submittals shall be electronically sent at one time. Without authorization, incomplete submittals shall be rejected.

B. Provide written certification that shop drawings are in accordance with the specifications and are dimensionally correct with reference to available space.

C. All submittals will be reviewed a maximum of two (2) times. The cost of additional submittal reviews beyond those two specified will be charged to the Contractor.

D. Shop drawings for the Engineer's files are required on the following items:

1. Furnace Units.
2. Condensing Units.
3. Filters.
4. Exhaust Fans.
5. Grilles and Registers.
6. Air Balance Certification.
7. Ductwork Materials Including Duct Accessories.
8. Duct Insulation Materials.
9. Complete Mechanical Equipment Electrical Data and Wiring Details.

2.4 EQUIPMENT AND MATERIAL SUBSTITUTIONS

A. It is the responsibility of the Contractor to investigate any desired substitutions for specified equipment prior to submission of his bid. The Mechanical Contractor shall be responsible for any changes required in mechanical, electrical, structural or vibration isolation systems and shall bear all cost for those changes whether the substitute equipment is named by manufacturer in the specifications or is submitted to the Architect for "or equal" consideration. All changes shall be accomplished in a manner acceptable to the Architect per Section 01 60 00 at no additional cost to the Owner.

B. In order to obtain prior approval on equipment or material not specified in Division 23 Specifications or Equipment Schedules, Mechanical Contractor MUST submit to the Engineer any proposed equipment or material ten (10) working days prior to the bid date.

C. If ANY substitute equipment is submitted to Engineer for approval, without said equipment having been pre-approved, the entire submittal will be rejected for resubmittal.

D. Any equipment manufacturers which are a subsidiary to the listed acceptable manufacturers are not considered equal. Therefore, it is the responsibility of the Contractor and equipment supplier to obtain prior approval as described in paragraph 2.4, this Section.

2.5 ELECTRICAL MOTORS

A. Provide motors of a recognized manufacturer, wound for the voltage specified, and in conformance to latest standards of the manufacturer and performance of the National Electrical Manufacturers Association and the Institute of Electrical and Electronic Engineers. Provide motors as manufactured by General Electric, Westinghouse, Century or Siemens-Allis, Baldor or approved equal.

B. Provide motors rated for continuous duty at 100% of rated capacity and temperature raise of 40 degrees Centigrade open type; 50 degrees Centigrade drip and splash proof; 55 degrees Centigrade explosion proof and totally enclosed above an ambient of 40 degrees Centigrade.

C. Unless otherwise required, provide integral horsepower, polyphase motors, Class B, general purpose, squirrel cage, open type induction motors, T-frame.

D. Provide single phase fractional horsepower motors of the open capacitor type. Generally, motors under 1/2 horsepower may be split phase type unless otherwise specified. Provide motors rated 1/2 horsepower or less with integral overcurrent protection.

E. Insure the insulation resistance between stator conductor and frames of motors is not less than 1/2 megohm. Provide shop test of motors including temperature rise, insulation resistance, motor terminal voltage, normal operating line current, RPMs, breaker or switch size with fusing and overload relay sizes.

PART 3 EXECUTION

3.1 COORDINATION OF WORK

A. Compare the mechanical drawings and Specifications with the drawings and Specifications for other trades and report any discrepancies between them to the Engineer and obtain from him written instruction for changes necessary in the mechanical work. Install the mechanical work in cooperation with other trades installing inter-related work. Before installation, make proper provisions to avoid interferences in a manner approved by the Engineer. Make all changes required in the work caused either by neglect or existing field conditions at no cost to the Owner.

B. It is the responsibility of the General Contractor, Plumbing Contractor, Mechanical Contractor and Electrical Contractor, and Sprinkler Contractor to coordinate installation of all equipment. Equipment installed prior to proper coordination, which interferes with the harmony and intent of the specifications and drawings, will be removed and reinstalled at the cost of the responsible Contractor.

C. Furnish anchor bolts, sleeves, inserts and supports required for the mechanical work. Locate anchor bolts, sleeves, inserts and supports as directed by the trade requiring them and insure that they are properly installed.

D. Slots, chases, openings and recesses in existing structure shall be cut, patched and repaired by the Contractor.

E. Adjust locations of pipes, ducts, equipment fixtures, etc., to accommodate the work and for interferences anticipated and encountered. Determine the exact route and location of each pipe and duct prior to fabrication.

1. Provide right-of-way to lines that pitch over those that do not pitch. For example, Plumbing drains normally have right-of-way. Lines whose elevations cannot be changed have the right-of-way over lines whose elevations can be changed.

2. Make offsets, transitions and changes in direction in pipes and ducts as required to maintain proper head room and pitch.

F. Install all mechanical work to permit removal without damage to other parts, to coils, fan shafts and wheels, filters, belt guards, sheaves and drives and all other parts requiring periodic replacement or maintenance. Arrange pipes, ducts and equipment to permit ready access to valves, cocks, traps, starters, motors, control components and to clear the openings of swinging and overhead doors and of access panels.

G. Change the cross sectional dimensions of ductwork when required to meet job conditions, but maintain at least the same equivalent cross sectional area. Secure the approval of the Engineer prior to fabrication of ductwork requiring such changes. Sizes shown on the plans are clear dimensions; add for internal insulation if specified.

3.2 RECORD DRAWINGS

A. Maintain record drawings showing exact locations and sizes, as actually installed, of piping, drains, cleanouts, ductwork, controls and equipment as specified herein. Deliver to the Owner/Architect upon completion and acceptance of the work, one (1) complete set of contract drawings marked to indicate all deviations from intended installation.

B. Record drawings shall be provide in hard copy form, as well as, on a DVD in PDF form.

3.3 CUTTING AND PATCHING

A. The General Contractor shall be responsible for all required cutting, patching, etc., incidental to this work and shall make all required repairs thereafter to the satisfaction of the Engineer. Do not cut into any major structural element, beam or column without the written approval of the Engineer.

B. Openings in fire or smoke barriers for air handling ductwork or air movement shall be protected in accordance with NFPA 90A and 90B and the Mechanical Code.

C. Pipes, conduits, cables, wires, air ducts, pneumatic tubes and ducts and similar handling service equipment that pass through fire or smoke barriers shall be protected in accordance with NFPA 101.

D. All fire stopping assemblies must be UL approved assemblies.

3.4 EQUIPMENT START-UP AND TESTING

A. Instruct the Owner's operating personnel during start-up and separate operating tests of each major item of equipment. During the operating tests, prove the operation of each item of equipment to the satisfaction of the Engineer. Give at least seven (7) days notice to the Engineer of equipment start-up and operating tests.

B. Refer to Section 23 08 00 for additional information.

3.5 CATALOG DATA FOR OWNER

A. Provide, in looseleaf binders, two (2) sets of a compilation of catalog data of each manufactured item of equipment used in the mechanical work and present this compilation to the Owner/Architect for transmittal to the Owner before final payment is made. Include descriptive data and printed installation, operating and maintenance instructions for each item of equipment. Provide a complete double index as follows:

1. Listing of products alphabetically by name.

2. Listing the names of manufacturers whose products have been incorporated in the work alphabetically together with their addresses and the names and addresses of the local sales representatives.

3. Certificates of Final Inspections.

4. Complete spare parts data with current prices and supply sources.

5. Extended warranties.

B. Deliver to the Owner all special tools, lubricants, extra materials and any other products necessary for the proper operation and maintenance of the mechanical and plumbing systems.

C. Provide project record documents indicating all changes from contract documents made during construction.

D. Submit all Certificates of Final Inspections from the Administrative Authorities.

E. Submit TAB reports on approved forms. Final TAB report submittals shall include all required rebalances if any are required.

3.6 INSTRUCTION OF OWNER'S REPRESENTATIVE

A. Instruct the representative of the Owner in the proper operation and maintenance of all elements of the mechanical system. Spend not less than five (5) days in such formal

instruction and additional time as directed by the Engineer to fully prepare the Owner to operate and maintain the mechanical equipment.

B. Provide classroom and hands-on training of Owner's designated personnel on operation and maintenance of the HVAC system, control system, and all equipment items indicated. Provide the following training as required to fully qualify the Owner's designated personnel. All training must be video taped to a CD and a copy included in each operation and maintenance closeout manual.

1. Furnace Units.

2. Condenser Units.

3. Return Fan/Relief Fan.

4. Split System AC or Heat Pumps.

3.7 PROTECTIVE COATINGS

A. Paint exterior surfaces of steel piping run in or through concrete floor fill, under tile floors or underground, and aluminum surfaces in contact with masonry, with one coat of acid resisting bituminous base paint.

B. Paint all exposed galvanized ducts behind grilles flat black.

3.8 NOISE CONTROL

A. It is intended that the mechanical systems as installed under this contract be free from objectionable noise when the system is operating. The system shall operate at noise levels below criteria recommended for the application by ASHRAE. Provide vibration isolation accessories and isolate equipment, pipeline, ductwork, etc., as required so as to insure an acceptable noise level in all of the mechanical systems.

3.9 CLEANING AND ADJUSTING

A. Do not allow waste material and rubbish to accumulate in or above the premises. After completion of this work, remove rubbish, tools, scaffolding and surplus materials from and about the building and leave all work clean and ready for use. Clean all equipment, pipes, valves and fittings of grease, metal cuttings and sludge. Repair any stoppage, discoloration or other damage to parts of the building, its finish or furnishings due to failure to properly clean the mechanical systems, without additional cost to the Owner. Adjust all automatic control devices for proper operation.

3.10 SYSTEM OPERATING TESTS

A. After the successful completion of all equipment start-up and test requirements, perform the following tests on the complete mechanical systems:

1. First Operating Test by Contractor: Prove the operation of the mechanical systems and of each individual item in the systems. Give at least 10 day prior notice to the Engineer of

such tests. Adjust and set proper quantities to all items and equipment. Should any item of the systems fail to perform in an approved manner, repeat this test until approved by the Engineer. During this test, balance circulation of heating and cooling water to balancing cocks, valves, thermostats and similar Items to insure that the mechanical systems perform as intended.

2. Checking by Owner and Engineer: Following the successful completion of first operating tests by the Contractor, the Owner and the Engineer have the privilege of making such tests as they may desire during a period of three weeks to ascertain in detail if any corrections are to be made to the system. At the end of the testing by the Owner and the Engineer, the Engineer may direct the Contractor in writing to make such corrections to the systems as are within the scope of the contract.

3. Contractor's Corrections to Systems: Make all required corrections to the systems and notify the Engineer in wiring that the corrections outlined have been completed. Give at least seven (7) days notice of a final three-day operating test.

4. Three-Day Operating Test: Perform an operating test to the satisfaction of the Engineer for a period of three (3) days. Should any element of the systems not perform properly, make all required corrections and repeat the test until successfully performed.

    a. Submit the Form of Record proposed by the Contractor for the recording of all measurements to the Engineer for approval at least two weeks before the approved form will be required by the Contractor.

    b. Measurements: Make the following measurements at two-hour intervals (5 measurements per 8-hour day) during the three-day operating test.

        1. Electrical: Running amperes and voltage of each motor 3/4 horsepower or larger.

        2. Air temperatures in each heated or air conditioned space and outdoor temperatures.

    c. Instruments: Provide all instruments, materials and labor to perform the tests and to obtain and record the measurements specified herein, including the furnishing of all required record forms as approved by the Engineer. Submit for the Engineer's approval, complete shop drawings or catalog data for all instruments to be used for the three day operating test and obtain approval at least two weeks before the instruments will be required for test measurements.

    d. Report: Submit four (4) copies of a written report of the three-day operating test on the approved Form of Record to the Engineer for approval and subsequent transmittal to the Owner.

3.11 MOTOR CONTROL

A. General: Provide each motor 1/8 horsepower or larger with a suitable controller and devices that will perform the functions as specified for the respective motors, together with manual reset thermal overload, protection in each undergrounded conductor. Provide the controller either integral with circuit protective device or mounted in separate enclosure. Starters shall be Allen-Bradley, G.E., Westinghouse, Square D or approved equal.

B. Control: Automatic control devices such as thermostats, float or pressure switches may control the starting and stopping of motor directly, provided the device used is designated for that purpose and has an adequate horsepower rating. When automatic control device does not have such a rating, use a magnetic starter with the automatic control device actuating the pilot control circuit. When combination manual and automatic control is specified and the control device operates the motor directly, provide a manual motor starter and selector switch. When combination manual and automatic control is specified and the automatic control device actuates the pilot control circuit, a magnetic control device actuates the pilot control provided. Provide all magnetic starters with push buttons or selector switches in the covers. Provide connections to the selector switch such that only the normal automatic regulating control devices will be bypassed when the switch is in the manual position. Connect all safety control devices, such as low or high pressure cutouts, high temperature cutouts and motor overload protective devices in the motor control circuit in both the manual and automatic positions of the selector switch control circuit. Make connections to any selector switch or to more than one (1) automatic regulatory control device in accordance with wiring diagrams recommended by the manufacturer and approved by the Engineer. Where required for manual control, provide push-button stations consisting of two (2) momentary contact operators, 600 volts, 10 amperes installed and wired for three wire control to provide under-voltage relays, auxiliary contacts or other devices required for a complete system.

C. Location: Where the controller is located within sight of the motor driven equipment (fifty feet or less), the controller and circuit protective device shall be capable of being locked in the open position. Where the controller is located out of sight of the motor driven equipment (more than fifty feet) provide a non-fused safety disconnect, suitable for the service, and which opens all ungrounded conductors simultaneously, at or on the motor driven equipment.

D. Enclosure: Enclosure to be general purpose, NEMA Type 1 unless noted otherwise (NEMA Type 1 gasketed). The circuit breaker shall be operable by hand from outside the enclosure and shall be so interlocked with the door or doors that it must be returned to the "OFF" position before the door can be opened.

E. Push-buttons: Provide maintained contact, standard duty type in a general purpose, NEMA Type 1 enclosure for surface mounting rated for 10 amperes continuous at 600 volts or less.

3.12 ACCESS PANELS

A. Provide access panels as required in all walls, ceilings and ductwork to service and have access to all valves, operating parts and duct mounted fire dampers. For all ceiling and wall access doors that are required in gypsum board and plaster, provide minimum 24" x 24",

unless due to structural restraints the access door can be reduced to a minimum of 18" x18", Milcor type appropriate for the construction involved.

3.13 TEMPORARY HEATING AND COOLING

A. Permanent heating and cooling systems may be used to provide temporary heating and cooling to the building during construction, if the following requirements are met:

1. Provide filters in equipment filter racks.

2. Provide filter material at entrance to all return air ducts or over permanent return air grilles. All return air ductwork is to be protected from construction dust and debris. If return air duct work is not protected prior to equipment startup for temporary use, the Contractor will pay to have the entire ductwork system of the affected equipment thoroughly cleaned prior to Owner occupancy.

3. Contractor shall provide and pay for operation, maintenance, regular replacement of filters and worn or consumed parts.

4. Shall replace any equipment that is damaged during temporary usage with new equipment.

5. All warranty periods shall not begin until Certificate of Substantial Completion is issued.

6. Verify with engineer that the installation is ready and approved for operation.

B. Just prior to turning the building or portions of the building over to the Owner, Contractor will replace all filters on equipment used for temporary ventilation, heat or cooling during construction.

C. Do not turn water into the system until the systems have been thoroughly cleaned and approved by the Engineer.

3.14 DEMOLITION

A. There are areas in the existing building in which demolition will have to be performed due to the requirements for remodeling. The demolition work involved is not fully described herein; however, the information given on the electrical and mechanical drawings and the information set out in the specifications will substantially serve to inform the mechanical Contractor as to the full extent of the demolition required.

B. Contractor should visit job site to verify extent of demolition required to complete project.

C. It is the intent of this Specification that all required demolition work be fully and completely performed and all work be accomplished in a neat and workmanlike manner.

D. Remove all existing piping, fittings, heating, cooling, ventilation equipment that is required to accomplish the remodel work. All existing utilities that are disconnected shall be capped recessed in walls and floors. Contractor shall be responsible for visiting building and determining the extent of the demolition work. Contractor shall provide any necessary

temporary piping required to keep existing building utilities (water, gas and sewer) in operation until new construction is completed to the extent that the new utilities can be reconnected.

E. All rubbish, debris and expendable items resulting from demolition work shall be removed from the premises as it accumulates and disposed of at an off-site location by the Contractor.

3.15 SALVAGE

A. Except as otherwise specified herein, or noted on drawings, the Contractor shall receive title to all building materials indicated to be demolished or removed which are not specifically designated as being retained by the Owner, said title to vest in the Contractor immediately upon receipt of Work Order. All salvage materials removed shall be taken from the premises promptly, as the storage of salvage materials on the site will not be permitted. Bidders shall take into account the salvage value to them of materials removed and such value shall be reflected in the bids.

B. All items of usable equipment shall remain the property of the Owner. All such items of equipment which are to be removed and which are not to be reused shall be stored on the premises by the Contractor as directed by the Owner.

C. Usable items shall be determined by the Owner and shall include existing heating and cooling pumps and other equipment so designated as "usable" by the Owner.

3.16 FINALLY

A. It is the intention that this specification shall provide a complete installation except as herein before specifically excepted. All accessory construction and apparatus necessary or advantageous in the operation and testing of the work shall be included. The omission of specific reference to any part of the work necessary for such complete installation shall not be interpreted as relieving this Contractor from furnishing and installing such parts.

END OF SECTION

SECTION 23 05 53

IDENTIFICATION FOR HVAC PIPING & EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Stencils.

D. Ceiling tacks.

1.2 REFERENCE STANDARDS

1.3 SUBMITTALS

A. See Section 23 01 00 - General HVAC Provisions, for submittal procedures.

B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.

C. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number. Valve locations with tag numbers shall also be indicated on "as-built" drawings.

D. Product Data: Provide manufacturers catalog literature for each product required.

E. Manufacturer's Installation Instructions: Indicate special procedures, and installation.

F. Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS

2.1 IDENTIFICATION APPLICATIONS

A. Air Handling Units: Nameplates.

B. Dampers: Ceiling tacks, where located above lay-in ceiling.

C. Ductwork: Stencilled painting.

D. Instrumentation: Tags.

E. Relays: Tags.

F. Small-sized Equipment: Tags.

G. Thermostats: Nameplates.

H. Valves: Tags and ceiling tacks where located above lay-in ceiling.

2.2 NAMEPLATES

A. Manufacturers:

1. Advanced Graphic Engraving.

2. Kolbi Pipe Marker Co.

3. Seton Identification Products.

4. Substitutions: See Section 23 01 00 - General HVAC Provisions.

B. Description: Laminated three-layer plastic with engraved letters.

1. Letter Color: White.

2. Letter Height: 1/2 inch.

3. Background Color: Black.

4. Plastic: Conform to ASTM D709.

2.3 TAGS

A. Manufacturers:

1. Advanced Graphic Engraving.

2. Brady Corporation.

3. Kolbi Pipe Marker Co.

4. Seton Identification Products.

5. Substitutions: See Section 23 01 00 - General HVAC Provisions.

B. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter.

C. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.

D. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame. Valve tag chart should should indicate valve size, valve model and valve location. Valve locations with tag numbers shall also be indicated on "as-built" drawings.

2.4 STENCILS

A. Manufacturers:

1. Brady Corporation.

2. Kolbi Pipe Marker Co.

3. Seton Identification Products.

4. Substitutions: See Section 23 01 00 - General HVAC Provisions.

B. Stencils: With clean cut symbols and letters of following size:

1. 3/4 to 1-1/4 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 1/2 inch high letters.

2. 1-1/2 to 2 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 3/4 inch high letters.

3. 2-1/2 to 6 inch Outside Diameter of Insulation or Pipe: 12 inch long color field, 1-1/4 inch high letters.

4. 8 to 10 inch Outside Diameter of Insulation or Pipe: 24 inch long color field, 2-1/2 inch high letters.

5. Over 10 inch Outside Diameter of Insulation or Pipe: 32 inch long color field, 3-1/2 inch high letters.

6. Ductwork and Equipment: 2-1/2 inch high letters.

2.5 CEILING TACKS

A. Manufacturers:

1. Craftmark.

2. Substitutions: See Section 23 01 00 - General HVAC Provisions.

B. Description: Steel with 3/4 inch diameter color coded head.

C. Color code as follows:

1. Yellow - HVAC equipment.

2. Red - Fire dampers/smoke dampers.

3. Blue - Heating/cooling valves.

PART 3 EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

B. Prepare surfaces in accordance with Section 09 91 00 for stencil painting.

3.2 INSTALLATION

A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Install tags with corrosion resistant chain.

C. Install ductwork with stencilled painting. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

D. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Testing, adjustment, and balancing of air systems.

B. Measurement of final operating condition of HVAC systems.

1.2 REFERENCE STANDARDS

A. AABC MN-1 - AABC National Standards for Total System Balance; Associated Air Balance Council; 2002.

B. ASHRAE Std 111 - Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.; 1988, with 1997 Errata.

C. NEBB (TAB) - Procedural Standards for Testing Adjusting Balancing of Environmental Systems; National Environmental Balancing Bureau; 2005, Seventh Edition.

D. SMACNA (TAB) - HVAC Systems Testing, Adjusting, and Balancing; Sheet Metal and Air Conditioning Contractors' National Association; 2002.

1.3 SUBMITTALS

A. See Section 23 01 00 - General HVAC Provisions, for submittal procedures.

B. Qualifications: Submit name of adjusting and balancing agency and TAB supervisor for approval within 30 days after award of Contract.

C. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.

1. Submit to Architect.

2. Submit six weeks prior to starting the testing, adjusting, and balancing work.

3. Include certification that the plan developer has reviewed the contract documents, the equipment and systems, and the control system with the Architect and other installers to sufficiently understand the design intent for each system.

4. Include at least the following in the plan:

a. Preface: An explanation of the intended use of the control system.

b. List of all air flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be

used.

c. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.

d. Identification and types of measurement instruments to be used and their most recent calibration date.

e. Discussion of what notations and markings will be made on the duct and piping drawings during the process.

f. Final test report forms to be used.

g. Detailed step-by-step procedures for TAB work for each system and issue, including:

    1. Terminal flow calibration (for each terminal type).

    2. Diffuser proportioning.

    3. Branch/submain proportioning.

    4. Rechecking.

    5. Diversity issues.

h. Expected problems and solutions, etc.

i. Criteria for using air flow straighteners or relocating flow stations and sensors .

j. Details of how TOTAL flow will be determined; for example:

    1. Air: Sum of terminal flows via control system calibrated readings or via hood readings of all terminals, supply (SA) and return air (RA) pitot traverse, SA or RA flow stations.

k. Specific procedures that will ensure that air side is operating at the lowest possible pressures and methods to verify this.

l. Confirmation of understanding of the outside air ventilation criteria under all conditions.

m. Method of verifying and setting minimum outside air flow rate will be verified and set and for what level (total building, zone, etc.).

n. Method of checking building static and exhaust fan and/or relief damper capacity.

o. Methods for making coil or other system plant capacity measurements, if specified.

p. Time schedule for TAB work to be done in phases (by floor, etc.).

q. Description of TAB work for areas to be built out later, if any.

r. Exhaust fan balancing and capacity verifications, including any required room pressure differentials.

s. Procedures for field technician logs of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests (scope and frequency).

t. Procedures for formal progress reports, including scope and frequency.

u. Procedures for formal deficiency reports, including scope, frequency and distribution.

D. Field Logs: Submit at least once a week to Construction Manager and Engineer. Field logs should be submitted with weekly progress reports and include a record of all discrepancies and issues encountered during the period covered.

E. Control System Coordination Reports: Communicate in writing to the controls installer all setpoint and parameter changes made or problems and discrepancies identified during TAB that affect, or could affect, the control system setup and operation.

F. Progress Reports.

G. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.

1. Submit to the Construction Manager, HVAC controls contractor, and Engineer within two weeks after completion of testing, adjusting, and balancing.

2. Revise TAB plan to reflect actual procedures and submit as part of final report.

3. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect and for inclusion in operating and maintenance manuals.

4. Provide reports in soft cover, letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.

5. Include actual instrument list, with manufacturer name, serial number, and date of calibration.

6. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.

7. Units of Measure: Report data in I-P (inch-pound) units only.

8. Include the following on the title page of each report:

a. Name of Testing, Adjusting, and Balancing Agency.

b. Address of Testing, Adjusting, and Balancing Agency.

c. Telephone number of Testing, Adjusting, and Balancing Agency.

d. Project name.

e. Project location.

f. Project Architect.

g. Project Engineer.

h. Project Contractor.

i. Project altitude.

j. Report date.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

A. Perform total system balance in accordance with one of the following:

1. AABC MN-1, AABC National Standards for Total System Balance.

2. ASHRAE Std 111, Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.

3. NEBB Procedural Standards for Testing Adjusting Balancing of Environmental Systems.

4. SMACNA HVAC Systems Testing, Adjusting, and Balancing.

5. Maintain at least one copy of the standard to be used at project site at all times.

B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.

C. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.

D. TAB Agency Qualifications:

1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.

2. Having minimum of two years documented experience.

3. Certified by one of the following agencies or methods:

   a. AABC, Associated Air Balance Council: www.aabchq.com; upon completion submit AABC National Performance Guaranty.

   b. NEBB, National Environmental Balancing Bureau: www.nebb.org.

   c. TABB, The Testing, Adjusting, and Balancing Bureau of National Energy Management Institute: www.tabbcertified.org.

   d. Test and Balance under direct supervision of a Professional Engineer registered in the State of Oklahoma.

E. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

F. Acceptable TAB Agencies:

1. NEBB.

2. AABC.

3. SMACNA.

4. TABB.

5. Substitutions: Not permitted.

3.2 EXAMINATION

A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:

1. Systems are started and operating in a safe and normal condition.

2. Temperature control systems are installed complete and operable.

3. Proper thermal overload protection is in place for electrical equipment.

4. Final filters are clean and in place. If required, install temporary media in addition to final filters.

5. Duct systems are clean of debris.

6. Fans are rotating correctly.

7. Fire and volume dampers are in place and open.

8. Air coil fins are cleaned and combed.

9. Access doors are closed and duct end caps are in place.

10. Air outlets are installed and connected.

11. Duct system leakage is minimized.

B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.

C. Beginning of work means acceptance of existing conditions. Since work will occur in phases, provide listing of system deficiencies for systems to be balanced during the specified phases.

3.3 PREPARATION

A. Hold a pre-balancing meeting at least one week prior to starting TAB work.

1. Require attendance by all installers whose work will be tested, adjusted, or balanced.

B. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect to facilitate spot checks during testing.

C. Provide additional balancing devices as required.

3.4 ADJUSTMENT TOLERANCES

A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply and outside air systems and plus or minus 10 percent of design for return and exhaust systems.

B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

3.5 RECORDING AND ADJUSTING

A. Field Logs: Maintain written logs including:

1. Running log of events and issues.

2. Discrepancies, deficient or uncompleted work by others.

3. Contract interpretation requests.

4. Lists of completed tests.

B. Ensure recorded data represents actual measured or observed conditions.

C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

D. Mark on the drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.

E. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

G. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.

H. Check and adjust systems approximately six months after final acceptance and submit report.

I. After all adjustments and corrections have been performed to balance system as designed, additional readjustment shall be performed to satisfy desired temperature.

3.6 AIR SYSTEM PROCEDURE

A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities . Test and balance all air handlers for the three design positions i.e. minimum (5% adjustable) outside air, design outside air and economizer operation.

B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.

C. Measure air quantities at air inlets and outlets.

D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

E. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.

F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.

G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.

I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.

J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

K. Where modulating dampers are provided, take measurements and balance at extreme conditions.

L. Measure building static pressure and adjust supply, return, barometric relief dampers, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches positive static pressure near the building entries.

M. Check multi-zone units for motorized damper leakage. Adjust air quantities with mixing dampers set first for cooling, then heating, then modulating.

N. Measure and record supply, return, outside and exhaust air cfm, fan rpm, motor amps, coil entering and leaving air, temperatures (both wet and dry bulb temperatures), outside air (wet and dry bulb temperatures) for cooling and heating operations, system static pressures shall be measured at the required conditions at the minimum and maximum fan speeds.

O. Measure and record the following air handling and distribution systems.

1. Supply, return, outside air and exhaust when system is in the economizer operation. Measure and record supply air and outside air temperatures (both wet and dry bulb).

3.7 SCOPE

A. Test, adjust, and balance the following:

1. Forced Air Furnaces
2. Air Cooled Refrigerant Condensers
3. Air Coils
4. Fan Coils.
5. Fans.
6. Air Filters.
7. Air Inlets and Outlets.

3.8 MINIMUM DATA TO BE REPORTED

A. Electric Motors:

1. Manufacturer
2. Model/Frame
3. HP/BHP
4. Phase, voltage, amperage; nameplate, actual, no load
5. RPM
6. Service factor
7. Starter size, rating, heater elements
8. Sheave Make/Size/Bore

B. V-Belt Drives:

1. Identification/location
2. Required driven RPM
3. Driven sheave, diameter and RPM
4. Belt, size and quantity
5. Motor sheave diameter and RPM
6. Center to center distance, maximum, minimum, and actual

C. Combustion Equipment:

1. Boiler manufacturer
2. Model number
3. Serial number
4. Firing rate
5. Overfire draft
6. Gas meter timing dial size
7. Gas meter time per revolution
8. Gas pressure at meter outlet
9. Gas flow rate
10. Heat input
11. Burner manifold gas pressure
12. Percent carbon monoxide (CO)
13. Percent carbon dioxide (CO2)
14. Percent oxygen (O2)
15. Percent excess air
16. Flue gas temperature at outlet
17. Ambient temperature
18. Net stack temperature
19. Percent stack loss
20. Percent combustion efficiency

21. Heat output

D. Air Cooled Condensers:

1. Identification/number
2. Location
3. Manufacturer
4. Model number
5. Serial number
6. Entering DB air temperature, design and actual
7. Leaving DB air temperature, design and actual
8. Number of compressors

E. Air Moving Equipment:

1. Location
2. Manufacturer
3. Model number
4. Serial number
5. Arrangement/Class/Discharge
6. Air flow, specified and actual
7. Return air flow, specified and actual
8. Outside air flow, specified and actual
9. Total static pressure (total external), specified and actual
10. Inlet pressure
11. Discharge pressure
12. Sheave Make/Size/Bore
13. Number of Belts/Make/Size
14. Fan RPM

F. Return Air/Outside Air:

1. Identification/location

2. Design air flow
3. Actual air flow
4. Design return air flow
5. Actual return air flow
6. Design outside air flow
7. Actual outside air flow
8. Return air temperature
9. Outside air temperature
10. Required mixed air temperature
11. Actual mixed air temperature
12. Design outside/return air ratio
13. Actual outside/return air ratio

G. Exhaust Fans:

1. Location
2. Manufacturer
3. Model number
4. Serial number
5. Air flow, specified and actual
6. Total static pressure (total external), specified and actual
7. Inlet pressure
8. Discharge pressure
9. Sheave Make/Size/Bore
10. Number of Belts/Make/Size
11. Fan RPM

H. Duct Traverses:

1. System zone/branch
2. Duct size

3. Area
4. Design velocity
5. Design air flow
6. Test velocity
7. Test air flow
8. Duct static pressure
9. Air temperature
10. Air correction factor

I. Flow Measuring Stations:

1. Identification/number
2. Location
3. Size
4. Manufacturer
5. Model number
6. Serial number
7. Design Flow rate
8. Design pressure drop
9. Actual/final pressure drop
10. Actual/final flow rate
11. Station calibrated setting

J. Air Distribution Tests:

1. Air terminal number
2. Room number/location
3. Terminal type
4. Terminal size
5. Area factor
6. Design velocity

7. Design air flow
8. Test (final) velocity
9. Test (final) air flow
10. Percent of design air flow

END OF SECTION

SECTION 23 07 13

DUCT INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Duct insulation.

B. Duct Liner.

C. Insulation jackets.

D. Adhesive, tie wires, tape

1.2 RELATED REQUIREMENTS

A. Section 23 01 00 - General HVAC Provisions.

B. Section 23 05 53 - Identification for HVAC Piping & Equipment.

C. Section 23 31 00 - Ducts: Glass fiber ducts.

1.3 REFERENCE STANDARDS

A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.

C. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013 (Reapproved 2019).

D. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).

E. ASTM C916 - Standard Specification for Adhesives for Duct Thermal Insulation; 2020.

F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.

G. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2023.

H. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015.

I. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association; 2006.

J. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.

K. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. See Section 23 01 00 - General HVAC Provisions, for submittal procedures.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

C. Manufacturer's Instructions: Indicate installation procedures necessary to ensure acceptable workmanship and that installation standards will be achieved.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section with not less than five years of documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with a minimum five years of documented experience and approved by manufacturer.

C. Perform work at ambient and equivalent temperatures as recommended by the adhesive manufacturer. Work shall be performed only by mechanics who regularly perform this type of work only.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.

B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.7 FIELD CONDITIONS

A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.1 REQUIREMENTS FOR ALL PRODUCTS OF THIS SECTION

A. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84, NFPA 255, or UL 723.

B. Adhesives to be waterproof.

C. Recovering jackets 6 ounce per square yard canvas attached with a lagging fire retardant adhesive. Install on exposed ductwork insulation. Cover thoroughly with several coats of sizing.

2.2 GLASS FIBER, FLEXIBLE

A. Manufacturer:

1. Knauf Insulation.
2. Johns Manville Corporation.
3. Owens Corning Corp.
4. CertainTeed Corporation.
5. Substitutions: See Section 23 01 00 - General HVAC Provisions.

B. Insulation: ASTM C553; flexible, noncombustible blanket.

1. 'K' value: 0.36 at 75 degrees F, when tested in accordance with ASTM C518.
2. Maximum Service Temperature: 450 degrees F.
3. Maximum Water Vapor Sorption: 5.0 percent by weight.
4. Maximum Moisture Absorption: 0.20 percent by volume.

C. Vapor Barrier Jacket:

1. Kraft paper with glass fiber yarn and bonded to aluminized film.
2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E 96/E 96M.
3. Moisture Vapor Transmission: ASTM E 96; 0.02 perm.
4. Secure with pressure sensitive tape.

D. Vapor Barrier Tape:

1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.

E. Outdoor Vapor Barrier Mastic:

1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

F. Tie Wire: Annealed steel, 16 gage.

2.3 GLASS FIBER, RIGID

A. Manufacturer:

1. Knauf Insulation.
2. Johns Manville Corporation.
3. Owens Corning Corp.
4. CertainTeed Corporation.
5. Substitutions: See Section 23 01 00 - General HVAC Provisions.

B. Insulation: ASTM C612; rigid, noncombustible blanket.

1. 'K' value: 0.24 at 75 degrees F, when tested in accordance with ASTM C518.
2. Maximum service temperature: 450 degrees F.
3. Maximum Water Vapor Sorption: 5.0 percent.
4. Maximum Moisture Absorption: 0.20 percent by volume.
5. Maximum Density: 8.0 lb/cu ft.
6. Density: 3.0 lb/cu ft.

C. Vapor Barrier Jacket:

1. Kraft paper with glass fiber yarn and bonded to aluminized film.
2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E 96/E 96M.
3. Moisture vapor transmission: ASTM E 96; 0.04 perm.
4. Secure with pressure sensitive tape.

D. Vapor Barrier Tape:

1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.

E. Indoor Vapor Barrier Finish:

1. Cloth: Untreated; 9 oz/sq yd weight, glass fabric.
2. Vinyl emulsion type acrylic, compatible with insulation, white color.

2.4 JACKETS

A. Canvas Jacket: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire retardant lagging adhesive.

1. Lagging Adhesive:

a. Compatible with insulation.

B. Mineral Fiber (Outdoor) Jacket: Asphalt impregnated and coated sheet, 50 lb/square.

C. Aluminum Jacket: ASTM B209 (ASTM B209M).

1. Thickness: 0.016 inch sheet.

2. Finish: Embossed.

3. Joining: Longitudinal slip joints and 2 inch laps.

4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.

5. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

2.5 DUCT LINER

A. Manufacturers:

1. Knauf Insulation.

2. Johns Manville Corporation.

3. Owens Corning Corp.

4. CertainTeed Corporation.

B. Insulation: Non-corrosive, incombustible glass fiber complying with ASTM C1071; semi-rigid duct liner; impregnated surface and edges coated with poly vinyl acetate polymer, acrylic polymer, or black composite.

1. Fungi Resistance: ASTM G21.

2. Substitutions: See Section 23 01 00 - General HVAC Provisions.

3. Apparent Thermal Conductivity: Maximum of 0.31 at 75 degrees F.

4. Service Temperature: Up to 250 degrees F.

5. Rated Velocity on Coated Air Side for Air Erosion: 5,000 fpm, minimum.

6. Minimum Noise Reduction Coefficients:

a. 1/2 inch Thickness: 0.30.

b. 1 inch Thickness: 0.45.

c. 1-1/2 inches Thickness: 0.60.

d. 2 inch Thickness: 0.70.

C. Adhesive: Waterproof, fire-retardant type, ASTM C916.

D. Liner Fasteners: Galvanized steel, welded with press-on head.

2.6 MATERIALS

A. External Insulation

1. Concealed Round Ducts: Flexible glass fiber insulation, minimum installed R-value of R-6, with factory applied reinforced aluminum foil vapor barrier for systems conveying air at less than room temperature.

B. Internal Insulation

1. Rectangular Ducts and Plenums: Internal duct insulation shall be semi-rigid duct liner board manufactured from glass fibers bonded with a thermosetting resin. Insulation shall be coated on one side with a fire resistant black coating and shall have a minimum installed R-value of R-6. Duct liner shall be installed by cutting side pieces of insulation to lap both top and bottom sections for maximum support. Install side pieces first. Side pieces and bottom piece shall be attached with 4" strips of adhesive at one foot intervals. Top section of insulation shall be attached with Stick-Klip fasteners secured by Miracle adhesive spaced one fastener per two square feet of insulation. Edges of insulation shall be butted with adhesive to insure a tight joint and provide a smooth surface.

C. Kitchen Hood Grease Exhaust Ducts Insulation

1. Provide two layers of 1 1/2 inch thick UL Listed fire proof blanketing insulation equal to CertainTeed Corporation Flame Check Duct Insulation. Insulation shall be completely encapsulated in a poly aluminum foil fiberglass reinforced scrim. Provide 4-inch wide pressure sensitive tape to seal cut edges of encapsulated blanket. Install insulation per manufacturers recommendation.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that ducts have been tested before applying insulation materials.

B. Verify that surfaces are clean, foreign material removed, and dry.

C. Finish with system at ambient conditions.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. Insulated ducts conveying air below ambient temperature:

1. Provide insulation with vapor barrier jackets.

2. Finish with tape and vapor barrier jacket.

3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.

4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

D. Insulated ducts conveying air above ambient temperature:

1. Provide with or without standard vapor barrier jacket.

2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.

E. Ducts Exposed in Mechanical Equipment Rooms or Finished Spaces : Finish with canvas jacket sized for finish painting.

F. External Duct Insulation Application:

1. Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive or tape to match jacket.

2. Secure insulation without vapor barrier with staples, tape, or wires.

3. Install without sag on underside of duct. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift duct off trapeze hangers and insert spacers.

4. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.

5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

G. Duct and Plenum Liner Application:

1. Adhere insulation with adhesive for 100 percent coverage.

2. Secure insulation with welded mechanical liner fasteners. Refer to SMACNA HVAC Duct Construction Standards - Metal and Flexible and NAIMA Fibrous Glass Duct Liner Standards (latest edition) for spacing.

3. Seal and smooth joints. Seal and coat transverse joints.

4. Seal liner surface penetrations with adhesive.

5. Duct dimensions indicated are net inside dimensions required for air flow. Increase duct size to allow for insulation thickness.

3.3 SCHEDULES

A. Exhaust Ducts: Externally wrap.

B. Outside Air Intake Ducts:

1. Round: Externally insulate with 2-inch thick insulation, minimum installed R-value of R-6.

2. Rectangular: Internally insulate with 1-inch thick semi-rigid duct liner with adhesive and welded mechanical fasteners, minimum installed R-value of R-6.

C. Plenums: Internally insulate with 1-inch thick insulation, minimum installed R-value of R-6.

D. Concealed Supply Ducts:

1. Round Duct: Externally insulate with 2-inch thick insulation, minimum installed R-value of R-6.

2. Rectangular: Internally insulate with 1-inch thick, semi-rigid duct liner, minimum installed R-value of R-6, with adhesive and welded mechanical fasteners.

E. Concealed Return Air Ducts and Plenums:

1. Round: Externally insulate with 2-inch thick insulation, minimum installed R-value of R-6.

2. Rectangular: Internally insulate with 1-inch thick, minimum installed R-value of R-6, semi-rigid duct liner with adhesive and welded mechanical fasteners.

3. Plenums: Internally insulate with 1.5-inch thick, minimum installed R-value of R-6, semi-rigid duct liner with adhesive and welded mechanical fasteners.

END OF SECTION

SECTION 23 23 00

REFRIGERANT PIPING AND SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Piping.

B. Refrigerant.

C. Moisture and liquid indicators.

D. Valves.

E. Strainers.

F. Check valves.

G. Filter-driers.

H. Solenoid valves.

I. Expansion valves.

1.2 RELATED REQUIREMENTS

A. Section 22 07 19 - Piping Insulation.

B. Section 23 07 19 - HVAC Piping Insulation.

C. Section 23 54 00 - Furnaces.

D. Section 23 63 13 - Air Cooled Refrigerant Condensers.

E. Division 26 - Equipment Wiring: Electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

A. AHRI 710 - Performance Rating of Liquid-Line Driers; 2009.

B. AHRI 750 - Thermostatic Refrigerant Expansion Valves; 2007.

C. AHRI 760 - Performance Rating of Solenoid Valves for Use With Volatile Refrigerants; 2007.

D. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2022, with Addendum (2024).

E. ASHRAE Std 34 - Designation and Safety Classification of Refrigerants; 2022, with Errata (2024).

F. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels; 2023.

G. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2023.

H. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes; 2018.

I. ASME B31.9 - Building Services Piping; 2020.

J. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.

K. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2013.

L. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2019.

M. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018, with Amendment (2019).

1.4 SYSTEM DESCRIPTION

A. Where more than one piping system material is specified ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

B. Provide pipe hangers and supports in accordance with ASME B31.5 unless indicated otherwise.

C. Liquid Indicators:

1. Use line size liquid indicators in main liquid line leaving condenser.

2. If receiver is provided, install in liquid line leaving receiver.

3. Use line size on leaving side of liquid solenoid valves.

D. Valves:

1. Use service valves on suction and discharge of compressors.

2. Use gage taps at compressor inlet and outlet.

3. Use gage taps at hot gas bypass regulators, inlet and outlet.

4. Use check valves on compressor discharge.

5. Use check valves on condenser liquid lines on multiple condenser systems.

E. Refrigerant Charging (Packed Angle) Valve: Use in liquid line between receiver shut-off valve and expansion valve.

F. Strainers:

1. Use line size strainer upstream of each automatic valve.

2. Where multiple expansion valves with integral strainers are used, use single main liquid line strainer.

3. On steel piping systems, use strainer in suction line.

4. Use shut-off valve on each side of strainer.

G. Filter-Driers:

1. Use a filter-drier immediately ahead of liquid-line controls, such as thermostatic expansion valves, solenoid valves, and moisture indicators.

2. Use a filter-drier on suction line just ahead of compressor.

3. Use sealed filter-driers in lines smaller than 1/2 inch outside diameter.

4. Use sealed filter-driers in low temperature systems.

5. Use sealed filter-driers in systems utilizing hermetic compressors.

6. Use replaceable core filter-driers in lines of 3/4 inch outside diameter or greater.

7. Use filter-driers for each solenoid valve.

H. Solenoid Valves:

1. Use in liquid line of systems operating with single pump-out or pump-down compressor control.

2. Use in liquid line of single or multiple evaporator systems.

3. Use in oil bleeder lines from flooded evaporators to stop flow of oil and refrigerant into the suction line when system shuts down.

1.5 SUBMITTALS

A. See Section 23 01 00 - General HVAC Provisions, for submittal procedures.

B. Product Data: Provide general assembly of specialties, including manufacturers catalogue information. Provide manufacturers catalog data including load capacity.

C. Shop Drawings: Indicate schematic layout of system, including equipment, critical dimensions, and sizes.

D. Design Data: Submit design data indicating pipe sizing. Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.

E. Test Reports: Indicate results of leak test, acid test.

F. Manufacturer's Installation Instructions: Indicate support, connection requirements, and isolation for servicing.

G. Project Record Documents: Record exact locations of equipment and refrigeration accessories on record drawings.

H. Maintenance Data: Include instructions for changing cartridges, assembly views, spare parts lists.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum three years of documented experience.

B. Design piping system under direct supervision of a licensed hvac company experienced in design of this type of work and licensed in the state where the Project is located.

1.7 REGULATORY REQUIREMENTS

A. Conform to ASME B31.9 for installation of piping system.

B. Welding Materials and Procedures: Conform to ASME (BPV IX) .

C. Welders Certification: In accordance with ASME (BPV IX).

D. Products Requiring Electrical Connection: Listed and classified by UL, as suitable for the purpose indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store piping and specialties in shipping containers with labeling in place.

B. Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.

C. Dehydrate and charge components such as piping and receivers, seal prior to shipment, until connected into system.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Filter-Driers:

1. Use a filter-drier immediately ahead of liquid-line controls, such as thermostatic expansion valves, solenoid valves, and moisture indicators.

2.2 REGULATORY REQUIREMENTS

2.3 PIPING

A. Copper Tube to 7/8 inch OD: ASTM B88 (ASTM B88M), Type K (A), annealed.

1. Fittings: ASME B16.26 cast copper.

2. Joints: Flared.

B. Pipe Supports and Anchors:

1. Conform to ASME B31.5.

2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Carbon steel adjustable swivel, split ring.

3. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.

4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

5. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.

6. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.

7. Vertical Support: Steel riser clamp.

8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

9. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

10. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

11. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.4 REFRIGERANT

A. Refrigerant: As defined in ASHRAE Std 34.

1. R-410A.

2.5 MOISTURE AND LIQUID INDICATORS

A. Manufacturers:

1. Henry Technologies.

2. Parker Hannifin/Refrigeration and Air Conditioning.

3. Sporlan Valve Company.

4. Substitutions: See Section 23 01 00 - General HVAC Provisions.

B. Indicators: Single port type, UL listed, with copper or brass body, flared or solder ends, sight glass, color coded paper moisture indicator and plastic cap; for maximum temperature of 200 degrees F and maximum working pressure of 460 psi.

2.6 VALVES

A. Manufacturers:

1. Hansen Technologies Corporation.

2. Henry Technologies.

3. Danfoss Automatic Controls.

4. Substitutions: See Section 23 01 00 - General HVAC Provisions.

B. Diaphragm Packless Valves:

1. UL listed, globe or angle pattern, forged brass body and bonnet, phosphor bronze and stainless steel diaphragms, rising stem and handwheel, stainless steel spring, nylon seat disc, solder or flared ends, with positive backseating; for maximum working pressure of 500 psi and maximum temperature of 275 degrees F.

C. Packed Angle Valves:

1. Forged brass , forged brass seal caps with copper gasket, rising stem and seat , molded stem packing, solder or flared ends; for maximum working pressure of 500 psi and maximum temperature of 275 degrees F.

D. Ball Valves:

1. Two piece forged brass body with teflon ball seals and copper tube extensions, brass seal cap, chrome plated ball, stem with neoprene ring stem seals; for maximum working pressure of 500 psi and maximum temperature of 325 degrees F.

E. Service Valves:

1. Forged brass body with copper stubs, brass caps, removable valve core, integral ball check valve, flared or solder ends, for maximum pressure of 500 psi.

2.7 STRAINERS

A. Straight Line or Angle Line Type:

1. Brass or steel shell, steel cap and flange, and replaceable cartridge, with screen of stainless steel wire or monel reinforced with brass; for maximum working pressure of 430 psi.

B. Straight Line, Non-Cleanable Type:

1. Steel shell, copper plated fittings, stainless steel wire screen, for maximum working pressure of 500 psi.

2.8 CHECK VALVES

A. Manufacturers:

1. Hansen Technologies Corporation.

2. Parker Hannifin/Refrigeration and Air Conditioning.

3. Sporlan Valve Company.

4. Substitutions: See Section 01 60 00 - Product Requirements.

5. Substitutions: See Section 23 01 00 - General HVAC Provisions.

B. Globe Type:

1. Cast bronze or forged brass body, forged brass cap with neoprene seal, brass guide and disc holder, phosphor-bronze or stainless steel spring, teflon seat disc; for maximum temperature of 300 degrees F and maximum working pressure of 425 psi.

C. Straight Through Type:

1. Brass body and disc, phosphor-bronze or stainless steel spring, neoprene seat; for maximum working pressure of 500 psi and maximum temperature of 250 degrees F.

2.9 FILTER-DRIERS

A. Manufacturers:

1. Flow Controls Division Emerson Electric Co.

2. Parker Hannifin/Refrigeration and Air Conditioning.

3. Sporlan Valve Company.

4. Substitutions: See Section 23 01 00 - General HVAC Provisions.

B. Performance:

1. Flow Capacity - Liquid Line: As indicated in schedule, minimum, rated in accordance with AHRI 710.

2. Flow Capacity - Suction Line: As indicated in schedule, minimum, rated in accordance with AHRI 730 (I-P).

3. Pressure Drop: 2 psi, maximum, when operating at full connected evaporator capacity.

4. Design Working Pressure: 500 psi, minimum.

C. Cores: Molded or loose-fill molecular sieve desiccant compatible with refrigerant, activated alumina, and filtration to 40 microns; of construction that will not pass into refrigerant lines.

D. Construction: UL listed.

1. Replaceable Core Type: Steel shell with removable cap.

2. Sealed Type: Copper shell.

3. Connections: As specified for applicable pipe type.

2.10 SOLENOID VALVES

A. Manufacturers:

1. Flow Controls Division of Emerson Electric.

2. Parker Hannifin/Refrigeration and Air Conditioning.

3. Sporlan Valve Company.

4. Substitutions: See Section 23 01 00 - General HVAC Provisions.

B. Valve: AHRI 760, pilot operated, copper or brass body and internal parts, synthetic seat, stainless steel stem and plunger assembly (permitting manual operation in case of coil failure), integral strainer, with flared, solder, or threaded ends; for maximum working pressure of 500 psi.

C. Coil Assembly: UL listed, replaceable with molded electromagnetic coil, moisture and fungus proof, with surge protector and color coded lead wires, integral junction box.

2.11 EXPANSION VALVES

A. Manufacturers:

1. Flow Controls Division of Emerson Electric.

2. Parker Hannifin/Refrigeration and Air Conditioning.

3. Sporlan Valve Company.

4. Substitutions: See Section 23 01 00 - General HVAC Provisions.

B. Angle or Straight Through Type: AHRI 750; design suitable for refrigerant, brass body, internal or external equalizer, mechanical pressure limit (maximum operating pressure MOP feature), adjustable superheat setting, replaceable inlet strainer, with replaceable capillary tube and remote sensing bulb.

C. Selection: Evaluate refrigerant pressure drop through system to determine available pressure drop across valve. Select valve for maximum load at design operating pressure and minimum 10 degrees F superheat. Select to avoid being undersized at full load and excessively oversized at part load.

PART 3 EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.2 INSTALLATION

A. Install refrigeration specialties in accordance with manufacturer's instructions.

B. Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.

C. Install piping to conserve building space and avoid interference with use of space.

D. Group piping whenever practical at common elevations and locations. Slope piping one percent in direction of oil return.

E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

F. Inserts:

1. Provide inserts for placement in concrete formwork.

2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.

4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

G. Pipe Hangers and Supports:

1. Install in accordance with ASME B31.5.

2. Support horizontal piping as scheduled.

3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.

4. Place hangers within 12 inches of each horizontal elbow.

5. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.

6. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

7. Provide copper plated hangers and supports for copper piping.

H. Arrange piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required. Slope horizontal piping 0.40 percent in direction of flow.

I. Provide clearance for installation of insulation and access to valves and fittings.

J. Provide access to concealed valves and fittings.

K. Flood piping system with nitrogen when brazing.

L. Where pipe support members are welded to structural building frame, brush clean, and apply one coat of zinc rich primer to welding.

M. Prepare unfinished pipe, fittings, supports, and accessories ready for finish painting.

N. Insulate piping and equipment; refer to Section and Section 23 07 16.

O. Follow ASHRAE Std 15 procedures for charging and purging of systems and for disposal of refrigerant.

P. Provide replaceable cartridge filter-driers, with isolation valves and valved bypass.

Q. Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.

R. Provide external equalizer piping on expansion valves with refrigerant distributor connected to evaporator.

S. Install flexible connectors at right angles to axial movement of compressor, parallel to crankshaft.

T. Fully charge completed system with refrigerant after testing.

U. Provide electrical connection to solenoid valves. Refer to Division 26.

3.3 FIELD QUALITY CONTROL

A. Test refrigeration system in accordance with ASME B31.5.

B. Pressure test system with dry nitrogen to 200 psi. Perform final tests at 27 inches vacuum and 200 psi using electronic leak detector. Test to no leakage.

3.4 SCHEDULES

A. Hanger Spacing for Copper Tubing.

1. 1/2 inch, 5/8 inch, and 7/8 inch OD: Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. 1-1/8 inch OD: Maximum span, 6 feet; minimum rod size, 1/4 inch.
3. 1-3/8 inch OD: Maximum span, 7 feet; minimum rod size, 3/8 inch.
4. 1-5/8 inch OD: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. 2-1/8 inch OD: Maximum span, 8 feet; minimum rod size, 3/8 inch.
6. 2-5/8 inch OD: Maximum span, 9 feet; minimum rod size, 3/8 inch.
7. 3-1/8 inch OD: Maximum span, 10 feet; minimum rod size, 3/8 inch.
8. 3-5/8 inch OD: Maximum span, 11 feet; minimum rod size, 1/2 inch.
9. 4-1/8 inch OD: Maximum span, 12 feet; minimum rod size, 1/2 inch.

END OF SECTION

SECTION 23 31 00

DUCTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Metal ductwork.

B. Duct cleaning.

1.2 RELATED REQUIREMENTS

A. Section 11 40 00 - Foodservice Equipment: Kitchen range hoods.

B. Section 23 07 13 - Duct Insulation: External insulation and duct liner.

C. Section 23 33 00 - Duct Accessories.

D. Section 23 33 30 - Air Duct Sealants.

E. Section 23 37 00 - Air Outlets and Inlets.

F. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC.

1.3 REFERENCE STANDARDS

A. ASHRAE (FUND) - ASHRAE Handbook - Fundamentals; Most Recent Edition Cited by Referring Code or Reference Standard.

B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

C. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2015b.

D. ASTM A480/A480M - Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip; 2015.

E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

F. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.

G. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

H. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.

I. ASTM C14M - Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe (Metric).; 2020.

J. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.

K. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2018, with Editorial Revision (2020).

L. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry; 2018, with Editorial Revision (2020).

M. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2017, with Editorial Revision (2020).

N. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2015.

O. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2015.

P. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; 2024.

Q. SMACNA (LEAK) - HVAC Air Duct Leakage Test Manual; Sheet Metal and Air Conditioning Contractors' National Association; 2012, 2nd Edition.

R. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.

S. SMACNA (KVS) - Kitchen Ventilation Systems and Food Service Equipment Fabrication and Installation Guidelines; 2001.

1.4 DEFINITIONS

A. Duct Sizes: Duct sizes indicated on drawings are inside clear dimensions.

B. Low Pressure: Static pressure in duct less than 1" WG and velocities less than 2000 fpm (10 meters/second).

1.5 SUBMITTALS

A. See Section 23 01 00 - General HVAC Provisions, for submittal procedures.

B. Product Data: Provide data for duct materials, duct liner, and duct connections.

C. Shop Drawings: Indicate duct fittings, particulars such as gages, sizes, welds, and configuration prior to start of work for all systems.

D. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA (LEAK) - HVAC Air Duct Leakage Test Manual.

E. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

F. Confirm ductwork has been fabricated and installed in accordance with recommendations and SMACNA standards.

1.6 QUALITY ASSURANCE

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

B. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum five years of documented experience.

1.7 REGULATORY REQUIREMENTS

A. Construct ductwork to NFPA 90A, NFPA 90B, and NFPA 96, standards.

1.8 FIELD CONDITIONS

A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.

B. Maintain temperatures within acceptable range during and after installation of duct sealants.

PART 2 PRODUCTS

2.1 MATERIALS

A. Galvanized Steel for Ducts: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G90/Z275 coating.

B. Aluminum for Ducts: ASTM B209 (ASTM B209M); aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock: Alloy 6061-T651 or of equivalent strength.

C. Stainless Steel for Ducts: ASTM A 240/A 240M, Type 316.

D. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.

1. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.

2. VOC Content: Not more than 250 g/L, excluding water.

3. Surface Burning Characteristics: Flame spread of zero, smoke developed of zero, when tested in accordance with ASTM E84.

4. For Use With Flexible Ducts: UL labeled.

5. Products:

a. Seal all joints and seams on sheet metal supply, return, makeup air and exhaust ductwork with "Hardcast" type DT sealing tape and type FTA adhesive or "Hardcast" iron grip 601 duct sealant installed in strict accordance with manufacturer's instructions. Clean all dirt, oil, moisture, etc., before applying adhesive. Duct tape, UL listed or not, is not acceptable.

b. Substitutions: See Section 23 01 00 - General HVAC Provisions.

E. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

F. Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:

1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.

2. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.

3. Concrete Screw Type Anchors: Complying with ICC-ES AC193.

4. Masonry Screw Type Anchors: Complying with ICC-ES AC106.

5. Other Types: As required.

2.2 DUCT ASSEMBLIES

A. All Ducts: Galvanized steel, unless otherwise indicated.

B. Low Pressure Supply (Heating Systems): 1 inch w.g. pressure class, galvanized steel.

C. Return and Relief: 1 inch w.g. pressure class, galvanized steel.

D. General Exhaust: 1 inch w.g. pressure class, galvanized steel.

E. Kitchen Cooking Hood Exhaust: 1 inch w.g. pressure class, stainless steel or 16 gage black iron.

1. Construct of 16 gage black iron using continuous external welded joints in rectangular sections.

2. Construct of 18 gage stainless steel using continuous external welded joints in rectangular sections.

F. Outside Air Intake: 1 inch w.g. pressure class, galvanized steel.

G. Combustion Air: 1 inch w.g. pressure class, galvanized steel.

2.3 DUCTWORK FABRICATION

A. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

B. No variation of duct configuration or size permitted except by written permission. Size round duct installed in place of rectangular ducts in accordance with ASHRAE Handbook - Fundamentals.

C. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

D. Provide air foil turning vanes when rectangular elbows must be used.

E. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

F. Fabricate continuously welded round duct fittings two gages heavier than duct gages indicated in SMACNA Standard. Joints shall be minimum 4 inch cemented slip joint, brazed or electric welded. Prime coat welded joints.

G. Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.

H. Lap metal duct in direction of air flow. Hammer down edges and slips to leave smooth duct interior.

I. Size round ducts installed in place of rectangular ducts from ASHRAE Table of Equivalent Rectangular and Round Ducts. No variation of duct configuration or sizes permitted except by written permission.

J. Rigidly construct metal ducts with joints mechanically tight, substantially airtight, braced and stiffened so as not to breathe, rattle, vibrate or sag. Caulk duct joints and connections with sealant as ducts are being assembled.

2.4 MANUFACTURED DUCTWORK AND FITTINGS

A. Flexible Ducts: Two ply vinyl film supported by helically wound spring steel wire.

1. Insulation: Fiberglass insulation with aluminized fiberglass scrim vapor barrier film.

2. Pressure Rating: 6 inches WG positive and 1.0 inches WG negative.

3. Maximum Velocity: 5000 fpm.

4. Temperature Range: -10 degrees F to 160 degrees F.

5. R-6.0 Formaldehyde free insulation.

6. UL -181 (UL listed).

7. Manufacturers:

a. Hart & Cooley.

b. Flex Master.

c. Substitutions: See Section 23 01 00 - General HVAC Provisions.

2.5 KITCHEN HOOD EXHAUST DUCTWORK

A. Duct shall not pass through fire walls or fire partitions.

B. Ducts shall be constructed of and supported by carbon steel not less than 0.054 Inches (No. 16 MSG) in thickness or stainless steel not less than 0.043 inches (No. 18 MSG) in thickness.

C. All seams, joints, penetrations, and duct to hood collar connections shall have a liquid tight continuous external weld.

D. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, SMACNA Kitchen Ventilation Systems and Food Service Equipment Fabrication & Installation Guidelines and NFPA 96.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install, support, and seal ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

B. Install in accordance with manufacturer's instructions.

C. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

D. Flexible Ducts: Connect to metal ducts with draw bands.

E. Kitchen Range Hoods: Install when provided by Section 11 40 00 then fit-out with respective ductwork and accessories to interconnect exhaust system.

F. Kitchen Hood Exhaust: Provide residue traps at the base of vertical risers with provisions for the cleanout.

G. Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.

H. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

I. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

J. Use crimp joints with or without bead for joining round duct sizes 8 inch and smaller with crimp in direction of air flow.

K. Use double nuts and lock washers on threaded rod supports.

L. Connect diffusers or light troffer boots to low pressure ducts directly or with 5 feet maximum length of flexible duct held in place with strap or clamp.

M. Connect flexible ducts to metal ducts per manufacturer's recommendations.

N. At exterior wall louvers, seal duct to louver frame and install blank-out panels.

O. All round and rectangular duct installed in exposed areas shall be paint lock duct.

3.2 CLEANING

A. Clean duct systems with high power vacuum machines. Protect equipment that could be harmed by excessive dirt with filters, or bypass during cleaning. Provide adequate access into ductwork for cleaning purposes.

B. If determined by the Architect and/or Engineer, that during construction the duct systems were not adequately protected and dirt/debris was allowed to enter the installed ductwork, then it will be required by the HVAC contractor for the duct system to be cleaned. If required, clean duct systems with high power vacuum machines. Protect equipment that could be harmed by excessive dirt with filters, or bypass during cleaning. Provide adequate access into ductwork for cleaning purposes.

END OF SECTION

SECTION 23 33 00

DUCT ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Air turning devices/extractors.

B. Backdraft dampers - metal.

C. Duct access doors.

D. Duct test holes.

E. Fire dampers.

F. Flexible duct connections.

G. Volume control dampers.

1.2 RELATED REQUIREMENTS

A. Section 23 31 00 - Ducts.

B. Division 26 - Electrical: Electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

A. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2015.

B. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.

C. UL 33 - Safety Heat Responsive Links for Fire-Protection Service; Current Edition, Including All Revisions.

D. UL 555 - Standard for Fire Dampers; Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. See Section 23 01 00 - General HVAC Provisions, for submittal procedures.

B. Project Record Drawings: Record actual locations of access doors, access doors, test holes, and fire dampers.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. Extra Fusible Links: Two of each type and size.

1.5 QUALITY ASSURANCE

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

B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect dampers from damage to operating linkages and blades.

PART 2 PRODUCTS

2.1 AIR TURNING DEVICES/EXTRACTORS

A. Manufacturers:

1. Krueger.

2. PCI Industries, Inc; Pottorff Brand.

3. Ruskin Company.

4. Titus.

5. Substitutions: See Section 23 01 00 - General HVAC Provisions.

B. Multi-blade device with blades aligned in short dimension; steel or aluminum construction; with individually adjustable blades, mounting straps.

C. Multi-blade device with radius blades attached to pivoting frame and bracket, steel or aluminum construction, with worm drive mechanism with removable key operator.

2.2 BACKDRAFT DAMPERS - METAL

A. Manufacturers:

1. Louvers & Dampers, Inc.

2. Nailor Industries Inc.

3. PCI Industries, Inc; Pottorff Brand.

4. Ruskin Company.

5. Substitutions: See Section 23 01 00 - General HVAC Provisions.

B. Gravity Backdraft Dampers, Size 18 x 18 inches or Smaller, Furnished with Air Moving Equipment: Air moving equipment manufacturer's standard construction.

C. Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: Galvanized steel, with center pivoted blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

2.3 DUCT ACCESS DOORS

A. Manufacturers:

1. Nailor Industries Inc.
2. Ruskin Company.
3. Greenheck Fan Corporation.
4. SEMCO Incorporated.
5. Substitutions: See Section 23 01 00 - General HVAC Provisions.

B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

C. Fabrication: Rigid and close-fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ducts, install minimum 1 inch thick insulation with sheet metal cover.

1. Less Than 12 inches Square: Secure with sash locks.
2. Up to 18 inches Square: Provide two hinges and two sash locks.
3. Up to 24 x 48 inches: Three hinges and two compression latches with outside and inside handles.
4. Larger Sizes: Provide an additional hinge.

D. Access doors with sheet metal screw fasteners are not acceptable.

2.4 DUCT TEST HOLES

A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

B. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

2.5 FIRE DAMPERS

A. Manufacturers:

1. Louvers & Dampers, Inc.

2. Nailor Industries Inc.

3. Ruskin Company.

4. Greenheck Fan Corporation.

5. Substitutions: See Section 23 01 00 - General HVAC Provisions.

B. Fabricate in accordance with NFPA 90A and UL 555, and as indicated.

C. Ceiling Dampers: Galvanized steel, 22 gage frame and 16 gage flap, two layers 0.125 inch ceramic fiber on top side and one layer on bottom side for round flaps, with locking clip.

D. Horizontal Dampers: Galvanized steel, 22 gage frame, stainless steel closure spring, and lightweight, heat retardant non-asbestos fabric blanket.

E. Multiple Blade Dampers: 16 gage galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, 1/8 x 1/2 inch plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.

F. Curtain Type Dampers: Galvanized steel with interlocking blades. Provide dynamic style dampers with stainless steel closure springs and latches for closure under air flow conditions. Configure with blades out of air stream.

G. Fusible Links: UL 33, separate at 160 degrees F with adjustable link straps for combination fire/balancing dampers.

2.6 FLEXIBLE DUCT CONNECTIONS

A. Manufacturers:

B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

C. Connector: Fabric crimped into metal edging strip.

1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz per sq yd.

a. Net Fabric Width: Approximately 3 inches wide.

2. Metal: 3 inches wide, 24 gage thick galvanized steel.

2.7 VOLUME CONTROL DAMPERS

A. Manufacturers:

1. Louvers & Dampers, Inc.

2. Nailor Industries Inc.

3. Ruskin Company.

4. Greenheck Fan Company.

5. Jer-Air Manufacturing.

6. United Enertech.

7. Substitutions: See Section 23 01 00 - General HVAC Provisions.

B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

C. Single Blade Dampers: Fabricate for duct sizes up to 6 x 30 inch.

1. Fabricate for duct sizes up to 6 x 30 inch.

2. Blade: 24 gage, minimum.

D. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8 x 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.

1. Blade: 18 gage, minimum.

E. End Bearings: Except in round ducts 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings.

F. Quadrants:

1. Provide locking, indicating quadrant regulators on single and multi-blade dampers.

2. On insulated ducts mount quadrant regulators on minimum 2-inch stand-off mounting brackets, bases, or adapters.

3. Where rod lengths exceed 30 inches provide regulator at both ends.

2.8 MISCELLANEOUS PRODUCTS

A. Duct Opening Closure Film: Mold-resistant, self-adhesive film to keep debris out of ducts during construction.

1. Thickness: 2 mils.

2. High tack water based adhesive.

3. UV stable light blue color.

4. Elongation Before Break: 325 percent, minimum.

PART 3 EXECUTION

3.1 PREPARATION

A. Verify that electric power is available and of the correct characteristics.

3.2 INSTALLATION

A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible. Refer to Section 23 31 00 for duct construction and pressure class.

B. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

C. Provide duct access doors for inspection and cleaning before and after filters, coils, fans and elsewhere as indicated. Provide minimum 8 x 8 inch size for hand access, size for shoulder access, and as indicated. Provide 4 x 4 inch for balancing dampers only. Review locations prior to fabrication.

D. Provide duct test holes where indicated and required for testing and balancing purposes.

E. Provide fire dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by Authorities Having Jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.

F. Demonstrate re-setting of fire dampers to Owner's representative.

G. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment.

H. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum 2 duct widths from duct take-off.

END OF SECTION

SECTION 23 33 30

AIR DUCT SEALANTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Air duct sealants for permanently sealing fabricated joints and seams of HVAC air ducts and thermal insulation.

B. Reinforcing membrane for sealants.

1.2 RELATED SECTIONS

A. Section 23 07 13 - Duct Insulation.

B. Section 23 31 00 - HVAC Ducts and Casings.

C. Section 23 33 00 - Duct Accessories.

1.3 REFERENCES

A. ASTM D 1668 - Standard Specification for Glass Fabrics (Woven and Treated) for Roofing and Waterproofing; 1995.

B. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2005.

C. ASTM E 96/E 96M - Standard Test Methods for Water Vapor Transmission of Materials; 2005.

D. UL 181A - Closure Systems for Use with Rigid Air Ducts and Air Connectors; Underwriters Laboratories Inc.; 2005.

E. UL 181B - Closure Systems for Use with Flexible Air Ducts and Air Connectors; Underwriters Laboratories Inc.; 2005.

1.4 SUBMITTALS

A. See Section 23 01 00 - General HVAC Provisions, for submittal procedures.

B. Product Data: Manufacturer's product data, including physical properties and application instructions.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.

B. Store materials in accordance with manufacturer's instructions. Protect from freezing.

1. Storage Temperature: 40 to 100 degrees F.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Do not apply below 35 degrees F. or above 120 degrees F.

B. Avoid high humidity.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer:

1. Hardcast, Inc.

2. RCD Corporation.

B. Substitutions: See Section 23 01 00 - General HVAC Provisions.

C. Supply all products specified in this section from a single manufacturer.

2.2 AIR DUCT SEALANTS

A. Low to High Velocity Air Duct Sealant: Non-toxic, water-based, fiber-reinforced adhesive-sealant; for permanently sealing fabricated joints and seams of sheet metal air ducts, UL 181 listed rigid fiberglass air ducts, UL 181 listed flexible air ducts, and thermal insulation; for repairing damaged and leaking air ducts; for sealing conditioned spaces from air infiltration.

1. Type: Elastomeric terpolymer emulsion.

2. Underwriters Laboratories Listed: UL 181A-M and UL 181B-M.

3. Solids by Weight: 67 percent, plus or minus 2 percent.

4. Weight per Gallon: 10.5 pounds, plus or minus 0.20 pounds.

5. Wet Film Coverage: 100 linear feet per gallon at 1/16 inch thick by 3 inches wide.

6. Consistency: Thixotropic, non-sagging.

7. Adhesive Cure: 72 hours at 50 percent humidity and 70 degrees F.

8. Service Temperature Limits: Minus 10 degrees to 180 degrees F.

9. Water Vapor Transmission Rate: 0.6157 perms in accordance with ASTM E 96.

10. Flame Spread Index: Not greater than 5, when tested in accordance with ASTM E 84.

11. Smoke Developed Index: Zero, when tested in accordance with ASTM E 84.

B. Low to High Velocity Air Duct Sealant: Hardcast Iron Grip 601 non-toxic, water-based, adhesive-sealant; for permanently sealing fabricated joints and seams of sheet metal air ducts, UL 181 listed rigid fiberglass air ducts, UL 181 listed flexible air ducts, and thermal insulation; for repairing damaged and leaking air ducts; for sealing conditioned spaces from air infiltration.

1. Type: Elastomeric terpolymer emulsion.
2. Underwriters Laboratories Listed: UL 181A-M and UL 181B-M.
3. Solids by Weight: 70 percent, plus or minus 2 percent.
4. Wet Film Coverage: 320 linear feet per gallon at 20 mil thick by 3 inches wide.
5. Consistency: Thixotropic, non-sagging.
6. Adhesive Cure: 48 hours at 50 percent humidity and 70 degrees F.
7. Flame Spread Index: Not greater than 5, when tested in accordance with UL-723.
8. Smoke Developed Index: Zero, when tested in accordance with UL-723.

C. Reinforcing Membrane: RCD "Glasscoat" inorganic woven fiberglass reinforcing membrane; conforming to irregular surfaces for sealing and coating thermal insulation, air ducts, return air plenums, equipment, vessels, pipes, and fittings.

1. ASTM D 1668, Type III.
2. Nominal Dry Weight: 1.2 to 2.0 ounces per square yard.
3. Saturated Weight: 1.6 to 2.6 ounces per square yard.
4. Nominal Thread Count: 10 by 20.
5. Breaking Strength, Saturated: 75 warp, 75 fill minimum.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine surfaces to receive air duct sealants.

B. Notify Architect of conditions that would adversely affect application of sealants. Do not proceed with application until unsatisfactory conditions are corrected.

3.2 SURFACE PREPARATION

A. Prepare surfaces in accordance with manufacturer's instructions.

B. Remove water, dirt, oil, grease, and corrosion from surfaces to receive air duct sealants.

3.3 APPLICATION

A. Apply air duct sealants in accordance with manufacturer's instructions.

B. Apply to sheet metal air ducts, UL 181 listed rigid fiberglass air ducts, UL 181 listed flexible air ducts, thermal insulation, and other surfaces where indicated.

C. Do not thin or mix.

D. Apply tack coat at rate of 2 gallons per 100 square feet.

E. Embed reinforcing membrane into tack coat.

F. Apply finish coat at rate of 2 gallons per 100 square feet.

G. Allow drying time as follows:

1. Minimum 6 hours when used outdoors if wet weather is imminent.

2. Minimum 24 hours before using air duct system.

3. Additional time as required by air temperature and humidity conditions.

END OF SECTION

SECTION 23 34 23

POWER VENTILATORS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Roof exhausters.

1.2 RELATED REQUIREMENTS

A. Section 23 31 00 - HVAC Ducts and Casings.

B. Section 23 33 00 - Duct Accessories: Backdraft dampers.

C. Division 26 - Electrical: Equipment Wiring.

1.3 REFERENCE STANDARDS

A. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating; 2016, with Errata (2018).

B. AMCA 261 - Directory of Products Licensed to Use the AMCA Certified Ratings Seal; Air Movement and Control Association International, Inc.; http://www.amca.org/licenses/search.aspx.

C. AMCA 300 - Reverberation Room Methods of Sound Testing of Fans; 2024.

D. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data; 2022.

E. NEMA MG 1 - Motors and Generators; 2014.

1.4 SUBMITTALS

A. See Section 23 01 00 - General HVAC Provisions, for submittal procedures.

B. Product Data: Provide data on fans and accessories including fan curves with specified operating point clearly plotted, power, RPM, sound power levels at rated capacity, and electrical characteristics and connection requirements.

C. Manufacturer's Instructions: Indicate installation instructions.

D. Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.5 QUALITY ASSURANCE

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

B. Equivalent fan selections shall not increase or decrease motor horsepower, increase top speed by more than 10%, or increase inlet air velocity by more than 20% from that specified.

C. Provide fans capable of accommodating static pressure variations of plus or minus 10%.

D. Provide balanced variable for motors 15 horsepower and under.

E. Statically and dynamically balance fans to eliminate vibration or noise transmission to occupied areas of the building.

F. Provide belt guards on belt driven fans.

G. Provide safety screen where inlet or outlet is exposed.

H. Prime coat fan wheels and housing factory inside and outside. Prime coating on aluminum parts is not required.

1.6 FIELD CONDITIONS

A. Permanent ventilators may be used for ventilation during construction only after ductwork is clean, filters are in place, bearings have been lubricated, and fan has been test run under observation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acme.

B. Econ-Air.

C. Captive Aire.

D. Greenheck.

E. Loren Cook Company.

F. Twin Cities Blower.

G. Substitutions: See Section 23 01 00 - General HVAC Provisions.

2.2 POWER VENTILATORS - GENERAL

A. Performance Ratings: Determined in accordance with AMCA 210 and bearing the AMCA Certified Rating Seal.

B. Sound Ratings: AMCA 301, tested to AMCA 300, and bearing AMCA Certified Sound Rating Seal.

C. Fabrication: Conform to AMCA 99.

D. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705.

E. Electrical Components: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

F. Kitchen Range Hood Exhaust Fans: Comply with requirements of NFPA 96.

2.3 ROOF EXHAUSTERS

A. Performance Ratings:

1. Refer to fan schedule on plan sheet for fan performance.

B. Fan Unit: V-belt or direct driven as indicated, with spun aluminum housing; resilient mounted motor; 1/2 inch mesh, 0.62 inch thick aluminum wire birdscreen; square base to suit roof curb with continuous curb gaskets.

C. Roof Curb: 14 inch high self-flashing of galvanized steel with continuously welded seams, built-in cant strips.

D. Kitchen Exhaust Roof Curb: Provide hinged, 24 inch high self-flashing of galvanized steel with continuously welded seams, insulation and curb bottom, ventilated double wall, and hinged curb adapter.

E. Disconnect Switch: Factory wired, non-fusible, in housing for thermal overload protected motor and solid state speed controller.

F. Backdraft Damper: Gravity actuated, aluminum multiple blade construction, felt edged with offset hinge pin, nylon bearings, blades linked, and line voltage motor drive, power open, spring return.

G. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheave selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Secure roof exhausters with stainless steel lag screws to roof curb.

C. Extend ducts to roof exhausters into roof curb. Counterflash duct to roof opening.

D. Provide sheaves required for final air balance.

E. Install backdraft dampers on inlet to roof exhausters.

3.2 SCHEDULES

A. Drawing Code: See plan Schedule.

B. Air Flow Capacity: See plan Schedule.

C. Static Pressure: See plan Schedule.

D. Motor hp:

1. Electrical Characteristics: See plan Schedule.

E. Accessories:

1. See plan Schedule.

END OF SECTION

SECTION 23 37 00

AIR OUTLETS AND INLETS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Sqaure ceiling diffusers.

B. Registers/grilles.

1. Ceiling-mounted, exhaust and return register/grilles.

C. Louvers:

1.2 REFERENCE STANDARDS

A. AHRI 880 (I-P) - Performance Rating of Air Terminals; 2017 (Reaffirmed 2023).

B. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating; 2023.

1.3 SUBMITTALS

A. See Section 23 01 00 - General HVAC Provisions, for submittal procedures.

B. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

C. Project Record Documents: Record actual locations of air outlets and inlets.

1.4 QUALITY ASSURANCE

A. Test and rate air outlet and inlet performance in accordance with ASHRAE Std 70.

1.5 QUALITY ASSURANCE

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

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Air Devices, Inc.

B. Carnes Company HVAC.

C. Krueger.

D. Nailor.

E. Price Industries.

F. Ruskin.

G. Titus.

H. Tuttle-Bailey.

I. Substitutions: See Section 23 01 00 - General HVAC Provisions.

2.2 SQAURE CEILING DIFFUSERS

A. Type: Provide high performance 3-cone diffuser diffuser to discharge air in 360 degree pattern .

B. Frame: Surface mount, inverted T-Bar type. In plaster ceilings, provide plaster frame and ceiling frame.

C. Fabrication: Steel or aluminum as indicated on drawings with baked enamel finish.

D. Color: As shown on drawings.

E. See Air Distribution Schedule on drawings for details and accessories.

2.3 CEILING RETURN REGISTERS/GRILLES

A. Type: Streamlined blades, 1/2 inch minimum depth, 1/2 inch maximum spacing, with blades set at 45 degrees, horizontal face.

B. Frame: Surface mount, inverted T-Bar type. In plaster ceilings, provide plaster frame and ceiling frame.

C. Fabrication: Steel or aluminum as indicated on drawings with baked enamel finish.

D. Color: As shown on the drawings.

E. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face where not individually connected to exhaust fans, where indicated on plans.

F. See Air Distribution Schedule on drawings for details and accessories.

2.4 LOUVERS

A. Type: 6 inch deep with blades on 45 degree slope with center baffle and return bend, heavy channel frame, 1/4 inch square mesh screen over exhaust and 1/4 inch square mesh screen over intake.

B. Color: As shown on the drawings.

C. Fabrication: 12 gage thick extruded aluminum, welded assembly, with finish as indicated on Air Distribution Schedule.

D. Mounting: Furnish with standard frame and extended sill for installation.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.

C. Install diffusers to ductwork with air tight connection.

D. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, despite whether dampers are specified as part of the diffuser, or grille and register assembly.

E. Paint ductwork visible behind air outlets and inlets matte black.

F. Provide minimum 6" deep plenum box on back of all return and exhaust grilles.

3.2 SCHEDULES

A. Air Outlet and Inlet Schedule

1. Drawing Code: Refer to plan schedule.
2. Manufacturer: As scheduled on drawings.
3. Model: As scheduled on drawings.
4. Description: As scheduled on drawings.
5. Finish: As scheduled on drawings.
6. Service: As scheduled on drawings.
7. Mounting: As scheduled on drawings.
8. Accessories: As scheduled on drawings.

END OF SECTION

SECTION 23 38 12

COMMERCIAL-KITCHEN HOODS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Kitchen ventilation hood.

1.2 RELATED SECTIONS

A. Section 23 07 13 - Duct Insulation.

B. Section 23 31 00 - Ducts.

1.3 REFERENCES

A. FM P7825 - Approval Guide; Factory Mutual Research Corporation; current edition.

B. NEMA MG 1 - Motors and Generators; National Electrical Manufacturers Association; 2003.

C. NFPA 70 - National Electrical Code; National Fire Protection Association; 2008.

D. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems

E. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems

F. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; National Fire Protection Association; 2008.

1.4 SYSTEM DESCRIPTION

A. Hood:

1. Kitchen ventilation hood(s) shall be of the Type I, full compensating canopy wall mounted group with the capability to replace 80% of the exhausted air with fresh outside air. Air shall be supplied through perforated panels in a manner that does not interfere with the cooking operations beneath the hood(s). Perforated panels shall be located on the bottom of the plenum to ensure precise volume control and shall limit the throw to within several feet of the hood.

2. Oven and Fryer hood(s) shall be of the Type I, full compensating wall mounted style with the capability to replace 80% of the exhausted air with fresh outside air. Air shall be supplied through perforated panels in a manner that does not interfere with the cooking operations beneath the hood(s). Perforated panels shall be located on the bottom of the plenum to ensure precise volume control and shall limit the throw to within several feet of the hood.

3. The hood(s) casing shall be constructed of a minimum of 18 ga. type 304 stainless steel. The hood(s) shall be constructed using the standing seam method for optimum strength. End panels shall have stamped vertical ribs, evenly spaced, to add additional strength and rigidity. All seams shall be welded liquid tight and all exposed internal welds shall be ground and polished to match the original surface of the metal. Lighter material gauges, alternate material types and finishes (400 series stainless steel, cold rolled steel, etc.) and non liquid tight welds (tack weld, spot weld, etc.) are not acceptable. All unexposed interior surfaces shall be constructed of a minimum 18 ga. corrosion resistant steel including, but not limited to ducts, plenum, and brackets.

4. The hood(s) shall include a filter housing constructed of the same material as the hood. The filters shall be aluminum (stainless steel or Teflon coated) baffle type, U. L. 1046 Classified, and in sufficient number and sizes to ensure optimum performance as specified by the filter manufacturer. The filter housing shall terminate in a pitched, full length grease trough which shall drain into a removable grease container.

5. Vaporproof, U. L. Listed incandescent (recessed incandescent, recessed fluorescent) light fixtures shall be prewired to a junction box situated at the top of the hood for field connection. Wiring shall conform to the requirements of the National Electrical Code (NFPA #70- Latest Edition).

6. They shall be U. L. Listed with fire damper with fusible link rating not to exceed 286 degrees F. They shall be built in accordance with National Fire Protection Association (NFPA) Bulletin #96, International Conference of Building Officials (ICBO), Southern Building Code Congress International (SBCCI), and bear the National Sanitation Foundation (NSF) Seal of Approval. The hood manufacturer shall provide, on request, the necessary data that confirms compliance with the code authorities listed above (NER report required). The hood volume shall be calculated utilizing a computerized thermal updraft velocity method.

7. Hood manufacturer shall supply complete computer generated submittal drawings including hood sections views(s) and hood plan view(s). These drawings must be available to the engineer and owner for their use in construction, operation and maintenance.

1.5 SUBMITTALS

A. See Section 23 01 00 - General HVAC Provisions, for submittal procedures.

B. Provide shop drawings of hood showing materials, weights, dimensions, connections, accessories and hanging information.

C. Certificates: Certify that products of this section meet or exceed specified requirements.

1.6 QUALITY ASSURANCE

A. Perform in accordance with NFPA 96 standard, city of Tahlequah, Oklahoma.

1. Maintain one copy on project site.

B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.

C. Installer Qualifications: Company specializing in performing the work of this section with minimum five years of experience.

D. Products Requiring Electrical Connection: Listed and classified by UL or testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.7 PRE-INSTALLATION MEETING

A. Convene one week before starting work of this section.

1.8 PROJECT CONDITIONS

A. Coordinate hood installation with size, location and installation of service utilities.

B. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

1.9 WARRANTY

A. Correct defective Work within a one year period after Date of Substantial Completion.

B. Provide five year manufacturer warranty for hood.

C. All warranties to begin at Date of Substantial Completion as accepted by the Owner.

1.10 EXTRA MATERIALS

A. Supply one extra hood filter for Owner's use in maintenance of project.

1.11 MAINTENANCE SERVICE

A. Provide service and maintenance of hood for twelve months from Date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Captive-Aire Systems, Inc.

B. Greenheck.

C. Econ-Air.

D. Substitutions: See Section 23 01 00 - General HVAC Provisions.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that installation area is ready to receive hood and associated hardware.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with plans and specifications.

3.3 STARTING EQUIPMENT

A. Provide manufacturer's field representative to prepare and start equipment.

B. Adjust for proper operation within manufacturer's published tolerances.

C. Demonstrate proper operation of equipment to Owner's designated representative.

3.4 SCHEDULES

A. See Kitchen Ventilation Hood Information on drawings.

3.5 SPECIAL TESTING

A. Provide any special testing as required by local AHJ.

END OF SECTION

SECTION 23 40 00

AIR CLEANING DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Disposable, extended area panel filters.

1.2 RELATED REQUIREMENTS

A. Division 26 - Electrical: Electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

A. AHRI 850 (I-P) - Performance Rating of Commercial and Industrial Air Filter Equipment; 2013 (Reaffirmed 2023).

B. ASHRAE Std 52.1 - Gravimetric and Dust-Spot Procedures for Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.[CHOICE TEXT]

C. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size; 2017, with Addendum (2022).

1.4 PERFORMANCE REQUIREMENTS

A. Conform to Section 7.4.

1. Dust Spot Efficiency: Plus or minus 5 percent.

1.5 SUBMITTALS

A. See Section 23 01 00 - General HVAC Provisions, for submittal procedures.

B. Product Data: Provide data on filter media, filter performance data, filter assembly and filter frames, dimensions and connection requirements.

C. Shop Drawings: Indicate filter assembly and filter frames, dimensions and connection requirements.

D. Manufacturer's Installation Instructions: Indicate assembly and change-out procedures.

E. Operation and Maintenance Data: Include instructions for operation, changing, and periodic cleaning.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. Extra Filters: One additional set of each type and size of disposable panel filters to be installed at the time the building is conveyed to the Owner.

1.6 QUALITY ASSURANCE

A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.1 FILTER MANUFACTURERS

A. American Filtration Inc.

B. AAF International/American Air Filter.

C. Camfil Farr Company.

D. Substitutions: See Section 23 01 00 - General HVAC Provisions.

2.2 DISPOSABLE, EXTENDED AREA PANEL FILTERS

A. Media: UL 900 Class 1, pleated, lofted, non-woven, reinforced cotton and synthetic fabric; supported and bonded to welded wire grid by corrugated aluminum separators.

1. Frame: Cardboard.

2. Nominal size: to match equipment filter size requirements.

3. Nominal thickness: 2 inches.

B. Rating, per ASHRAE Std 52.1:

1. Dust spot efficiency: MERV 8.

2. Initial resistance at 500 FPM face velocity: 0.30 inch WG.

3. Recommended final resistance: 0.9 inch WG.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install air cleaning devices in accordance with manufacturer's instructions.

B. Prevent passage of unfiltered air around filters with felt, rubber, or neoprene gaskets.

C. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with clean set.

3.2 SCHEDULES

A. Air Filter Schedule

1. Refer to plan Equipment Schedule.

END OF SECTION

SECTION 23 54 00

FURNACES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Forced air furnaces.

B. Controls.

1.2 RELATED REQUIREMENTS

A. Section 23 01 00 - General HVAC Provisions.

B. Section 23 07 13 - Duct Insulation: Duct Liner.

C. Section 23 31 00 - Ducts.

D. Division 26 - Electrical.

1.3 REFERENCE STANDARDS

A. NFPA 54 - National Fuel Gas Code; 2024.

B. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2015.

C. NFPA 211 - Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances; 2024.

1.4 SUBMITTALS

A. See Section 23 01 00 - General HVAC Provisions, for submittal procedures.

B. Product Data: Provide rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.

C. Shop Drawings: Indicate assembly, required clearances, and location and size of field connections.

D. Manufacturer's Instructions: Indicate rigging, assembly, and installation instructions.

E. Project Record Documents: Record actual locations of components and connections.

F. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.

G. Warranty: Submit manufacturers warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

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

B. Installer Qualifications: Company specializing in performing the work of this section with minimum five years of documented experience and approved by manufacturer.

1.6 REGULATORY REQUIREMENTS

A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.7 WARRANTY

A. Provide five year manufacturers warranty for solid state ignition modules.

B. Provide ten year manufacturers warranty for heat exchangers.

C. All warranties to begin at Date of Substantial Completion as accepted by the Owner.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Trane Inc.

B. York International Corporation.

C. Rheem Manufacturing Company / RUUD.

D. Daikin.

E. Lennox Industries, Inc.

F. Substitutions: See Section 23 01 00- General HVAC Provisions.

2.2 GAS FIRED FURNACES

A. Annual Fuel Utilization Efficiency (AFUE): 0.96 ("condensing").

B. Units: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, heating element, controls, air filter, and accessories; wired for single power connection with control transformer.

1. Safety certified by CSA in accordance with ANSI Z 21.47.

2. Venting System: Direct.

3. Combustion: Sealed

4. Air Flow Configuration: Refer to drawings.

5. Heating: Natural gas fired.

6. Accessories:

    a. See schedule on drawings for required accessories.

C. Performance:

1. Refer to Furnace Schedule. Gas heating capacities are sea level ratings.

D. Cabinet: Steel with baked enamel finish, easily removed and secured access doors with safety interlock switches, glass fiber insulation with reflective liner.

E. Primary Heat Exchanger:

1. Material: Hot-rolled steel

2. Shape: Tubular type.

F. Gas Burner:

1. Atmospheric type with adjustable combustion air supply,

2. Gas valve provides 100 percent safety gas shut-off; 24 volt combining pressure regulation, safety pilot, manual set (On-Off), pilot filtration, automatic electric valve.

3. Electronic pilot ignition, with hot surface igniter.

4. Non-corrosive combustion air blower with permanently lubricated motor.

G. Gas Burner Safety Controls:

1. Thermocouple sensor: Prevents opening of gas valve until pilot flame is proven and stops gas flow on ignition failure.

2. Flame rollout switch: Installed on burner box and prevents operation.

3. Vent safety shutoff sensor: Temperature sensor installed on draft hood and prevents operation, manual reset.

4. Limit Control: Fixed stop at maximum permissible setting, de-energizes burner on excessive bonnet temperature, automatic resets.

H. Supply Fan: Centrifugal type rubber mounted with direct or belt drive with adjustable variable pitch motor pulley.

I. Motor: 1750 rpm single speed, permanently lubricated, hinge mounted.

J. Air Filters: 2 inch thick glass fiber, disposable type arranged for easy replacement.

K. Operating Controls

1. Room Thermostat: Cycles burner to maintain room temperature setting.

2. Supply Fan Control: Energize from bonnet temperature independent of burner controls, with adjustable timed off delay and fixed timed on delay, with manual switch for continuous fan operation. Provide continuous low speed fan operation.

2.3 THERMOSTATS

A. Manufacturers:

1. Lennox Industries, Inc.

2. Substitutions: Not permitted.

B. Room Thermostat: Low voltage, electric solid state microcomputer based room thermostat with remote sensor:

1. System selector switch (heat-off) and fan control switch (auto-on).

2. Preferential rate control to minimize overshoot and deviation from setpoint.

3. Set-up for four separate temperatures per day.

4. Instant override of setpoint for continuous or timed period from one hour to 31 days.

5. Short cycle protection.

6. Programming based on every day of the week.

7. Selection features including degree F or degree C display, 12 or 24 hour clock, keyboard disable, remote sensor, fan on-auto.

8. Battery replacement without program loss.

9. Thermostat display:

a. Time of day.

b. Actual room temperature.

c. Programmed temperature.

d. Programmed time.

e. Duration of timed override.

f. Day of week.

g. System mode indication: heating, cooling, fan auto, off, and on, auto or on, off.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that substrates are ready for installation of units and openings are as indicated on shop drawings.

B. Verify that proper power supply is available and located correctly.

C. Verify that proper fuel supply and pressure are available for connection.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions and requirements of authorities having jurisdiction.

B. Install furnace on insulated furnace stand.

C. Install in accordance with NFPA 90A.

D. Install gas fired furnaces in accordance with NFPA 54.

E. Provide vent connections in accordance with NFPA 211.

F. Pipe drain from humidifier to nearest drain.

G. Mount air cooled condenser on 4 inch thick concrete pad. Allow minimum 6 inches on all sides of equipment.

3.3 SCHEDULES

A. Furnaces:

1. See Schedule on drawings.

END OF SECTION

SECTION 23 62 13

AIR COOLED CONDENSING UNITS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Condensing unit package.

B. Charge of refrigerant and oil.

C. Controls and control connections.

D. Refrigerant piping connections.

E. Motor starters.

F. Electrical power connections.

1.2 RELATED REQUIREMENTS

A. Section 23 23 00 - Refrigerant Piping and Specialties.

B. Section 23 54 00 - Furnaces.

C. Section 23 82 16 - Air Coils.

D. Division 26 - Electrical: Electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

A. AHRI 210/240 - Standard for Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; 2008.

B. AHRI 365 (I-P) - Performance Rating of Commercial and Industrial Unitary Air-Conditioning Condensing Units; 2009.

C. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2022, with Addendum (2024).

D. ASHRAE Std 23.1 - Methods for Performance Testing Positive Displacement Refrigerant Compressors and Condensing Units that Operate at Subcritical Pressures of the Refrigerant; 2019.

E. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; 2013, Including All Amendments and Errata.

F. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical; Current Edition, Including All Revisions.

1.4 PERFORMANCE REQUIREMENTS

A. Condenser:

1. Refer to plan Schedule.

B. Electrical Characteristics:

1. Refer to plan Schedule.

1.5 SUBMITTALS

A. Section 23 01 00 - General HVAC Provisions: Procedures for submittals.

B. Product Data: Provide rated capacities, weights specialties and accessories, electrical nameplate data, and wiring diagrams. Make submission with coils, fan-coil units, and air handling units with coils to ensure capacities are complementary.

C. Shop Drawings: Indicate components, assembly, dimensions, weights and loadings, required clearances, and location and size of field connections. Include schematic layouts showing condensing units, cooling coils, refrigerant piping, and accessories required for complete system.

D. Design Data: Indicate pipe and equipment sizing.

E. Manufacturer's Instructions: Submit manufacturer's complete installation instructions.

F. Operation and Maintenance Data: Include start-up instructions, maintenance instructions, parts lists, controls, and accessories.

G. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

1.8 WARRANTY

A. Provide a five year warranty to include coverage for refrigerant compressors.

B. All warranties to begin at Date of Substantial Completion as accepted by the Owner.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Trane Inc.

B. York International Corporation.

C. Rheem Manufacturing Company / RUUD.

D. Daikin.

E. Lennox Industries, Inc.

F. Substitutions: See Section 23 01 00 - General HVAC Provisions.

2.2 MANUFACTURED UNITS

A. Units: Self-contained, packaged, factory assembled and pre-wired units suitable for outdoor use consisting of cabinet, compressors, condensing coil and fans, integral sub-cooling coil, controls, liquid receiver, wind deflector, and screens.

B. Construction and Ratings: In accordance with AHRI 210/240. Test in accordance with ASHRAE Std 23.

C. Construction and Ratings: In accordance with ARI 210/240, ARI 365, and UL 207. Testing shall be in accordance with ASHRAE Std 23.

2.3 CASING

A. House components in welded steel frame with galvanized steel panels with weather resistant, baked enamel finish.

B. Mount starters, disconnects, and controls in weatherproof panel provided with full opening access doors. Provide mechanical interlock to disconnect power when door is opened.

C. Provide removable access doors or panels with quick fasteners and piano hinges.

2.4 CONDENSER COILS

A. Coils: Aluminum fins mechanically bonded to seamless copper tubing. Provide sub-cooling circuits. Air test under water to 425 psig, and vacuum dehydrate. Seal with holding charge of nitrogen.

B. Coil Guard: Hail Guard.

2.5 FANS AND MOTORS

A. Vertical discharge direct driven propeller type condenser fans with fan guard on discharge. Equip with roller or ball bearings with grease fittings extended to outside of casing.

B. Weatherproof motors suitable for outdoor use, single phase permanent split capacitor or 3 phase, with permanent lubricated ball bearings and built in current and thermal overload protection.

C. Horizontal discharge, double width, double inlet forward curved centrifugal type condenser fans, equipped with roller or ball bearings with grease fittings extended to outside of casing, V-belt drive with belt guard.

2.6 COMPRESSORS

A. Compressor: Hermetic reciprocating type or hermetic scroll type.

B. Mounting: Statically and dynamically balance rotating parts and mount on rubber-in-shear vibration isolators. Internally isolate hermetic units on springs.

C. Motor: Constant speed 1800 rpm suction gas cooled with electronic sensor and winding over temperature protection, designed for across-the-line starting. Furnish with starter.

2.7 REFRIGERANT CIRCUIT

A. Provide each unit with one refrigerant circuit or two independent refrigerant circuits, factory supplied and piped. Refer to Section 23 23 00.

B. For each refrigerant circuit, provide:

1. Filter dryer replaceable core type.
2. Liquid line sight glass and moisture indicator.
3. Thermal expansion valve for maximum operating pressure.
4. Insulated suction line.
5. Suction and liquid line service valves and gage ports.
6. Liquid line solenoid valve.
7. Charging valve.
8. Discharge line check valve.
9. Compressor discharge service valve.
10. Condenser pressure relief valve.

2.8 CONTROLS

A. On unit, mount weatherproof steel control panel, NEMA 250, containing power and control wiring, molded case disconnect switch, factory wired with single point power connection. Factory mount disconnect switch on unit under provisions of Section 26 05 83.

B. For each compressor, provide across-the-line or part winding starter, non-recycling compressor overload, starter relay, and control power transformer or terminal for controls power. Provide manual reset current overload protection. For each condenser fan, provide across-the-line starter with starter relay.

C. Provide safety controls arranged so any one will shut down machine:

1. High discharge pressure switch (manual reset) for each compressor.

2. Low suction pressure switch (manual reset) for each compressor.

3. Oil Pressure switch (manual reset).

D. Provide the following operating controls:

1. Five minute off timer prevents compressor from short cycling.

2. Low ambient temperature controls.

3. Hot gas bypass sized for minimum compressor loading on one compressor only, bypasses hot refrigerant gas to evaporator.

4. Low ambient thermostat to lock out compressor at low ambient temperatures.

E. Provide controls to permit operation down to 0 degrees F ambient temperature.

1. Thermostat to cycle fan motors in response to outdoor ambient temperature.

2. Head pressure switch to cycle fan motors in response to refrigerant condensing pressure.

3. Solid state control to vary speed of one condenser fan motor in response to refrigerant condensing pressure.

4. Electronic control consisting of mixing damper assembly, controlled to maintain constant refrigerant condensing pressure.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's installation instructions.

B. Complete structural, mechanical, and electrical connections in accordance with manufacturer's installation instructions.

C. Provide for connection to electrical service.

D. Install units on concrete base as indicated.

E. Install units on roof curbs as indicated.

F. Provide connection to refrigeration piping system and evaporators. Refer to Section 23 23 00. Comply with ASHRAE Std 15.

3.2 SYSTEM STARTUP

A. Supply initial charge of refrigerant and oil for each refrigeration system. Replace losses of oil or refrigerant prior to end of correction period.

B. Charge system with refrigerant and test entire system for leaks after completion of installation. Repair leaks, put system into operation, and test equipment performance.

C. Shut-down system if initial start-up and testing takes place in winter and machines are to remain inoperative. Repeat start-up and testing operation at beginning of first cooling season.

D. Provide cooling season start-up, and winter season shut-down for first year of operation.

3.3 SCHEDULES

A. Air Cooled Condensing Units

1. As scheduled on drawings.

END OF SECTION

SECTION 23 74 33

PACKAGED MAKE-UP AIR UNITS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Kitchen hood make-up air unit.

1.2 RELATED SECTIONS

A. Section 23 07 13 - Ductwork Insulation: Duct Wrap.

B. Division 26 - Equipment Wiring Systems: Electrical supply to units.

1.3 REFERENCES

A. NFPA 70 - National Electrical Code; National Fire Protection Association; 2008.

1.4 SUBMITTALS

A. See Section 23 01 00 - General HVAC Requirements, for submittal procedures.

B. Product Data: Submit schedule of equipment typically indicating sizes and number of units, including capacity data.

C. Shop Drawings: Submit drawings indicating components, assembly, dimensions, weights, required clearances, location and size of field connections.

D. Design Data: Submit product data indicating capacities, weights, specialties and accessories, electrical requirements and wiring diagram.

E. Manufacturer's Instructions: Submit Manufacturer's Installation Instructions. Indicate rigging, assembly, and installation instructions.

F. Submit operation and maintenance data.

1. Include manufacturer's descriptive literature, operating instructions, maintenance instruction and unit parts.

G. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.5 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 the work of this section with minimum five years of documented experience and approved by manufacturer.

1.6 PROJECT CONDITIONS

A. Coordinate unit installation with size, location and installation of service utilities.

B. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

1.7 WARRANTY

A. Correct defective Work within a one year period after Date of Substantial Completion.

B. Provide one year manufacturer's parts warranty.

C. Provide a 10-year non-prorated parts warranty on the heat exchanger, burners and draft hood assembly. Parts only.

D. All warranties to begin at Date of Substantial Completion as accepted by the Owner.

PART 2 PRODUCTS

2.1 PACKAGED ROOF TOP GAS AIR HANDLER

A. Manufacturers:

1. Sterling.

2. Reznor.

3. Greenheck.

4. CaptiveAire.

B. Substitutions: See Section 23 01 00 - General HVAC Provisions.

C. Housing: Unit housing shall be constructed of 20 gauge G-90 galvanized steel. The wall panels and roof panels shall be fabricated by forming double-standing, self-locking seams that require no additional support. The floor and wall panels shall be caulked air tight with a silicone caulk. All casing panels shall be attached with sheet metal screws or rivets, which can be removed to field service large components. The unit base shall be suitable for curb or flat mount. Housing construction should be suitable for outdoor or indoor installation. Blower door shall provide easy access to blower, motor and drives. Access doors shall be provided on both front and backside of unit providing full access to every part of the unit. Internal ridged board 1" x 1.5" foil face installation shall be installed on roof, walls and base of casing.

D. Base: The base shall be constructed of galvanized steel for improved rigidity. Base shall be structurally reinforced to accommodate the blower assembly and burner.

E. Blower: Blower(s) shall be forward-curved, centrifugal, Class I or II (depending on application requirements), double width, double inlet, constructed G-90 galvanized steel. Unit

shall have a heavy-duty, solid-steel shaft. Wheels shall be balanced in two planes and done in accordance with AMCA standard 204-96, Balance Quality and Vibration Levels for Fans. The wheel blades shall be aerodynamically designed to minimize turbulence, increase efficiency and reduce noise. The wheel blades shall be securely attached to the wheel inlet ring. The wheel shall be firmly attached to the fan shaft with setscrews and keys. The blower assembly shall be isolated from the fan structure with vibration isolators.

F. Motor and Motor Compartment: Motors shall be heavy-duty ball bearing type and furnished at the specified voltage, phase and enclosure. Motor mounting plate shall be constructed of heavy gauge galvanized steel and shall be designed to provide easy adjustment of the belt tension.

G. Shaft and Bearings: Shafts shall be precision ground and polished. Heavy duty, pre-lubricated bearings shall be selected for a minimum (L50) life in excess of 200,000 hours of operation at maximum cataloged operating speed. They shall be designed for, and individually tested, specifically for us in air handling applications.

H. Belts and Drives: Belts shall be oil and heat resistant, non-static, grip-notch type. Drives shall be cast type, precision machined and keyed, and secured attached to the fan and motor shafts. Fan operating speed shall be factory set using adjustable pitch motor pulleys. Blower drives shall be fully adjustable. All drives shall be a minimum of 2 grooves and 2 HP.

I. A single point electrical connection shall be supplied. The control circuit voltage shall be 115 volts. A control transformer shall be provided, when required. The control wiring shall be carried in wire channel or conduit. Wiring in control enclosures shall be in accordance with the NEC and the local code as it may affect the installation. Motor starter shall be provided. Starter shall be line voltage, definite purpose type.

J. Accessories

1. Filters: The filters shall be 2" thick, aluminum mesh, coated with super-filter adhesive. Aluminum-mesh filters shall have aluminum frames with media to be layers of slit and expanded aluminum, caring in pattern to obtain maximum depth loading. Washable 2" filters shall be enclosed in two-piece, die-cut frame with diagonal supports. Frame shall be constructed of heavy-duty beverage board. Filter media is supported on the air leaving side by a metal grid.

2. Fresh-air inlet hood shall be constructed of G-90 galvanized steel with bird screen.

3. Curb shall be 20", constructed of 18-gauge G-90 galvanized steel as a completed welded assembly.

4. Variable Frequency Drives (VFD) on the supply and exhaust fan where indicated on the drawings.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that roof is ready for installation of units and openings are as indicated on submittal drawings.

B. Verify that proper power supply is available.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Mechanical Contractor shall be responsible for all required communication between make-up air unit(s) and exhaust fan(s) with VFDs.

3.3 STARTING EQUIPMENT

A. Provide manufacturer's field representative to prepare and start equipment.

B. Adjust for proper operation within manufacturer's published tolerances.

C. Demonstrate proper operation of equipment to Owner's designated representative.

3.4 PROTECTION

A. Protect installed equipment from subsequent construction operations.

END OF SECTION

SECTION 23 81 26

SMALL-CAPACITY SPLIT-SYSTEM AIR CONDITIONERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Air cooled condensing units.

B. Indoor ductless fan & coil units.

C. Controls.

1.2 RELATED REQUIREMENTS

A. Division 26 - Electrical: Electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

A. AHRI 210/240 - Standard for Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; 2008.

B. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2022, with Addendum (2024).

C. ASHRAE Std 23.1 - Methods for Performance Testing Positive Displacement Refrigerant Compressors and Condensing Units that Operate at Subcritical Pressures of the Refrigerant; 2019.

D. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2015.

1.4 SUBMITTALS

A. See Section 23 01 00 - General HVAC Provisions, for submittal procedures.

B. Product Data: Provide rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.

C. Shop Drawings: Indicate assembly, required clearances, and location and size of field connections.

1. Design Data: Indicate refrigerant pipe sizing.

D. Manufacturer's Instructions: Indicate rigging, assembly, and installation instructions.

E. Project Record Documents: Record actual locations of components and connections.

F. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.

G. Warranty: Submit manufacturers warranty and ensure forms have been filled out in Owner s name and registered with manufacturer.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 60 00 - Product Requirements, for additional provisions.

2. Extra Filters: Two filters for each indoor unit.

1.5 QUALITY ASSURANCE

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

B. Installer Qualifications: Company specializing in performing the work of this section with minimum five years of documented experience and approved by manufacturer.

1.6 WARRANTY

A. Provide five year manufacturers warranty for compressors.

B. All warranties to begin at Date of Substantial Completion as accepted by the Owner.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Daikin.

B. Mitsubishi.

C. LG.

D. Substitutions: See Section 23 01 00 - General HVAC Provisions.

2.2 INDOOR UNITS FOR DUCTLESS SYSTEMS

A. Indoor Units: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, evaporator coil, and controls; wired for single power connection with control transformer.

1. Capacity: Refer to drawings.

B. Evaporator Coils: Copper tube aluminum fin assembly, galvanized or polymer drain pan sloped in all directions to drain, drain connection, refrigerant piping connections, restricted distributor or thermostatic expansion valve.

1. Construction and Ratings: In accordance with AHRI 210/240 and UL listed.

C. Remote Actuators:

2.3 OUTDOOR UNITS

A. Outdoor Units: Self-contained, packaged, pre-wired unit consisting of cabinet, with compressor and condenser.

1. Construction and Ratings: In accordance with AHRI 210/240 with testing in accordance with ASHRAE Std 23 and UL listed.

B. Air Cooled Condenser: ARI 520; Aluminum fin and copper tube coil, with direct drive axial propeller fan resiliently mounted, galvanized fan guard.

C. Accessories: Filter drier, high pressure switch (manual reset), low pressure switch (automatic reset), service valves and gage ports, thermometer well (in liquid line).

1. Provide thermostatic expansion valves.

2. Provide heat pump reversing valves.

D. Operating Controls:

1. Control by room thermostat to maintain room temperature setting.

2. Low Ambient Kit: Provide refrigerant pressure switch to cycle condenser fan on when condenser refrigerant pressure is above 285 psig and off when pressure drops below 140 psig for operation to 0 degrees F.

E. Mounting Pad: Roof curb, minimum 20 inches high, sized to match unit.

2.4 ACCESSORY EQUIPMENT

A. Room Thermostat: Wall-mounted, electric solid state microcomputer based room thermostat with remote sensor to maintain temperature setting; low-voltage; with following features:

1. System selector switch (heat-off-cool) and fan control switch (auto-on).

2. Set-up for four separate temperatures per day.

3. Instant override of setpoint for continuous or timed period from one hour to 31 days.

4. Short cycle protection.

5. Programming based on every day of the week.

6. Selection features including degree F or degree C display, 12 or 24 hour clock, keyboard disable, remote sensor, fan on-auto.

7. Battery replacement without program loss.

8. Manufacturers:

a. Provided by Control Contractor.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that substrates are ready for installation of units and openings are as indicated on shop drawings.

B. Verify that proper power supply is available and in correct location.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions and requirements of local authorities having jurisdiction.

B. Install in accordance with NFPA 90A.

C. Install refrigeration systems in accordance with ASHRAE Std 15.

D. Pipe drain from cooling coils to nearest drain.

3.3 SCHEDULE

A. Refer to plan Schedule.

END OF SECTION

SECTION 23 82 16

AIR COILS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Refrigerant coils.

1.2 RELATED REQUIREMENTS

A. Section 23 23 00 - Refrigerant Piping and Specialties.

B. Section 23 31 00 - Ducts: Installation of duct coils.

C. Division 26 - Electrical. Electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

A. AHRI 410 - Standard for Forced-Circulation Air-Cooling and Air-Heating Coils; 2001 (R2011).

B. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.

1.4 SUBMITTALS

A. See Section 23 01 00 - General HVAC Provisions.

B. Product Data: Provide coil and frame configurations, dimensions, materials, rows, connections, and rough-in dimensions.

C. Shop Drawings: Indicate coil and frame configurations, dimensions, materials, rows, connections, and rough-in dimensions.

D. Certificates: Certify that coils are tested and rated in accordance with ARI 410.

E. Warranty: Submit manufacturer's warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

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

B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect coil fins from crushing and bending by leaving in shipping cases until installation, and by storing indoors.

B. Protect coils from entry of dirt and debris with pipe caps or plugs.

1.7 WARRANTY

A. Provide five year manufacturer warranty for coils.

B. All warranties to begin at Date of Substantial Completion as accepted by the Owner.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Same as equipment supplier.

B. Substitutions: See Section 23 01 00 - General HVAC Provisions.

2.2 REFRIGERANT COILS

A. Tubes: 5/8 inch OD seamless copper or brass arranged in parallel or staggered pattern, expanded into fins, silver brazed joints.

B. Fins: Aluminum or copper continuous plate type with full fin collars. Solder coat copper fin coils.

C. Casing: Die formed channel frame of 16 gage galvanized steel with 3/8 inch mounting holes on 3 inch centers. Provide tube supports for coils longer than 36 inches.

D. Headers: Seamless copper or brass tubes with silver brazed joints.

E. Liquid Distributors: Brass or copper venturi type distributor with seamless copper distributor tubes, 5/16 inch outside diameter; maximum 12 circuits per distributor.

F. Testing: Air test under water at 300 psi for working pressure of 250 psi; clean, dehydrate, and seal with dry nitrogen charge.

G. Configuration: Down feed with bottom suction to prevent trapping of oil.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturers written instructions.

B. Install in ducts and casings in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

1. Support coil sections independent of piping on steel channel or double angle frames and secure to casings.

2. Provide frames for maximum three coil sections.

3. Arrange supports to avoid piercing drain pans.

4. Provide airtight seal between coil and duct or casing.

5. Refer to Section 23 31 00.

C. Protect coils to prevent damage to fins and flanges. Comb out bent fins.

D. Install coils level. Install cleanable tube coils with 1:50 pitch.

E. Make connections to coils with unions and flanges.

F. Refrigerant Coils: Provide sight glass in liquid line within 12 inches of coil. Refer to Section 23 23 00.

G. Insulate headers located outside air flow as specified for piping. Refer to Section 23 07 19.

3.2 SCHEDULES

A. Heating and Cooling Coils: Same as equipment manufacturer.

END OF SECTION

SECTION 26 00 10

GENERAL ELECTRICAL PROVISIONS

PART 1 GENERAL

1.1 WORK INCLUDED

A. Furnish and install all electrical wiring, systems, equipment and accessories in accordance with the specifications and drawings. Specifications and drawings are complimentary except that, in case of conflict, the most stringent will govern.

B. Judgment shall be exercised to install electrical work in a practical manner to function properly, simplify future maintenance, and to fit building construction and finish. Items not shown or specified which are required to produce a complete, operative and finished system shall be provided.

C. The electrical plans are a guide to the Contractor to show general arrangement of conduit and wiring and equipment required. If any error omissions or obscurities appear therein, which are questionable, do not conform to good practice, or appear contrary to the purpose and intent of the work, the Contractor shall promptly notify the Architect and Engineer and apply for directions before construction. The exact location of conduit runs and lengths shall be determined by the Contractor in the field.

D. The drawings may be superseded by later revised or detailed drawings or specification addenda prepared by the Architect. The Contractor shall conform to all reasonable change without extra cost to the Owner. All items not specifically mentioned in the specifications or noted on the drawings, but which are obviously necessary to make a complete working installation, shall be included.

E. Examine the premises in accordance with Division 1 and Division 2 of the specifications.

F. The Owner may furnish some equipment. Electrical Contractor is responsible to check the drawings and specifications for equipment that will be furnished by the Owner. Furnish the electrical connections, etc., on all Owner furnished equipment.

G. Should the particular equipment which any bidder proposes to install, require other space conditions than those indicated on the drawings, arrange for such space with the Engineer before submitting a bid. Should changes become necessary because of failure to comply with this clause, install the changes without additional expense.

H. Where electrical equipment is installed that causes electrical noise interference with other electrical systems installed under this contract, equip the offending equipment with isolating transformers, filters, shielding or any other means as required for the satisfactory suppression of the interference as determined by the Engineer.

I. Comply with National Electric Code, NFPA, appropriate Building Code, and all local, state, and national ordinances.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. The General Conditions and Supplementary General Conditions of the contract are an integral part of Division 26 of the Specifications. Carefully note its contents in performance of the work.

B. The General Requirements as included in Division 1 of the Specifications are an integral part of Division 26. Carefully note its contents in performance of the work.

C. Examine all of the contract drawings and specifications, field verify existing conditions, or otherwise determine the extent of related work in other divisions before submitting a quotation for the work in this division. Coordinate the work in this division with work in other divisions through the Electrical Contractor. No extra payment will be made for additional work required by failure to coordinate the work. Should drastic changes from original drawings be necessary, the Contractor shall notify the Architect and secure written approval and agreement from the Architect on necessary adjustments.

D. The architectural, mechanical and structural plans and specifications, including Information to Bidders and other pertinent documents issued by the Architect or Engineer are a part of this Specification and the accompanying electrical plans. Comply with them in every respect. Examine all the above carefully.

1. Failure to comply does not relieve the Contractor of responsibility nor may it be used as a basis for additional compensation due to omission of architectural, mechanical and structural details from the electrical drawings.

E. Related work in other divisions requiring cooperation and coordination with this division includes, but is not limited to, the following:

1. Power arranged under Division 1.

2. Perform all cutting and patching as required under Division 1.

3. Furnish all sleeves, inserts, anchors and supports required by this work to be installed in concrete or masonry and coordinate with the respective trades under Division 3 and 4 for proper locations and installation.

4. Flash and seal roof penetrations in accordance with Division 7. Furnish locations and sizes and coordinate the installation with the respective trade.

5. Perform painting of electrical equipment and materials in finished areas as required under Division 9. Touch up or prime any surfaces required in this division in accordance with Division 9. Provide factory finishes as specified in other sections of this division.

6. Install branch circuits and make final connections to any equipment requiring electric power that is furnished and installed by the Contractor or by the Owner. Perform the electrical work according to approved shop drawings.

7. Install empty raceways and outlet boxes or branch circuits for equipment to be furnished by others and installed after completion of the contract.

8. Install and connect motor starters furnished under Division 23 where starters are not an integral part of the equipment. Insure that starters generally conform to the requirements of this division.

9. 120 volt control wiring is furnished and installed by the Electrical Contractor in accordance with the requirements of Division 23.

10. Mechanical equipment control conduit system furnished and installed by the Mechanical Contractor.

11. Motors are furnished and installed generally as an integral part of equipment specified under Division 23 and must conform to the requirements of this division.

1.3 FEES, PERMITS AND INSPECTIONS

A. Obtain any and all required permits in connection with this work under the Contract and pay any and all fees in connection therewith to include fees by the utility companies.

B. Under this section of work the Contractor shall, upon completion of the work, furnish a certificate of final inspection to the Architect from the inspection department having jurisdiction.

1.4 CODES AND STANDARDS

A. All work shall be done in a good workmanlike manner. Materials and workmanship shall comply with all applicable local state and federal codes including, but not limited to, the following:

1. National Electrical Code, Latest Edition (NEC).

2. Underwriters' Laboratories, Inc. (UL).

3. Institute of Electrical and Electronic Engineers (IEEE).

4. Insulated Power Cable Engineers' Association (IPCEA).

5. National Electrical Manufacturers' Association (NEMA).

6. American Standards Association (ASA).

7. American Society for Testing Materials (ASTM).

8. State Fire Prevention Code.

9. Occupational Safety and Health Act (OSHA).

10. National Fire Protection Association (NFPA).

11. International Building Code (IBC).

B. Comply with all State and Federal ADA Accessible Guidelines in regard to accessible or handicapped features.

C. The latest specifications and standards available shall be used for the above.

D. In case of discrepancy between the applicable codes, plans and specifications, the most stringent shall govern.

E. Should the Contractor perform any work that does not comply with requirements of the applicable authorities, he shall bear all cost arising in correcting the deficiencies.

F. Equipment and materials which are not covered by UL standard will be accepted provided equipment and material is listed, labeled, certified or otherwise determined to meet safety requirements of a nationally recognized testing laboratory.

1.5 DEMOLITION

A. Coordinate all demolition with the General Contractor. All existing wiring is to be removed as necessary. Reuse existing circuits for relocated devices and light fixtures.

PART 2 PRODUCTS

2.1 QUALIFICATION (PRODUCTS AND SERVICES)

A. Approvals are required of products or services of proposed manufacturers, suppliers and installers and will be based upon submission by Contractor of certification.

B. Manufacturer's Qualifications, provide submittal information with the following: Manufacturer regularly and presently manufactures as one of the manufacturer's principal products the following items and has manufactured these items for at least five (5) years.

1. Wire and Cable - all types.

2. Light Fixtures.

3. Lighting Switches and Receptacles.

4. Dimmers.

5. Molded Case Circuit Breakers.

6. Fuses.

7. Conduit.

8. Wiring Devices.

9. Low Voltage Fusible and Non-Fusible Switches.

10. Conduit Supports and Fittings.

11. Fire Sealant.

C. Manufacturer's product submitted must have been in satisfactory operation on three (3) installations similar to this project for approximately five (5) years.

D. There must be a permanent service organization maintained or trained by manufacturer which will render satisfactory service to this installation within eight (8) hours of receipt of notification that service is needed.

E. Installer must have the technical qualifications, experiences, trained personnel and facilities to install specified items including at least three (3) years of successful installation of electrical work similar to that required on this project. Approval will not be given where the experience record is one of unsatisfactory performance.

F. The lighting wholesale supplier shall have an office and a stocking warehouse within 100 miles of the project site. The distributor/manufacturer's representative shall have an office within 100 miles of the project site, and shall have on staff a full time lighting designer as well as personnel who are available to service the project after completion.

2.2 MANUFACTURED PRODUCTS

A. Insure that materials and equipment furnished is of current production by manufacturers regularly engaged in the manufacture of such items for which replacement parts should be available.

1. Items not meeting this requirement but which otherwise meet technical specifications and merits of which can be established through reliable test reports or physical examination of representative samples will be considered.

B. Provide products of a single manufacturer when more than one (1) unit of the same product is needed.

C. Equipment Assemblies and Components:

1. All components of an assembled unit need not be products of the same manufacturer.

2. Manufacturers of equipment assemblies which include components made by others must assume complete responsibility for the final assembled unit.

3. Components must be compatible with each other and with the total assembly for the intended service.

4. Constituent parts which are similar must be the product of a single manufacturer.

5. Moving parts of any element of equipment of the units normally requiring lubrication must have means provided for such lubrication and must be adequately lubricated at factory prior to delivery.

D. Identify all factory wiring on the equipment being furnished and on all wiring diagrams.

E. Equipment and materials shall be new and shall bear the manufacturer's name, trade name and the UL label in every case where a standard has been established for the particular material.

F. Equipment and materials of the same general type shall be of the same make throughout the work to provide uniform appearance, operation and maintenance.

G. Dimensions: It shall be the responsibility of the Contractor to insure that items furnished fit the space available. He shall make necessary field measurements to ascertain space requirements, including those for connections, and shall furnish and install such sizes and shapes of equipment that the final installation shall suit the true intent and meaning of the drawings and specifications. Dimensions are to be taken from the architectural drawings.

H. Manufacturer's directions shall be followed completely in the delivery, storage, protection and installation of equipment and materials. Notify the Architect of any conflict between any requirement of the contract documents and the manufacturer's directions and obtain the Architect's written instruction before preceding with the work. Should the Contractor perform any work that does not comply with the manufacturer's directions or such written instructions from the Architect, he shall bear all costs arising in correcting the deficiencies.

I. The Contractor shall provide and install all accessories, and incidental items to complete the work, ready to use and fully operational.

2.3 EQUIPMENT RATINGS AND APPROVAL OF "EQUAL" EQUIPMENT

A. Equipment voltage ratings must be in accordance with the requirements indicated on the drawings or as specified.

B. Obtain written approval for any equipment which differs from the requirements of the drawings and specifications.

1. Furnish drawings showing all installation details, shop drawings, technical data and other pertinent information as required.

2. Approval by the Engineer of the equal equipment does not relieve the Contractor of the responsibility of furnishing and installing the equipment at no additional cost.

3. Furnish and install any other items required for the satisfactory installation of the equal equipment at no additional cost. This includes, but is not limited to, changes in branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels, and correlation with other work, subject to the jurisdiction and approval of the Engineer.

C. Equipment and materials specified herein are named to establish a standard of quality. Other material of equal quality may be substituted per Section 01 60 00 and with approval by the Architect.

D. It is the responsibility of the Contractor to investigate any desired substitutions for specified equipment prior to submission of his bid. The contractor shall be responsible for any changes

required in mechanical, electrical or structural systems resulting from equipment substitutions and shall bear all costs for those changes whether the substitute equipment is named by Architect for "equal" consideration or not. All changes shall be accomplished in a manner acceptable to the Architect at no additional cost to the Owner.

E. In order to obtain prior approval on equipment or material not specified in Division 26, 27 and 28 Specifications or Equipment Schedules, Contractor MUST submit to the Engineer any proposed equipment or material ten (10) working days prior to the bid date.

2.4 EQUIPMENT PROTECTION

A. Store all materials and equipment to be installed in the work so as to insure the preservation of their quality, workability, and fitness for the work intended. Provide storage provisions for protection from the elements, rust and physical damage. Place stored materials on clean, hard surfaces above ground and keep covered at all times to insure protection from paint, plaster, dust, water and other construction debris or operations. Install heaters under the protective cover where the equipment may be damaged due to moisture and weather conditions. Keep conduit ends plugged or capped and all covers closed on boxes, panels, switches, fixtures, etc., until installation of each item. Store all plastic conduit or duct out of direct sunlight in shaded areas. Located stored materials and equipment to facilitate prompt inspection. All boxes and packaging must remain intact.

B. Protect during installation, all equipment, controls, controllers, circuit protective devices, etc., against entry of foreign matter on the inside and be vacuum clean both inside and outside before testing, operating and painting.

C. Replace damaged equipment, as determined by the Engineer, in first class operating condition or return to source of supply for repair or replacement.

D. Protect painted surfaces with removable heavy Kraft paper, sheet vinyl or equal, installed at the factory and removed prior to final inspection.

E. Repair damaged paint on equipment and materials. Finish with same quality of paint and workmanship as used by manufacturer so repaired areas are not obvious.

F. All lighting fixtures are to be stored on the project in their original factory cartons.

2.5 EQUIPMENT ACCESSORIES

A. Furnish and install all equipment, accessories, connections and incidental items necessary to fully complete all work, ready for use, occupancy and operation by the Owner.

B. Where equipment requiring different arrangement or connections from those shown is provided, install the equipment to operate properly and in harmony with the intent of the drawings and specifications.

C. Support, plumb, rigid and true to line all work and equipment included. Study thoroughly all general, structural, electrical and mechanical drawings, shop drawings and catalog data to determine how equipment is to be supported, mounted or suspended and provide extra steel

bolts, inserts, pipe stands, brackets and accessories for proper supports whether or not shown on the drawings. When directed, submit drawings showing supports.

PART 3 EXECUTION

3.1 WORK PERFORMANCE

A. Furnish and install a temporary electrical distribution system of adequate feeder sizes to prevent excessive voltage drop. Install all temporary work in a neat and safe manner. Provide temporary lighting as necessary to furnish 2.5 footcandles on all work surfaces.

B. Field coordinate with other trades in ample time to build all chases and openings, set all sleeves, inserts and concealed materials, and provide clearances that may be required to accommodate materials and equipment. Lay out electrical work so that in case of interference with other items the layout may be altered to suit conditions encountered.

C. Cutting and Patching:

1. The Electrical Contractor shall be responsible for all required cutting, patching, etc., incidental to this work and shall make all required repairs thereafter to the satisfaction of the Engineer. Do not cut into any structural element, beam or column without the written approval of the Engineer.

2. Pipes, conduits, cables, wires, wire ducts and similar equipment that pass through fire or smoke barriers shall be protected in accordance with NFPA 101.

D. Wall Penetrations: When conduit, wireways, bus duct and other electrical raceways pass through fire partitions, fire walls, or walls and floors, install a firestop that provides an effective barrier against the spread of fire, smoke and gases. Firestop material must be packed tight and completely fill clearances between raceways and openings. Use firestop material conforming to the following:

1. All wall penetrations shall be caulked and sealed. Provide fire barrier pillows to protect the interior of conduits/sleeves passing through fire rated walls.

2. The Contractor shall furnish and install all necessary sleeves and chases for all work passing through and attaching to walls, ceilings or the roof.

3. Provide UL listed, fire rated poke through devices for floor penetrations as required by the Standard Building Code, National Fire Code and Life Safety Code.

4. Provide UL approved fire rated chases and fire sealing as required to maintain fire rating for all penetrations in fire rated walls.

5. Firestopping material must be of the latest type as supplied by leading manufacturers such as "3M".

6. Floor, exterior wall and roof seals must be watertight. Sleeve walls and floors which are cored for installation of conduit with steel tubing, grouted and the space between the

conduit and sleeve filled as specified herein. Where conduits pierce the roof, refer to architectural specifications and drawings for details. Provide pourable sealant as specified by the Roofing Contractor.

E. Do not use electrical hangers and other supports for other than electrical equipment and materials. Provide not less than a safety factor of five (5) and conform with any specific requirements as shown on the drawings or in the specifications.

F. Do not deviate from the plans and specifications without the full knowledge and consent of the Engineer. Should, at any time during the progress of the work, a new or existing condition be found which makes desirable a modification of the requirements of any particular item, report such item promptly to the Engineer for his decision and instruction.

G. Notify all other contractors of any deviations or special conditions. Resolve interferences between the work of the various contractors prior to installation. Remove, if necessary, work installed which is not in compliance with the plans and specifications as specified above, and properly reinstall without additional cost to the Owner.

H. This Contractor shall furnish all necessary scaffolding, cranes, tackle, tools and appurtenances of all kinds, and all labor required for the safe and expeditious execution of his contract.

3.2 EQUIPMENT INSTALLATION AND EQUIPMENT

A. Installation:

1. "Provide" and "Install" as used on the drawings and in the specifications means furnish, install, connect, adjust and test except where otherwise specified.

2. Install coordinated electrical systems, equipment and materials complete with auxiliaries and accessories installed.

B. Equipment Location: As close as practical to locations shown on drawings.

C. Working Spaces: Not less than specified in the National Electrical Code for all voltages specified.

D. Inaccessible Equipment:

1. Where the Engineer determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, remove and reinstall equipment as directed at no additional cost.

2. "Conveniently Accessible" is defined as being capable of being reached without the use of ladders or without climbing or crawling under or over obstacles such as motors, pumps, belt guards, transformers, piping and ductwork.

E. Equipment and Materials:

1. Install new equipment and materials unless otherwise specified.

2. Insure that equipment and materials are designed to provide satisfactory operation and operating life for environmental conditions where being installed. NEC and other code requirements applied to the installation and other code requirements apply to the installation in areas requiring special protection such as explosion proof, vapor-proof, water tight and weather-proof construction.

3.3 EQUIPMENT IDENTIFICATION

A. In addition to the requirements of the National Electrical Code, install identification signage which will clearly indicate information required for use and maintenance of items such as panelboards, cabinets, motor controllers (starters), safety switches, time clocks, contactors, separately enclosed circuit breakers, individual breakers, and controllers in switchgear and motor control assemblies, control devices and other significant equipment.

3.4 DRAWINGS AND SPECIFICATIONS

A. The drawings and specifications indicate the requirements for the systems, equipment, materials, operation and quality. They are not to be construed to mean limitation of competition to the products of specific manufacturers.

3.5 SYSTEM VOLTAGES

A. System voltage is 120/208 volts, three-phase, four-wire.

3.6 SUBMITTALS

A. Obtain the Engineer's approval for all equipment and materials before purchasing or delivery to the job site. Delivery, storage or installation of equipment or material which has not had prior approval is not permitted at the job site. Only equipment and material which have been approved by submittals may be used on this project. Refer to Section 26 00 10, Paragraph 2.3.E for substitutions.

B. Include in all submittals adequate descriptive literature, catalog cuts, shop drawings and other data necessary for the Engineer to ascertain that the proposed equipment and materials comply with specification requirements. Catalog cuts submitted for approval must be legible and clearly identify equipment being submitted.

C. Submit to the Engineer within (30) days after the awarding of the Contract, a complete set of brochures of shop drawings and descriptive data of all material and equipment proposed for the installation. All information shall be submitted electronically in "pdf" format, and shall be separated into electronic "pdf" files in three groups, lighting, switchgear and all others.

D. The submittals must include the following:

1. Information which confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, pictures, nameplate data and test reports as required.

2. Elementary and interconnection wiring diagrams for communication and signal systems, control system and equipment assemblies. All terminal points and wiring must be identified on wiring diagrams.

3. Parts list which must include those replacement parts recommended by the equipment manufacturer.

4. Approvals will be based on complete submission only.

E. Furnish shop drawings for the work involved in sufficient time so that no delay or changes will be caused. Thermofax copies are not acceptable - only permanent type prints are allowed.

F. Verify that shop drawings comply in all respects with the item originally specified. It is the Contractor's responsibility to procure the proper sizes, quantities, rearrangements, structural modifications or other modifications in order for the substituted item to comply with the established requirements.

G. Any shop drawings prepared to illustrate how equipment, conduit, fixtures, etc., can be fitted into available spaces will be examined under the assumption that the Contractor has verified all the conditions. Obtaining approval thereon does not relieve the Contractor of responsibility in the event the material cannot be installed as shown on the drawings.

H. Shop drawings need not cover detailed installation drawings prepared for the Contractor's own use, but be limited, as in the case of raceways, to necessary departures from the plans as prepared by the Engineer.

I. Submit working scale drawings of apparatus and equipment which in any way varies from these specifications and plans, to be reviewed by the Engineer before the work is started. Correct interferences with the structural conditions before the work proceeds.

J. Submit all shop drawings at the same time in a loose-leaf binder with double index as follows:

1. List the products by designated letter or number as indicated on plan sheets.

2. List the name and manufacturers whose products have been incorporated in the work alphabetically together with their addresses and the name and addresses of the local sales representative.

3. Provide indexes with sheet numbers and quantities of the products listed.

3.7 TESTS AND DEMONSTRATION

A. As equipment and materials are being installed and connected, test the installation for the following:

1. Short circuits and ground faults.

2. Insulation resistance at 500 volts DC.

3. Grounding continuity.

B. After tests are completed and necessary corrections are made, put each system into operation and demonstrate its performance to the satisfaction of the Owner's authorized representative.

C. Provide written documentation of tests and performance as requested by the Owner's authorized representative. The results are to be made part of the Closeout Documents.

D. Furnish all instruments, test equipment and personnel that are required for the particular test. Certify that equipment and gauges are in good working order. Remove equipment subject to damage during test from line before test is applied.

E. After installation is complete the Contractor shall conduct operating test of all electrical systems for approval by the Architect. Test shall include verification of direction of rotation for all motors. The equipment shall be demonstrated to operate in accordance with the requirements of the plans and specifications. The test shall be performed in the presence of the Architect or Engineer.

F. Provide certified test of the grounding electrode system. It shall test to 5 ohms or less.

3.8 COMPLETION AND ACCEPTANCE

A. Upon completion of the work and before final acceptance, perform the duties and provide the documents as follows in accordance with the General Conditions, Supplementary Conditions and Division 1 of Contract.

B. Remove all rubbish, tools and surplus materials accumulated during the execution of the work in this Division.

C. Touch up any equipment or finishes damaged during delivery or installation from the work in this Division.

D. Provide a written one-year guarantee of materials and work except for items that are specified to have a longer warranty. Items that have a published or normal life expectancy of less than one year, such as incandescent lamps are to be covered by the manufacturer's guarantee.

E. Provide systems and equipment installation, operating and maintenance instructions and catalog data for transmittal to the Owner. Place the data in a loose-leaf binder which contains an index of the products listed alphabetically by name and a separate index listing the manufacturers alphabetically by name and including the manufacturer's address and the name and address of their local representative.

F. Instruct the Owner's representative in the proper operation and maintenance of the systems and their elements as required or directed to familiarize the Owner in the operation and maintenance of the systems.

3.9 RECORD DRAWINGS

A. The Contractor shall keep a neat and accurate record of field changes made during construction. Changes shall be penciled in on a separate set of drawings used only for recording changes. At completion of the project the Contractor shall deliver this set to the

Architect for preparation of record drawings.

B. Record drawings shall include corrected panel schedules and riser diagram as well as all plan sheets.

3.10 FINALLY

A. It is the intention that this specifications shall provide a complete installation. All accessories and apparatus necessary for complete operational systems shall be included. The omission of specific reference to any part of the work necessary for such complete installation shall not be interpreted as relieving this Contractor from furnishing and installing such parts.

END OF SECTION

SECTION 26 05 19

WIRES AND CABLES

PART 1 GENERAL

1.1 WORK INCLUDED

A. Wires and cables.

1.2 RELATED WORK

A. Section 26 05 53: Identification.

PART 2 PRODUCTS

2.1 MATERIALS

A. Wire and cable shall be new, shall have size, grade of insulation, voltage and manufacturer name, permanently marked on outer covering at regular intervals.

B. Building Wiring: 95% conductivity, soft drawn conforming to requirements of the NEC and relevant ASTM specifications, copper, 600 volt insulation, dual rated THHN-THWN.

C. Branch Circuit Wiring: Conductors smaller than No. 12 AWG not permitted; No. 8 AWG and larger, stranded construction; smaller than No. 8, either solid or stranded.

D. Fire Alarm System Wiring: UL Listed plenum-rated cable for conductors installed in plenum rated spaces. Coordinate with Authority Having Jurisdiction.

E. Exterior Wiring: Bare stranded for ground, THWN-THHN for all other.

F. Use pre-insulated pressure connectors such as Scotchlock on stranded conductors No. 10 and smaller. Use approved high-pressure crimp sleeve connectors on No. 8 and larger conductors.

G. Where allowed by local inspecting authorities, type "MC" cable shall be allowed for fixture whips. It shall be installed using proper fittings and installation tools per NEC.

H. Low voltage cable is to be installed in conduit in areas with no ceiling.

PART 3 EXECUTION

3.1 INSTALLATION

A. Make conductor length for parallel feeders identical.

B. Lace or clip groups of conductors at panelboards, pull boxes and wireways.

C. Provide copper grounding conductors and straps.

D. Install wire and cable in code conforming raceway.

E. Use wire pulling lubricant for pulling No. 4 AWG and larger wire.

F. Install wire in conduit runs after concrete and masonry work is complete and after moisture is swabbed from conduits.

G. Splice only in accessible junction or outlet boxes. Install splices and taps which have mechanical strength and insulation rating equivalent-or-better than conductor and are compatible with conductor material.

H. Color code conductors to designate neutral conductor and phase as follows: 120/208V (phases) black, red, blue, (neutral) white, (ground) green; 277/480V (phases) orange, brown, yellow, (neutral) white with color stripe, (ground) green.

I. All 20 amp circuits are 2-#12, 1-#12 ground unless noted. Use #10 AWG conductors on 20 amp branch circuits which exceed 75 feet to the first outlet.

J. Install home runs as indicated on the panel schedules. Circuits may be grouped into 3-Phase home runs but in no case are more than 3 phase conductors allowed.

K. Sharing of neutrals is not allowed, to include lighting and power circuits.

L. Where conduit and wire are installed on the roof, refer to NEC Section 310.15.(B.)(2)(C) for derating/correcting factors for the distance installed from the roof.

M. No low-voltage wiring is to be visible in open ceiling areas; install in conduit.

3.2 MARKING

A. Identify circuits using wire markers at the following locations:

1. All power and lighting branch circuits and feeders at pull boxes, fixtures, outlets, motors, etc., indicating panel and circuit number at which each circuit or feeder originates.

2. All branch circuits in the panelboard gutters indicating corresponding branch circuit numbers.

3. All signal and control wires at all termination points such as cabinets, terminal boxes, equipment racks, control panels, consoles, etc. Install in accordance with approved schedules prepared by the equipment manufacturer or by the Contractor.

4. Mark both ends of all pull wires with tag reading "PULL WIRE" and numbered to refer to the same pull wire.

END OF SECTION

SECTION 26 05 26

GROUNDING

PART 1 GENERAL

1.1 WORK INCLUDED

A. Power system grounding.

B. Communication system grounding.

C. Building ground system.

1.2 RELATED WORK

A. Section 26 05 19: Wires and Cables.

B. Section 26 05 34: Conduit.

1.3 REGULATORY REQUIREMENTS

A. Install complete grounding system for the building(s) and all electrical equipment in accordance with National Electrical Code, Section 250.

PART 2 PRODUCTS

2.1 GROUNDING

A. Provide copper grounding conductors for grounding connections sized according to NEC.

PART 3 EXECUTION

3.1 POWER SYSTEM GROUNDING

A. Install NEC sized ground conductor, #12 AWG minimum, in all branch circuit and equipment conduits.

B. Bonding Jumpers: Provide green insulated wire, size correlated with over-current device protecting the wire. Connect to neutral only at service neutral bar.

C. Bonding Wires: Install bonding wire in flexible conduit connected at each end to a grounding bushing.

D. No strap type grounding clamps shall be used. All connections shall be made only after surfaces have been cleaned or ground to exposed metal.

E. The building structural steel shall be grounded as follows:

F. Bond the neutral (grounded conductor) to ground at one location only once per building at the building's main service disconnect. Bond per NEC Article 250.

G. Ground cable trays per N.E.C.

END OF SECTION

SECTION 26 05 29

SUPPORTING DEVICES

PART 1 GENERAL

1.1 WORK INCLUDED

A. Conduit supports.

PART 2 PRODUCTS

2.1 CONDUIT SUPPORTS

A. Single Runs: Galvanized conduit straps or ring bolt type hangers with specialty spring clips. All "Caddy" and "B-Line" hangers are approved.

B. Multiple conduits running horizontally at the same grade and elevation may be supported by trapezes of channels suspended on rods. All support components shall be adequate size for loaded weights being supported. Provide conduit racks with 25% spare capacity.

C. Perforated strap iron or wire shall not be used for supporting conduits or equipment.

D. Where large conduits are supported beneath bar joist, hanger rods shall be secured to angle irons of adequate size. Each angle shall span two or more joist to distribute the weight properly.

E. Supports shall be installed within three (3) feet of each coupling or connector.

F. Vertical Runs: Channel support with conduit fittings, clamp type supports where conduits penetrate floors.

2.2 ANCHOR METHODS

A. Hollow Masonry: Toggle bolts or spider type expansion anchors.

B. Solid Masonry: Lead expansion anchors or preset inserts.

C. Metal Surfaces: Machine screws, bolts or welded studs.

D. Wood Surfaces: Wood screws.

E. Concrete Surfaces: Self drilling anchors or power driven studs.

2.3 METAL FRAMING SYSTEMS

A. Provide metal framing systems for electrical equipment and conduits as required for proper support spacing and approved for the purpose. Powerstrut, Unistrut, Kindorf or equal.

PART 3 EXECUTION

3.1 INSTALLATION

A. Layout to maintain headroom, neat mechanical appearance, and to support equipment loads required.

B. Install horizontal supports at eight feet (8') on centers, at fittings and corners, and as required for proper support.

C. Provide a complete installation with all channels, accessories, screws, nuts, washers, inserts, springs, clamps, hangers, clips, fittings, brackets framing fittings, post bases and brackets to provide a structural rigid support or mounting system.

D. On the roof, provide B-Line DB series roof top support bases. Provide two supports per 10' length of conduit. Conduit to be 24" off the roof, minimum. Provide 1/2" rubber pads under the B-Line support blocks. Coordinate to be higher than other trades' piping on the roof. Install conduit in the ceiling space below where possible.

END OF SECTION

SECTION 26 05 34

CONDUIT

PART 1 GENERAL

1.1 WORK INCLUDED

A. Conduit and couplings.

B. Flexible conduit.

1.2 RELATED WORK

A. Section 26 05 53: Identification.

PART 2 PRODUCTS

2.1 MATERIALS

A. Conduit/Elbows: Rigid steel threaded ANSI C80.1; electrical metallic tubing ANSI C80.3, Schedule 40 PVC.

B. Couplings/Connectors: Threaded; liquid-tight; compression gland. Set screw type products are not allowed.

C. Flexible Conduit: Aluminum or steel armor, plastic jacketed type with liquid-tight connectors used only at motor/equipment terminations. Connectors are to be metal.

D. Metal Clad Cable: Type "MC" cable may be used where allowed by local codes for fixture whips only.

E. PVC or High Density Polyethylene Conduit: HDPE or PVC conduit is acceptable for underground and innerduct applications.

2.2 TYPE

A. Utilize rigid steel conduit (3/4" minimum) in the following locations:

1. In concrete.

2. In exterior locations.

3. Areas subject mechanical abuse.

B. Utilize electrical metallic tubing in other locations, 3/4" minimum. Only E.M.T. is allowed in walls. E.M.T. may be Steel or Aluminum.

C. Make connections to motors and equipment with PVC jacketed flexible conduit and liquid-tight connectors. Minimum size 1/2" for motor connections. Use 3/8" Greenfield flexible conduit only for fixture wiring. Provide sufficient length of flexible conduit to avoid

transmission of vibration. Install straps per NEC.

D. PVC conduit may be used for underground service entrance conduits and all low voltage under-slab applications. It is not to be installed exposed. Elbows for service conduits and panel feeders are to be galvanized rigid.

E. Flexible conduit is not allowed within walls.

F. Only service entrance conduits and panel feeder conduits may be installed under the slab, Exception being for floor boxes, cabinets and equipment located away from wals.

G. Conduit on the roof is rigid aluminum.

2.3 MARKING

A. All empty conduit shall be left with a pull string for future use, and shall be permanently marked on each end with like numbers.

B. Mark the conduits and boxes mentioned in this Section paragraph 2.2F as to circuits included and on the record drawings.

PART 3 EXECUTION

3.1 INSTALLATION

A. All wiring systems shall be installed in raceways consisting of galvanized steel tubing, PVC conduit, HDPE conduit, rigid galvanized steel, flexible steel conduit or neoprene covered flexible steel conduit.

B. Water tight junction boxes, fittings, expansion joints, compression fittings (for use with all electrical tubing), conduit hubs, etc., shall be provided, for all electrical systems wherever construction dictates, including, but not limited to, outdoor locations.

C. Flexible conduit used in outdoor locations or indoor locations where exposed to continuous or intermittent moisture shall be liquid tight, neoprene covered and UL listed. All fittings for such applications shall be liquid tight, nylon insulated throat type as manufactured by Thomas and Betts, Series 5331, or approved equal.

D. Sufficient slack shall be provided in all flexible conduit connections to reduce the effects of vibration.

E. Insulated bushings shall be used where rigid conduit is installed in any enclosure or junction box. In addition, insulated bushings shall be used on all conduits 1 1/4-inch and larger.

F. All conduit bends shall have a radius greater than or equal to that stipulated by the NEC.

G. Install conduit concealed in all areas excluding mechanical and electrical rooms and conduit to fixtures in rooms without ceilings.

H. For exposed runs, attach surface mounted conduit with clamps.

I. Coordinate installation of conduit in masonry work.

J. Install conduit free from dents and bruises. Plug ends to prevent entry of dirt or moisture.

K. All conduit systems shall be installed complete and shall be cleaned out before installation of conductors.

L. Alter conduit routing to avoid structural obstructions, minimizing crossovers.

M. Seal conduit with glass fiber where conduits leave heated area and enter unheated area.

N. Provide flashing and pitch pockets making watertight joints where conduits pass through roof or waterproofing membranes. Provide pourable sealant as approved by the Roofing Contractor.

O. Install UL approved expansion fittings complete with grounding jumpers where conduits cross building expansion joints (review architectural and structural drawings and coordinate with General Contractor to determine expansion joint locations). Provide bends or offsets in conduit adjacent to building expansion joints where conduit is installed above suspended ceilings.

P. Avoid routing conduit through public spaces with exposed structure where possible.

Q. Route all exposed conduits parallel or perpendicular to building lines. Coordinate all exposed conduit locations with the Architect prior to rough-in.

R. In exposed ceiling areas stub conduits feeding devices in walls out of the wall as high as possible at bottom of structure or bond beam, whichever is higher.

S. Allow minimum of 6-inch clearance at flues, steam pipes and heat sources. Allow 12-inch clearance at telephone conduits. Where possible, install horizontal raceway runs above water and steam piping.

T. Install conduit system from cabinets to boxes, boxes to outlet and outlet to outlet in such a manner as to be electrically continuous throughout.

U. Make bends or offsets with approved bender or hickey.

V. Where conduits are stubbed up for low voltage cabling or future use, do so neatly; furnish with nylon pull string, conduit caps and labeling on each end.

W. Securely support conduits from the structure using approved type clamps, hangers and assemblies. Space supports according to manufacturer's recommendations and accepted practice. Do not support conduits from ceiling suspension system. In no case exceed support spacing per NEC maximum.

X. Avoid installing conduit on the roof. Where necessary, support conduits via B-Line type DB supports and the appropriate strut straps. Support twice per 10' length of conduit. Use supports which hold conduit 24 inches above roof. Conduit on the roof is rigid aluminum. Provide 1/2" rubber pads under the conduit supports.

Y. Leave a nylon pull string in all empty conduits. Terminate empty conduit stubouts with bushing manufactured for that purpose.

Z. Install properly sized grounding conductor in all conduit.

AA. Elbows for service and panel feeders are to be galvanized rigid conduit.

BB. No conduit may be installed in slab. Conduit for stub-ups and panel feeders are to be installed with the top of the conduit at a minimum of four inches under the slab. Bed with one-half inch washed rock. Conduit for floor boxes is to be installed coming out of the bottom of the floor box and installed under slab.

CC. Provide conduit for all low voltage cable installed in areas which have no ceiling or hard ceilings.

DD. All data/telephone conduits are to be "home-run" to an area above an accessible ceiling. No "Daisy Chaining" allowed.

EE. No "Daisy Chaining" of fixtures is allowed.

FF. Seal conduits where they transition from underground distribution system to the interior of a building or structure, refer to N.E.C. 225.27.

END OF SECTION

SECTION 26 05 37

OUTLET AND PULL BOXES

PART 1 GENERAL

1.1 WORK INCLUDED

A. Outlet boxes.

B. Pull and junction boxes.

1.2 RELATED WORK

A. Section 26 05 53: Identification.

B. Section 26 27 26: Wall Switches, Receptacles and Plate Covers.

C. Section 27 10 05: Conduit for Telephone/Data and TV Raceway System.

PART 2 PRODUCTS

2.1 MATERIALS

A. Boxes: Hot dip galvanized, 1.25 oz/sq.ft. or cadmium plated, conforming to UL requirements.

B. Interior Boxes: Pressed sheet steel blanked for conduit.

C. Exterior Boxes: Corrosion-resistant cast, deep type, with face plate gasket and corrosion-resistant fasteners.

D. For Ceiling: 4" square boxes for receiving three or less 3/4" conduits.

E. For Flush Mounting in Walls: 4" square boxes with matching plaster cover for single or two gang outlets. For larger boxes, use solid type or special units, with flush plates.

F. Surface Mounted: 4" square.

G. Pull Boxes and Junction Boxes: Metal construction, conforming to National Electrical Code, with screw-on or hinged cover.

H. Flush Mounted Pull Boxes: Provide overlapping covers with flush head cover retaining screws, prime coated.

I. For floor boxes, refer to the electrical legend on the plans.

PART 3 EXECUTION

3.1 INSTALLATION

A. Mount outlet boxes flush in areas other than mechanical rooms, electrical rooms, above removable ceilings, and on exposed structure in rooms without ceilings.

B. Do not install boxes back-to-back in same wall, allow 6" minimum horizontal spacing between boxes.

C. Do not use sectional or handy boxes unless specifically requested.

D. For boxes mounted in exterior walls, make sure that there is insulation behind outlet boxes to prevent condensation in boxes.

E. For outlets mounted above counters, benches and splashbacks, coordinate location and mounting heights with built-in units. Adjust outlet mounting height to agree with required location for equipment served.

F. Securely mount each outlet box to metal studs with outlet box mounting supports. Secure to at least two studs or install box stabilizers as manufactured by "B-Line" and "Caddy".

G. Do not install more than three 3/4" conduits into one 4" outlet box. Do not use more than one extension ring on a box.

H. For heights of outlets above the finished floor in permanent partitions, use the following unless otherwise noted: To Center of Device:

1. Convenience Receptacles: 18" or as directed.
2. Brackets: As directed.
3. Switches: 46" or as directed.
4. Telephone Outlets: 18" or as directed.
5. Other Outlets: As directed or indicated.
6. Over Counters: 6" above countertop, horizontal at windows or where indicated.
7. Fire Alarm Pull stations: Minimum 42” and Max 48” measured vertically, from the floor level to activating handle or lever.
8. Fire Alarm Audio Visual Device: 80” to top of box

I. Locate pull boxes and junction boxes above removable ceiling or in electrical rooms, utility rooms or storage areas.

J. Install pull boxes of the proper size and depth to accommodate the required conduits and wires.

K. When installing outlet boxes in fire rated walls, provide fire blocking material on the back side of the boxes.

L. Coordinate box mounting height with brick courses, where applicable.

M. Study all devices and light fixtures, providing and installing applicable outlet and back boxes as necessary.

N. Boxes for fire alarm systems are to be painted red.

END OF SECTION

SECTION 26 05 53

IDENTIFICATION

PART 1 GENERAL

1.1 WORK INCLUDED

A. Provide and install identification markers.

1.2 RELATED WORK

A. Section 26 05 19: Wires and Cables.

B. Section 26 05 34: Conduit.

C. Section 26 05 37: Outlet and Pull Boxes.

D. Section 26 24 16: Panelboards.

E. Section 26 28 18: Motor and Circuit Disconnects.

PART 2 PRODUCTS

2.1 MATERIALS

A. Provide nameplates of laminated phenolic plastic with engraved letters 3/16" high at push-button stations, thermal overload switches, receptacles, wall switches and similar devices where the nameplate is attached to the device plate. At all other locations, make lettering 1/4" high, unless otherwise detailed on the drawings. Securely fasten nameplates to the equipment. Motor nameplates may be non-ferrous metal not less than 0.03" thick, die stamped.

B. Pre-marked, self adhesive, wrap around type markers, manufacturers: Brady, T&B, E-Z Code.

PART 3 EXECUTION

3.1 INSTALLATION

A. General: Equip the following items with nameplates:

1. All motors, motor starters, motor control center, push-button stations, control panels, time switches.

2. Disconnect switches, fused or unfused, switchboards and panelboards, circuit breakers, contactors or relays in separate enclosure.

3. Power receptacles where the nominal voltage between any pair of contacts is greater than 150 volts.

4. Wall switches controlling outlets for lighting fixtures or equipment where the outlets are not located within sight of the controlling switch.

5. Special electrical systems at junction and pull boxes terminal cabinets and equipment racks.

B. Adequately describe the function of or use of the particular equipment involved. Where nameplates are detailed on the drawings, use inscription and size of letters as shown. Include on nameplates for panelboards and switchboards the panel designation, voltage and phase of the supply. The name of the machine or the motor nameplates for a particular machine must be the same as the one used on all motor starter, disconnect and push button station nameplates for that machine.

C. The Contractor shall provide typed panel schedules for all electrical panels. Schedules shall reflect actual wiring incorporating all field changes. Copies of Panel Schedules from the construction drawings are not acceptable.

1. Panel Schedules shall reflect room numbers as depicted by the Owner as well as construction numbers.

D. Label all junction boxes with a black permanent marker indicating circuit number and distribution panel or motor control center feeding the circuits contained therein.

E. At each panel, provide a phenolic plastic plate with 1/4-inch high engraved letters, stating the voltages in the panel, the color code of the wires in the panel, power supply origination, the arc flash hazard, and the date of the installation. Attach to the panel cover with stainless steel bolts, locknuts and nuts or locking nuts. At the main disconnect, provide a label noting the available fault current and date of installation.

F. All breakers within each panel are to be labeled.

G. All underground conduits are to be labeled as to each end.

END OF SECTION

SECTION 26 05 73

OVERCURRENT PROTECTIVE DEVICES

PART 1 GENERAL

1.1 WORK INCLUDED

A. Fuses.

B. Molded-case circuit breakers.

1.2 RELATED WORK

A. Section 26 24 16: Panelboards.

B. Section 26 28 18: Motor and Circuit Disconnects.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Fuses:

1. Bussman.

2. Littlefuse.

B. Breakers and Relays:

1. Eaton.

2. General Electric.

3. Siemens.

4. Square D.

2.2 CIRCUIT BREAKERS

A. General: Except as otherwise indicated, provide circuit breakers and ancillary components, of types, sizes, ratings and electrical characteristics indicated, which comply with manufacturer's standard design, materials, components and construction in accordance with published product information and as required for a complete installation.

B. Molded-Case Circuit Breakers: Provide factory assembled molded-case circuit breakers of frame assembled molded-case circuit breakers of frame size voltage and interrupting ratings as indicated on the drawings. Provide breakers with permanent thermal and instantaneous magnetic trips in each pole and ampere ratings and indicated. Construct with overcenter, trip-free, toggle type operating mechanisms with quick-make, quick break action and positive handle indication. Construct breakers for mounting and operating in any physical position and

operating in an ambient temperature of 40 Deg. C. Provide breakers with mechanical screw type removable connector lugs, AL/CU rated.

C. Any overcurrent protection device rated 1200A or higher shall be furnished with an enegy-reducing maintenance switching feature with local status indication. This feature shall be furnished with the overcurrent device by the manufacturer.

D. Tandem circuit breakers are not acceptable.

2.3 FUSES

A. General: Except as otherwise indicated, provide fuses of types, sizes, ratings and average time-current and peak let through current characteristics indicated, which comply with manufacturers' standard design, materials and construction in accordance with published product information and with industry standards and configurations.

B. Class RK1 and Class J Current Limiting Fuses: Provide UL Class RK1 and Class J current limiting fuses rated 200,000 RMS symmetrical interrupting current for protecting motors and equipment, equal to Buss LPN-RK or LPS-RK.

PART 3 EXECUTION

3.1 INSTALLATION OF OVERCURRENT PROTECTIVE DEVICES

A. Install overcurrent protective devices as indicated in accordance with the manufacturer's written instructions and with recognized industry practices to insure that protective devices comply with requirements. Comply with NEC and NEMA standards for installation of overcurrent protective devices.

B. Coordinate with other work, including electrical wiring work as necessary to interface installation of overcurrent protective devices.

C. Fasten circuit breakers without mechanical stresses, twisting or misalignment being exerted by clamps, supports or cabling.

3.2 FIELD QUALITY CONTROL

A. Prior to energization of overcurrent protective devices, test devices for continuity of circuitry and for short circuits. Correct malfunctioning units and then demonstrate compliance with requirements.

END OF SECTION

SECTION 26 27 26

WALL SWITCHES, RECEPTACLES, AND PLATE COVERS

PART 1 GENERAL

1.1 WORK INCLUDED

A. Wall switches.

B. Receptacles.

C. Plate covers.

1.2 RELATED WORK

A. Section 26 05 26: Grounding.

B. Section 26 05 37: Outlet and Pull Boxes.

C. Section 26 05 53: Identification.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Arrow Hart.

B. Bryant.

C. Eagle.

D. General Electric.

E. Hubbell.

F. Leviton.

G. P&S.

H. Substitutions: See Section 26 00 10 - General Electrical Provisions.

2.2 WALL SWITCHES

A. Acceptable Devices

1. Single Pole Switch: Type 1221, or equal.

2. Double Pole Switch: Type 1222, or equal.

3. Three-way Switch: Type 1223, or equal.

4. Four-way Switch: Type 1224, or equal.

5. Dimmers: Lutron "NOVA" Series or equal; size as required per the circuit wattage, 600 watt minimum. Provide type for the fixtures being dimmed.

6. Two-pole switches used to control two loads, like lights and exhaust fans in restrooms, must be "rated" for that duty.

7. Keyed Switches: Provide four keys per switch.

B. Materials

1. 120/277 Volt Switches: Quite slow make, slow break design, toggle handle with totally enclosed case, rated 20 ampere, specification grade. Provide matching two pole, three-way and four-way switches.

2. Color: Coordinate with the Architect.

3. Dimmers: Electronic switching type with toroid filter coil to eliminate RF interference.

4. Two-pole switches used to control two loads, like lights and exhaust fans in restrooms, must be "rated" for that duty.

5. Provide metal barrier between gangs in boxes, where adjacent switches have a potential in excess of 300V between conductors.

2.3 RECEPTACLES

A. Device: Receptacles In General Use Areas of Project: All receptacles shall be commercial grade and shall be "Tamper Resistant."

1. Duplex Receptacle: Type BR20TR, or equal.

2. Duplex Receptacle, GFCI: Type GFTR20, or equal.

3. Single Receptacle: Type 5361, or equal.

4. Special Outlets: See Plans.

5. Isolated Ground Receptacle: Type 5362IG, or equal.

B. Devices

1. Standard Duplex Receptacle: Nema 5-20R. Full gang size, polarized, duplex, parallel blade, U grounding slot, rated at 20 amperes, 125 volts, designed for split feed service.

2. Nameplates: Provide engraved or embossed plastic for receptacles other than standard duplex and standard single receptacles indicating voltage, phase and amperes.

3. Isolated ground outlets to be orange, emergency circuit devices to be red, all other device colors to be coordinated with the Architect.

4. Exterior receptacles are to be "GFI" and rated as "weather resistant".

2.4 PLATE COVERS

A. Materials

1. Stainless Steel: Type 302 or 304, No. 4 finish, 0.040 inches thick, accurately die cut, protected with release paper.

2. Cast Metal: Die cast profile, ribbed or strength, flash removed, primed with grey enamel, furnished complete with four mounting screws.

3. Gaskets: Resilient rubber or closed cell foam urethane.

4. Nylon: High-performance, molded nylon.

5. Stamped Metal: For use on 4" square boxes.

B. Device

1. Flush Mounting Plates: Beveled type with smooth rolled outer edge.

2. Surface Box Plates: Beveled, steel, pressure formed for smooth edge to fit box.

3. Weatherproof Plates: CAST METAL, gasketed; for receptacles, provide the weatherproof "while in use" type.

4. Where two-gang boxes are required for single gang devices, provide special plates with device opening in one gang and second gang blank.

PART 3 EXECUTION

3.1 INSTALLATION

A. Coordinate switch mounting location with architectural detail and heights as noted on plans.

B. Run separate neutral for each lighting circuit.

C. Install switches at 46" to center above finished floor, coordinate with brick layers where applicable.

D. Mount receptacles at mounting heights specified on the plans, 18" to center of the box unless noted otherwise.

E. Connect all devices using pigtails. Do not through-wire on device terminals.

F. Mount outlets for electric water coolers and other similar permanently installed plug connected equipment behind equipment according to approved installation drawing, coordinate with the equipment installer.

G. Install coverplates on wiring devices level and with all four edges in contact with finished surface.

H. Use stainless steel plates or nylon plates, color to match devices as specified by the Architect, in all interior areas unless noted. Use steel plates in mechanical and utility type areas.

END OF SECTION

SECTION 26 28 18

MOTOR AND CIRCUIT DISCONNECTS

PART 1 GENERAL

1.1 WORK INCLUDED

A. Provide and install motor and circuit disconnects.

1.2 REGULATORY REQUIREMENTS

A. Conform to National Electrical Code and to applicable inspection authority.

1.3 REFERENCES

A. Underwriters' Labs, Inc. Annual Product Directories.

B. Classification of Standard Types of Non-ventilated Enclosures for Electric Controllers, National Electrical Manufacturers Association.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Eaton.

B. General Electric.

C. Hubbell.

D. Leviton.

E. Square D.

2.2 EQUIPMENT

A. Provide motor and circuit disconnects with UL label.

B. Single Phase 120 Volt Disconnect Switches: Double pole toggle switch, Leviton MS302.

C. Provide with lockable covers.

D. Three-Phase Motor Disconnect Switches and Single Phase 240 Volt Disconnect Switches: 2 or 3 pole heavy duty fusible or non-fusible as shown, 250 or 480 volt as required in NEMA Type 1 or 3 enclosures. Provide with lugs for suitable wire range, with ground lug, copper current carrying parts, silver-tungsten contacts, reinforced fuse clips for type R rejection fuses.

E. Provide NEMA "4/4X" type disconnects within the kitchen area.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install motor and circuit disconnect as recommended by manufacturer and as required by Code.

B. Where required by local authorities, install disconnects for all roof mounted equipment separate from that equipment. Furnish (galvanized) "Unistrut" or angle iron mounting stands with B-Line DB series roof top support base. Coordinate with the equipment supplier and Roofing Contractor.

END OF SECTION

SECTION 26 51 00

INTERIOR BUILDING LIGHTING

PART 1 GENERAL

1.1 WORK INCLUDED

A. Installation of luminaires, supports and accessories.

B. Emergency lighting units.

C. Exit signs.

D. Lamps.

E. Ballasts, drivers, and accessories.

1.2 RELATED WORK

A. Section 26 05 19: Wires and Cables.

B. Section 26 05 29: Supporting Devices.

1.3 REFERENCES

A. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 SUBMITTALS

A. Submit shop drawings and product data in accordance with General Conditions including pertinent physical characteristics and complete photometric data reports from independent testing laboratory.

B. Shop Drawings: Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.

C. Product Data: Provide dimensions, ratings, and performance data.

D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Quality Assurance. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

E. Operation and Maintenance Data: Instructions for each product. Installation manuals are required.

1.5 COORDINATION

A. Confirm compatibility and interface of other materials with luminaire and ceiling system. Report discrepancies to the Engineer/Architect and defer ordering until clarified.

B. Supply plaster frames, trim rings and backboxes to other trades.

C. Coordinate with Division 23 to avoid conflicts between luminaires, supports, fittings and mechanical equipment.

D. Conform to requirements of NFPA 70.

E. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years experience.

F. Products: Listed and classified by Underwriters Laboratories, Inc. or testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

G. The lighting wholesale supplier shall have an office and a stocking warehouse within 100 miles of the project site. The distributor/manufacturer's representative shall have an office within 100 miles of the project site, and shall have on staff a full time lighting designer as well as personnel who are available to service the project after completion.

H. Any substitutions to the light fixture schedule shall be proven, by the manufacturer at the discretion of the Engineer, to be of equal or superior quality, material, and performance than the specified light fixtures. All requests for substitutions shall be submitted along with fixture specification sheets, photometric calculations and electronic ies files 10 days prior to bid opening date for review. Substitutions shall be requested in writing only, accompanied by the above listed electronic ies files. Substitutions will not be considered if they are indicated or implied in shop drawing submission without previous formal request. Substitutions will not be considered if they require substantial revision of the contract documents. The Contractor shall be responsible for any and all additional costs required by modifications to architectural, structural, mechanical or electrical facilities, devices, systems, etc. resulting from the approved substitution.

I. Light fixtures and ballasts are to comply with the fixture schedule and the Specifications.

PART 2 PRODUCTS

2.1 LUMINAIRES

A. Acceptable Manufacturers

1. Provide products of manufacturers as listed in the lighting fixture schedule or equal, subject to compliance with requirements.

2. Fixtures are to be supplied in manufacturer's standard cartons.

3. Substitutions: See Section 26 00 10 - General Electrical Provisions.

B. Lensed Luminaires

1. Pre-treat housing and finish in high reflectance baked white powder paint on exposed and reflective surfaces giving reflectance of 90% minimum average. Paint shall be applied after fabrication.

2. Reflective end plates may be 20 gauge metal.

3. Provide full 22 gauge steel housing.

4. Provide hinged frames with fully enclosed spring loaded cam latches and T-type hinges, removable for cleaning without tools. Support lay-in lenses on four sides with flip ends on short dimension.

5. Provide gasketing, stops and barriers to form light traps and prevent light leaks.

6. Design luminaire to dissipate ballast and lamp heat.

7. Use formed or ribbed backplates, endplates, reinforcing channels.

8. Provide virgin acrylic diffusers, 0.125" thick nominal, number 12 pattern, 7.8 oz. weight per square foot.

9. Furnish products as indicated in Fixture Schedule, or equal.

C. Recessed Luminaires

1. Supply recessed luminaire complete with trim type required for ceiling system installed. Before ordering, confirm ceiling construction details and architectural finish for each area. Supply with "IC" type housing or gyp board hat over the fixture, where insulation will cover.

2. Fixtures shall be delivered to the job site in factory provided individual cartons.

3. All damaged fixtures are to be replaced

2.2 LAMPS

A. Acceptable Manufacturers

1. General Electric.

2. Osram/Sylvania.

3. Philips.

B. LED Lamps

1. LED Lamps: Manufacturers must have Energy Star/DLC rating or shall offer LM-80 and TM-21 test reports to the public online.

2. LED estimated useful life: Minimum of 50,000 hours at 70% lumen maintenance, calculated based on LM-80 test data.

3. LED fixtures shall be modular and allow for separate replacement of LED lamps and drivers.User serviceable LED lamps and drivers shall be accessible and replaceable from the room side.

4. Light fixture provider shall provide all low voltage control wiring for dimmable fixture.

5. Note lamp color specifications on the fixture schedule, minimum CRI shall be 80.

6. All light fixtures shall be provided with a 5 year warranty on the LED and driver system.

2.3 BALLASTS AND DRIVERS

A. Provide ballasts that meet standards of an electrical testing laboratory and the Certified Ballasts Manufacturers' Association.

B. Acceptable Manufacturers:

1. Universal.

2. Philips/Advance.

3. Osram/Sylvania.

C. LED Drivers

1. LED drivers shall be electic-type, labeled as compliant with radio frequency interference (RFI) requirements of FCC Title 47 Part 15, and comply with NEMA SSL 1 " Electronic Drivers for LED Devices, Arrays, or System". LED drivers shall have a sound rating of "A", have a minimum efficiency of 85%, and be rated for a THD of less than 20 percent at all input voltages.

2. Dimmable LED drivers shall be 0-10V type unless otherwise noted on the schedule. Dimmable LED drivers shall be capable of dimming without LED strobling or flicker across their full drimming range.

3. Emergency LED drivers shall be manufactured by a company with a minimum of five (5) years service. They shall be factory installed and tested, to include red pilot lights. They shall be manufactured by Bodine Mfg. and be rated at 1100 lumens, minimum.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install lamps in accordance with manufacturer's instructions.

B. Provide spare lamps in the amount of 5% of the total count, or 5 each type, whichever is the greater number.

C. Provide ballasts of compatible design to lamps specified.

D. No "Daisy Chaining" of fixtures is allowed.

E. Install fixtures securely, in a neat and workmanlike manner.

F. Install suspended luminaires and exit signs using pendants supported from swivel hangers. Provide pendant length required to suspend luminaire at indicated height.

G. Support all luminaires independent of ceiling framing, directly from building structure by rod hangers and inserts or suspension wire, two per fixture.

H. Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prevent movement.

I. Install recessed luminaires to permit removal from below.

J. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.

K. Install clips to secure recessed grid-supported luminaires in place.

L. Install wall mounted luminaires, emergency lighting units, and exit signs at height as scheduled.

M. Manufactured wiring systems are approved. Provide submittals per Specifications.

3.2 RECESSED LUMINAIRES

A. Perform field inspection, testing, and adjusting in accordance with Section 26 00 10.

B. Install recessed luminaires to permit removal from below to gain access to outlet or pre-wired fixture box.

C. Install an accessible junction box not less than two feet away from the fixture and connect to it by not less than four feet nor more than six feet of flexible conduit, using type of fixture wire approved for this purpose.

D. Mount in suspended ceiling with exposed tee bar grid system, support directly from the building structure by a minimum of two support wires.

E. Hold insulation back from all fixtures by three (3) inches and clear on top.

F. A disconnecting means is required for all ballasted luminaires with double ended lamps. Install per NEC 410.130(G).

3.3 ALIGNMENT

A. Aim and adjust luminaires.

B. Align luminaires, clean diffusers and replace burned out lamps prior to final acceptance.

3.4 FIRE RATED CEILINGS

A. Where recessed fixtures will penetrate either fire-rated ceilings or fire rated gypsum board located above suspended ceilings, the fire-rated ceiling or gypsum board shall be continuous over and around the fixture housing and outlet box. Coordinate the ceiling and fixture installations to insure a continuous fire rated ceiling.

3.5 FINALLY

A. Remove dirt and debris from enclosures.

B. Clean photometric control surfaces as recommended by manufacturer.

C. Clean finishes and touch up damage.

D. Relamp luminaires that have failed lamps at Substantial Completion and all lamps that have been energized during construction for more than 500 hours.

END OF SECTION

SECTION 26 56 00

EXTERIOR LIGHTING

PART 1 GENERAL

1.1 WORK INCLUDED

A. Installation of luminaires, supports and accessories.

1.2 RELATED WORK

A. Section 26 05 19: Wires and Cables.

B. Section 26 51 00: Interior Building Lighting.

1.3 REFERENCES

A. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 SUBMITTALS

A. Submit shop drawings and product data in accordance with General Conditions including pertinent physical characteristics and complete photometric data reports from independent testing laboratory.

B. Shop Drawings: Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.

C. Product Data: Provide dimensions, ratings, and performance data.

D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Quality Assurance. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

E. Operation and Maintenance Data: Instructions for each product.

1.5 COORDINATION

A. Products: Listed and classified by Underwriters Laboratories, Inc. or testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Provide products of manufacturers as listed in the lighting fixture schedule, or equal.

B. LED Lamps

1. LED Lamps: manufacturers must have Energy Star/DLC rating or shall offer LM-80 and TM-21 test reports to the public online.

2. LED estimated useful life: Minimum of 50,000 hours at 70% lumen maintenance, calculated based on LM-80 test data.

3. LED fixtures shall be modular and allow for separate replacment of LED lamps and drivers.

4. Light fixture provider shall provide all low voltage control wiring for dimmable fixture.

5. All light fixtures shall be provided with a 5 year warranty on the LED and driver system.

6. Note lamp color specifications on the fixture schedule, minimum CRI shall be 80.

7. All exterior light fixtures shall be, at a minimum, IP64 rated.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install fixtures securely on poles and pole bases as shown on the plans.

3.2 FINALLY

A. Remove dirt and debris from enclosures.

B. Clean photometric control surfaces as recommended by manufacturer.

C. Clean finishes and touch up damage.

END OF SECTION

SECTION 27 10 05

CONDUIT FOR TELEPHONE/DATA AND TV RACEWAY SYSTEM

PART 1 GENERAL

1.1 WORK INCLUDED

A. Telephone/Data and TV raceway system.

1.2 RELATED WORK

A. Section 26 05 19: Wires and Cable.

B. Section 26 05 34: Conduit.

C. Section 26 05 37: Outlet and Pull Boxes.

D. Section 26 05 53: Identification.

1.3 SYSTEM DESCRIPTION

A. At TV locations, provide a 4" outlet box and plaster ring with 3/4" raceway to above a drop ceiling in an accessible area. Leave a pull string in each raceway. End each stub up with a 90-degree elbow. Mount as shown on the plans.

B. At all telephone/data locations, provide a 4" outlet box and plaster ring with 1" raceway to an accessible area above a ceiling. Leave a pull string in each raceway. End each stub-up with a 90-degree elbow.

PART 2 PRODUCTS

2.1 MATERIALS

A. Conduit: Refer to Section 26 05 34.

B. Outlet and Pull Boxes: Refer to Section 26 05 37.

PART 3 EXECUTION

3.1 INSTALLATION

A. Provide an insulated throat connector or plastic bushing where raceways are stubbed out above the ceiling, including a 90-degree elbow on the end of the conduit.

B. Provide a stainless steel or nylon blank cover plate for any outlet location which is not to be used. Allow for this quantity to be 50% of total data outlets.

C. Provide conduit for all low voltage wiring which is installed in areas which have no ceiling or hard ceiling and shall be painted blue.

D. All device plates are to be stainless steel or nylon.

END OF SECTION

SECTION 27 05 00

COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Grounding and Bonding
2. Identification
3. Pathways
4. Firestopping

B. Related Requirements:

1. Section 260526 "Grounding and Bonding for Electrical Systems".
2. Section 271000 “Structured Cabling”.
3. Section 274116 “Integrated Audio-Video Equipment”.
4. Section 281300 “Access Control Systems”.
5. Section 282300 “Video Surveillance Systems”.
6. ANSI/TIA Telecommunications Commercial Building Wiring Standards, current editions.
7. NFPA-70, National Electrical Code. (Check with the AHJ for the edition in force.)
8. BICSI, Telecommunications Distribution Methods Manual, current edition.
9. BICSI, Information Transport Systems Installation Methods Manual, current edition.
10. BICSI, Customer-Owned Outside Plant Design Reference Manual, current edition.
11. CNGIT GOV Network Construction Standards and Requirements Manual.
12. If a conflict exists and cannot be remediated by the above referenced codes, standards, and the Cherokee Nation Government Information Technology Network Construction Standards and Requirements Manual, CNGIT will have overall authority for the resolution.

1.3 DEFINITIONS

A. Access Provider: An operator that provides a circuit path or facility between the service provider and user. An access provider can also be a service provider.

B. BICSI: Building Industry Consulting Service International.

C. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

D. EMI: Electromagnetic interference.

E. FTP: Shielded twisted pair.

F. F/FTP: Overall foil screened cable with foil screened twisted pair.

G. F/UTP: Overall foil screened cable with unscreened twisted pair.

H. IDC: Insulation displacement connector.

I. LAN: Local area network.

J. Modular jack: Also commonly called an "outlet," it is the fixed, female connector.

K. MPTL: Modular Plug Terminated Link. Also commonly called a “plug” or "connector," it is the removable, male telecommunications connector. Formerly known as “direct connect”.

L. PBB: Primary bonding busbar. A busbar placed in a convenient and accessible location and bonded, by means of the telecommunications bonding conductor, to the building’s service equipment (power) ground (formerly known as the telecommunications main grounding busbar).

M. RBB: Rack bonding busbar. A busbar within a cabinet, frame, or rack.

N. RBC: Rack bonding conductor. Bonding conductor from the rack or rack bonding busbar to the telecommunications equipment bonding conductor.

O. RCDD: Registered Communications Distribution Designer.

P. Screen: A metallic layer, either a foil or braid, placed around a pair or group of conductors.

Q. SBB: Secondary bonding busbar. Formerly known as the telecommunications grounding busbar (TGB).

R. Service Provider: The operator of a telecommunications transmission service delivered through access provider facilities.

S. Shield: A metallic layer, either a foil or braid, placed around a pair or group of conductors.

T. S/FTP: Overall braid screened cable with foil screened twisted pair.

U. S/UTP: Overall braid screened cable with unscreened twisted pairs.

V. TBC: Telecommunication Bonding Conductor. The TBC bonds the PBB to the service equipment (power) ground. Formerly known as the bonding conductor for telecommunications (BCT).

W. TEBC: Telecommunications equipment bonding conductor. A conductor that connects the primary bonding busbar, secondary bonding busbar or supplementary bonding network to equipment racks or cabinets, rack bonding busbars or rack bonding conductors.

X. UTP: Unscreened/unshielded twisted pair.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.5 INFORMATIONAL SUBMITTALS

A. As-Built Data: Plans showing as-built locations of grounding and bonding infrastructure, including the following:

1. Ground rods.
2. Ground and roof rings.
3. TBC, PBB, SBBs, and routing of their bonding conductors.

B. Qualification Data: For Installer, installation supervisor, and field inspector.

C. Qualification Data: For testing agency and testing agency's field supervisor.

D. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Result of the ground-resistance test, measured at the point of TBC connection.
b. Result of the bonding-resistance test at each SBB and its nearest grounding electrode.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Installation Supervision: Installation shall be under the direct supervision of ITS Technician, who shall be always present when Work of this Section is performed at Project site.
2. Field Inspector: Currently registered by BICSI as an RCDD to perform the on-site inspections.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

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

B. Comply with UL 467 for grounding and bonding materials and equipment.

C. Comply with TIA-607-D.

2.2 CONDUCTORS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Chatsworth Products, Inc.
2. Panduit Corp.

B. Comply with UL 486A-486B.

C. Insulated Conductors: Stranded copper wire, green or green with yellow stripe insulation, insulated for 600 V, and complying with UL 83.

1. Ground wire for custom-length equipment ground jumpers shall be No. 6 AWG, 19-strand, UL-listed, Type THHN wire.
2. Cable Tray Equipment Grounding Wire: No. 6 AWG.

D. Cable Tray Grounding Jumper:

1. Not smaller than No. 6 AWG and not longer than 12 inches. If jumper is a wire, it shall have a crimped grounding lug with two holes and long barrel for two crimps. If jumper is a flexible braid, it shall have a one-hole ferrule. Attach with grounding screw or connector provided by cable tray manufacturer.
2. Not smaller than No. 10 AWG and not longer than 12 inches. If jumper is a wire, it shall have a crimped grounding lug with one hole and standard barrel for one crimp. If jumper is a flexible braid, it shall have a one- or two-hole ferrule. Attach with grounding screw or connector provided by cable tray manufacturer.

E. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmils, 14 strands of No. 17 AWG conductor, and 1/4 inch in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Tinned-copper tape, braided conductors terminated with two-hole copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

2.3 CONNECTORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

1. Chatsworth Products, Inc.
2. Panduit Corp.

B. Irreversible connectors listed for the purpose. Listed by an NRTL as complying with NFPA 70 for specific types, sizes, and combinations of conductors and other items connected. Comply with UL 486A-486B.

C. Compression Wire Connectors: Crimp-and-compress connectors that bond to the conductor when the connector is compressed around the conductor. Comply with UL 467.

1. Electroplated tinned copper, C and H shaped.

D. Signal Reference Grid Connectors: Combination of compression wire connectors, access floor grounding clamps, bronze U-bolt grounding clamps, and copper split-bolt connectors, designed for the purpose.

E. Busbar Connectors: Cast silicon bronze, solderless compression-type, mechanical connector; with a long barrel and two holes spaced on 5/8- or 1-inch centers for a two-bolt connection to the busbar.

F. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

G. Welded Connections shall be positioned In an accessible position to be inspected and labeled.

2.4 GROUNDING BUSBARS

A. Manufacturers: Panduit

1. Primary bonding busbar.
2. Secondary bonding busbar.
3. Refer to 271000 Appendix A for current part number

B. PBB: Predrilled, wall-mounted, rectangular bars of hard-drawn solid copper, 1/4 by 4 inches in cross section, length as indicated on Drawings. The busbar shall be NRTL listed for use as PBB and shall comply with TIA-607-D.

1. Predrilling shall be with holes for use with lugs specified in this Section.
2. Mounting Hardware: Stand-off brackets that provide a 4-inch clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.

C. SBB: Predrilled rectangular bars of hard-drawn solid copper, 1/4 by 2 inches in cross section, length as indicated on Drawings. The busbar shall be for wall mounting, shall be NRTL listed as complying with UL 467, and shall comply with TIA-607-D.

1. Predrilling shall be with holes for use with lugs specified in this Section.
2. Mounting Hardware: Stand-off brackets that provide at least a 2-inch clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.

D. Rack and Cabinet Grounding Busbars: Rectangular bars of hard-drawn solid copper, accepting conductors ranging from No. 14 to No. 2/0 AWG, NRTL listed as complying with UL 467, and complying with TIA-607-D. Predrilling shall be with holes for use with lugs specified in this Section.

1. Cabinet-Mounted Busbar: Terminal block, with stainless-steel or copper-plated hardware for attachment to the cabinet.
2. Rack-Mounted Horizontal Busbar: Designed for mounting in 19- or 23-inch equipment racks. Include a copper splice bar for transitioning to an adjoining rack, and stainless-steel or copper-plated hardware for attachment to the rack.
3. Rack-Mounted Vertical Busbar: 72 or 36 inches long, with stainless-steel or copper-plated hardware for attachment to the rack.

2.5 GROUND RODS

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

1. Harger Lightning & Grounding.
2. TE Connectivity Ltd.

B. Ground Rods: Copper-clad steel; 5/8” diameter by 96 inch length.

2.6 IDENTIFICATION

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Panduit Corporation

B. Self-laminating adhesive labels: Vinyl, thermal, transfer-printed, 3-mil-thick, multicolor, weather and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.

1. Minimum Nominal Size:
   a. 1-1/2 by 6 inches for raceway and conductors.
   b. 3-1/2 by 5 inches for equipment.
   c. As required by authorities having jurisdiction.

2.7 METAL CONDUICT AND FITTINGS

A. To be provided by others.

2.8 CABLE TRAY ACCESSORIES

A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.

1. Refer to 271000 Appendix A for current part numbers.

B. Barrier Strips: Same materials and finishes as for cable tray.

C. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

D. Firestop: Provide intumescent firestop blocks where cable trays are continuous through fire rated walls.

2.9 J-HOOKS

A. Description: Prefabricated cable supports for telecommunications cable.

B. Manufacturers: Panduit
1. Or approved equivalent.

2. Refer to 271000 Appendix A for current part numbers.

C. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

D. Comply with TIA-569-E.

2.10 SLEEVES

A. Subject to compliance with requirements, provide products by the following:

1. STI EZ Path fire assemblies.
2. Utilize gang plates where multiple cable management devices are required to penetrate fire rated assemblies.
3. Refer to 271000 Appendix A for current part numbers.

B. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral water stop unless otherwise indicated.

C. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

D. Sleeves & Pathways Penetrating Fire Rated Assemblies: Provide a cable management device where cables penetrate fire rated walls or floors. The fire-rated cable management device shall contain integrated intumescent firestop materials sufficient to maintain the hourly rating of the assembly being penetrated. The fire-rated cable management device shall contain an inner smoke seal capable of achieving an L-Rating less than or equal to 5 CFM/Square Foot for penetrations in smoke barriers.

E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

F. Sleeves for Rectangular Openings:

1. Material: Galvanized-steel sheet.
2. Minimum Metal Thickness:
   a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.

G. For sleeve cross-section rectangle perimeter 50 inches (1270 mm) or more and one or more sides larger than 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

H. Comply with requirements for identification products in Section 270553 "Identification for Communications Systems."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the ac grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of the electrical system.

B. Inspect the test results of the ac grounding system measured at the point of TBC connection.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with connection of the TBC only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Bonding shall include the ac utility power service entrance, the communications cable entrance, and the grounding electrode system. The bonding of these elements shall form a loop so that each element is connected to at least two others.

B. Comply with NECA 1.

C. Comply with TIA-607-D.

3.3 APPLICATION

A. J-Hooks

1. All cabling not in cable trays must be supported by J-Hooks with hook and loop fasteners spaced at intervals no greater than 5 feet.

B. Conductors: Install solid conductor for No. 8AWG and smaller and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

1. The bonding conductors between the SBB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.
2. The bonding conductors between the PBB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.

C. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2 AWG minimum.

D. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Structural Steel: Welded connectors.

E. Conductor Support:

1. Secure grounding and bonding conductors at intervals of not less than 36 inches.

F. Grounding and Bonding Conductors:

1. Install in the straightest and shortest route between the origination and termination point, and no longer than required. The bend radius shall not be smaller than eight times the diameter of the conductor. No one bend may exceed 90 degrees.
2. Install conductors without splices.
3. Support at not more than 36-inch intervals.
4. Install grounding and bonding conductors in 3/4-inch PVC conduit until conduit enters a telecommunications room. The grounding and bonding conductor pathway through a plenum shall be in EMT. Conductors shall not be installed in EMT unless otherwise indicated.

a. If a grounding and bonding conductor is installed in ferrous metallic conduit, bond the conductor to the conduit using a grounding bushing and bond both ends of the conduit to an SBB.

3.4 GROUNDING ELECTRODE SYSTEM

A. The TBC between the PBB and the ac service equipment ground shall be sized per TIA-607-D, paragraph 6.3 Conductors.

3.5 GROUNDING BUSBARS

A. Indicate locations of grounding busbars on Drawings. Install busbars horizontally, on insulated spacers 2 inches minimum from wall, 72 inches above finished floor unless otherwise indicated.

B. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

3.6 CONNECTIONS

A. Bond metallic equipment in a telecommunications equipment room to the grounding busbar in that room, using equipment grounding conductors not smaller than No. 6AWG.

B. Stacking of conductors under a single bolt is not permitted when connecting to busbars.

C. Assemble the wire connector to the conductor, complying with manufacturer's written instructions and as follows:

1. Use crimping tool and the die specific to the connector.
2. Pre twist the conductor.
3. Apply an antioxidant compound to all bolted and compression connections.

D. Primary Protector: Bond to the PBB with insulated bonding conductor.

E. Interconnections: Interconnect all SBBs with the PBB with the telecommunications backbone conductor. If more than one PBB is installed, interconnect PBBs using the backbone bonding conductor. The telecommunications backbone conductor and grounding equalizer conductor size shall not be less than 2 kcmils/linear foot of conductor length, up to a maximum size of No. 3/0 AWG unless otherwise indicated.

F. Telecommunications Enclosures and Equipment Racks: Bond metallic components of enclosures to the telecommunications bonding and grounding system. Install top-mounted or vertically mounted rack grounding busbar unless the enclosure and rack are manufactured with the busbar. Bond the equipment grounding busbar to the SBB No. 2 AWG bonding conductors.

G. Structural Steel: Where the structural steel of a steel frame building is readily accessible within the room or space, bond each SBB and PBB to the vertical steel of the building frame.

H. Electrical Power Panelboards: Where an electrical panelboard for telecommunications equipment is in the same room or space, bond each SBB to the ground bar of the panelboard.

I. Shielded Cable: Bond the shield of shielded cable to the SBB in communications rooms and spaces. Comply with TIA-568.1-D and TIA-568.2-D when grounding shielded balanced twisted-pair cables.

J. Rack and Cabinet-Mounted Equipment: Bond powered equipment chassis to the cabinet or rack grounding bar. Power connection shall comply with NFPA 70; the equipment grounding conductor in the power cord of cord- and plug-connected equipment shall be considered as a supplement to bonding requirements in this Section.

K. Access Floors: Bond all metal parts of access floors to the SBB.

L. Equipment Room Signal Reference Grid: Provide a low-impedance path between telecommunications cabinets, equipment racks, and the reference grid, using No. 6 AWG bonding conductors.

1. Install the conductors in grid pattern on 4-foot centers, allowing bonding of one pedestal from each access floor tile.
2. Bond the SBB of the equipment room to the reference grid at two or more locations.
3. Bond all conduits and piping entering the equipment room to the SBB at the perimeter of the room.

3.7 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA-606-C.

1. Administration Class: 1, 2, 3 or 4 as defined in TIA-606-C.
2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.

B. Paint and label colors for equipment identification shall comply with TIA-606-C for the appropriate level of administration.

C. Comply with requirements in Section 271000 "Structured Cabling" for cable and asset management software.

D. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

E. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.

F. Cable and Wire Identification:

1. Handwritten labels shall not be permitted.
2. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
3. Each wire connected to building-mounted devices is not required to be numbered at the device if wire color is consistent with associated wire connected and numbered within panel or cabinet.
4. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.
5. Label each terminal strip, and screw terminal in each cabinet, rack, or panel.
   a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group, extended from a panel or cabinet to a building-mounted device, with the name and number of a device.
   b. Label each unit and field within distribution racks and frames.
6. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and -connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

G. Labels shall be preprinted or computer-printed type, with a printing area and font color that contrast with cable jacket color but still comply with TIA-606-C requirements for the following:

1. Cables use flexible vinyl or polyester that flexes as cables are bent.

H. Grounding and bonding labels shall be preprinted or computer-printed type.

1. Label PBB(s) with "fs-PBB," where "fs" is the telecommunications space identifier for the space containing the PBB.
2. Label SBB(s) with "fs-SBB," where "fs" is the telecommunications space identifier for the space containing the SBB.
3. Label the TBC and each telecommunications backbone conductor at its attachment point: "WARNING! TELECOMMUNICATIONS BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT!"

3.8 FIELD QUALITY CONTROL

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

B. Perform tests and inspections.

C. Tests and Inspections:

1. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
2. Test the bonding connections of the system using an ac earth ground-resistance tester, taking two-point bonding measurements in each telecommunications

equipment room containing a PBB and an SBB and using the process recommended by BICSI TDMM. Conduct tests with the facility in operation.

a. Measure the resistance between the busbar and the nearest available grounding electrode. The maximum acceptable value of this bonding resistance is 100 milliohms.

3. Test for ground loop currents using a digital clamp-on ammeter, with a full-scale of not more than 10 A, displaying current in increments of 0.01 A at an accuracy of plus/minus 2.0 percent.

a. With the grounding infrastructure completed and the communications system electronics operating, measure the current in every conductor connected to the PBB and each SBB. Maximum acceptable ac current level is 1 A.

D. Excessive Ground Resistance: If resistance to ground at the TBC exceeds .5 ohms, notify Architect promptly and include recommendations to reduce ground resistance.

E. Grounding system shall be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

3.9 PATHWAY APPLICATION

A. Indoors: Apply pathway products as specified below unless otherwise indicated:

1. Pathways for Optical-Fiber or Communications Cable in Spaces Used for Environmental Air: Plenum-type, optical-fiber-cable pathway.

B. Minimum Pathway Size: 3/4-inch trade size for aluminum cables, and 1 inch for optical-fiber and copper cables.

C. Pathway Fittings: Compatible with pathways and suitable for use and location.

3.10 INSTALLATION

A. Comply with the following standards for installation requirements except where requirements on Drawings or in this Section are stricter:

1. NECA 1.
2. ANSI/BICSI N1-19.
3. TIA-606-C.
4. TIA-607-D.
5. TIA-569-E.
6. NECA 101
7. NECA 102.
8. NECA 105.
9. NECA 111.

B. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.

C. Comply with requirements in Section 078400 "Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

D. Complete pathway installation before starting conductor installation.

E. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches of changes in direction. Utilize long radius ells for all optical-fiber cables.

F. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid, and flexible, as follows:

1. 3/4-Inch Trade Size and Smaller: Install pathways in maximum lengths of 50 feet.
2. 1-Inch Trade Size and Larger: Install pathways in maximum lengths of 75 feet.
3. Install with a maximum of two 90-degree bends or equivalent for each 100 feet length of pathway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.

G. J-Hooks:

1. Size to allow a minimum of 25 percent future capacity without exceeding design capacity limits.
2. Shall be supported by dedicated support wires or threaded rod (minimum 3/8”). Do not use ceiling grid support wire or support rods.
3. Hook spacing shall allow no more than 6 inches of slack. The lowest point of the cables shall be no less than 6 inches adjacent to ceilings, mechanical ductwork and fittings, luminaires, power conduits, power, and telecommunications outlets, and other electrical and communications equipment.
4. Space hooks no more than 5 feet o.c.
5. Provide a hook at each change in direction.
6. J or U shape.

3.11 CABLE TRAY GROUNDING

A. Ground cable trays according to NFPA 70 unless additional grounding is specified. Comply with the manufacturer’s requirements to meet the UL listed assembly as tested.

B. Cable trays shall be bonded together in accordance with the manufacturer’s requirements to maintain UL listed assembly, with splice washer kits or splice plates listed for grounding purposes.

C. Cable trays with single-conductor power conductors shall be bonded together with a grounding conductor run in the tray along with the power conductors and bonded to the tray at 72-inch intervals. The grounding conductor shall be sized according to NFPA 70, Article 250.122, "Size of Equipment Grounding Conductors," and Article 392, "Cable Trays."

D. When using epoxy- or powder-coat painted cable trays as a grounding conductor, completely remove coating at all splice contact points or ground connector attachment.

After completing splice-to-grounding bolt attachment, repair the coated surfaces with coating materials recommended by cable tray manufacturer.

E. Bond cable trays to power source for cables contained within with bonding conductors sized according to NFPA 70, Article 250.122, "Size of Equipment Grounding Conductors."

3.12 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in this Section.

3.13 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078400 " Firestopping," and 271000 "Structured Cabling".

END OF SECTION

SECTION 27 05 28

PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal conduits and fittings.
2. Metal wireways and auxiliary gutters.
3. Metallic surface pathways.
4. Boxes, enclosures, and cabinets.
5. Polymer-concrete handholes and boxes for exterior underground cabling.
6. Fiberglass handholes and boxes for exterior underground cabling.

1.3 DEFINITIONS

A. ARC: Aluminum rigid conduit.

B. GRC: Galvanized rigid conduit.

C. IMC: Intermediate metal conduit.

D. PVC: Polyvinyl chloride conduit.

E. RTRC: Reinforced thermosetting resin conduit.

1.4 ACTION SUBMITTALS

A. Product data for the following:

1. Conduit and fittings.
2. Boxes, enclosures, and cabinets.
3. Underground handholes and boxes.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Pathway routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of pathway groups with common supports.
2. Underground ducts, piping, and structures in location of underground enclosures and handholes.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

A. Description: Metal raceway of circular cross section with manufacturer-fabricated fittings.

B. General Requirements for Metal Conduits and Fittings:

1. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.
2. Comply with TIA-569-E.

C. GRC: Comply with ANSI C80.1 and UL 6.

D. ARC: Comply with ANSI C80.5 and UL 6A.

E. IMC: Comply with ANSI C80.6 and UL 1242.

F. PVC-Coated Steel Conduit: PVC-coated [GRC] [IMC].

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch, minimum.

G. EMT: Comply with ANSI C80.3 and UL 797.

H. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
2. Fittings for EMT:

a. Material: Steel or die cast.
b. Type: Set screw or compression.

3. Expansion Fittings: PVC or steel to match conduit type, complying with UL-467, rated for environmental conditions where installed, and including flexible external bonding jumper.
4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.

I. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS AND FITTINGS

A. Description: Nonmetallic raceway of circular section with manufacturer-fabricated fittings.

B. General Requirements for Nonmetallic Conduits and Fittings:

1. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
2. Comply with TIA-569-E.

C. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

D. Rigid HDPE: Comply with UL 651A.

E. Continuous HDPE: Comply with UL 651A.

F. RTRC: Comply with UL 2515A and NEMA TC 14.

G. Fittings: Comply with NEMA TC 3; match to conduit or tubing type and material.

H. Solvents and Adhesives: As recommended by conduit manufacturer.

2.3 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

A. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.

B. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.

C. General Requirements for Nonmetallic Wireways and Auxiliary Gutters:

1. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
2. Comply with TIA-569-E.

D. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.

E. Solvents and Adhesives: As recommended by conduit manufacturer.

2.4 BOXES, ENCLOSURES, AND CABINETS

A. Description: Enclosures for communications.

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

1. Hoffman; nVent
2. MonoSystems, Inc.
3. Old Castle Infrastructure.
4. Quazite; Hubbell Incorporated, Power Systems.
5. Wiremold; Legrand North America, LLC.

C. General Requirements for Boxes, Enclosures, and Cabinets:

1. Comply with TIA-569-E.
2. Boxes, enclosures, and cabinets installed in wet locations shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for use in wet locations.
3. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
4. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.
5. Gangable boxes are [allowed] [prohibited].

D. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

E. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

F. Metal Floor Boxes:

1. Material: Cast metal.
2. Type: Fully adjustable.
3. Shape: Rectangular.
4. Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. Nonmetallic Floor Boxes: Nonadjustable, round or rectangular.

1. Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

H. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

I. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.

J. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

K. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 4, with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures:

a. Material: Steel.
b. Finished inside and out with manufacturer's standard enamel.

2. Nonmetallic Enclosures:

a. Material: Plastic.
b. Finished inside with radio-frequency-resistant paint.

3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

L. Cabinets:

1. NEMA 250, Type 3R galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.5 POLYMER-CONCRETE HANDHOLES

A. Description: Molded of sand and aggregate; bound together with polymer resin; and reinforced with steel, fiberglass, or a combination of the two.

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

1. Oldcastle Infrastructure Inc.; CRH Americas.
2. Quazite; Hubbell Incorporated, Power Systems.
3. Martin Enterprises

C. General Requirements for Polymer Concrete Handholes:

1. Boxes and handholes for use in underground systems shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
3. Comply with TIA-569-E and SCTE 77.

D. Configuration: Designed for flush burial with open bottom unless otherwise indicated.

E. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.

1. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
2. Cover Legend: Molded lettering, "COMMUNICATIONS".

F. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

G. Handholes 24 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.6 FIBERGLASS HANDHOLES AND BOXES

A. Description: Molded of fiberglass-reinforced polyester resin, with frame and covers of polymer concrete or fiberglass.

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

1. Oldcastle Infrastructure Inc.; CRH Americas.
2. Quazite; Hubbell Incorporated, Power Systems.
3. Martin Enterprises.

C. General Requirements for Fiberglass Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
3. Comply with TIA-569-E and SCTE 77.

D. Color of Frame and Cover: Gray or Green.

E. Configuration: Designed for flush burial with open bottom unless otherwise indicated.

F. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.

G. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.

H. Cover Legend: Molded lettering, "COMMUNICATIONS".

I. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

J. Handholes 24 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.7 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 an independent testing agency.
2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.1 PATHWAY APPLICATION

A. Outdoors: Apply pathway products as specified below unless otherwise indicated:

1. Exposed Conduit: RNC, Type EPC-40-PVC.
2. Concealed Conduit, Aboveground: GRC.
3. Underground Conduit: RNC, Type EPC-40-PVC.
4. Boxes and Enclosures, Aboveground: NEMA 250, Type 4.

B. Pathway Fittings: Compatible with pathways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.

C. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

D. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

A. Comply with the following standards for installation requirements except where requirements on Drawings or in this Section are stricter:

1. NECA 1.
2. ANSI/BICSI N1-2019.

3. TIA-569-E.
4. NECA 101
5. NECA 102.
6. NECA 105.
7. NECA 111.

B. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.

C. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

D. Comply with requirements in Section 270529 "Hangers and Supports for Communications Systems" for hangers and supports.

E. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling" for sleeves and sleeve seals for communications.

F. Keep pathways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.

G. Install conduit in the most direct path possible. Strive to keep conduit parallel and perpendicular as depicted.

H. The conduit system shall be continuous. (i.e. conduit, pull boxes, etc.) between the point of origin and the destination. Daisy chaining of conduit is not allowed under any variance or circumstance.

I. Conduit runs shall be no longer than 100’ between pull boxes.

J. Pull boxes shall not be used as corners. Conduit and cable shall enter one side and exit opposite side.

K. Pull boxes shall be sized to accept planned number of conduits plus 2 additional conduits of the same size.

L. Conduit system shall contain no bends greater than 90 degrees and no more than 180 degrees total bends in the aggregate.

M. If a bend greater than 90 degrees is required contractor shall install an appropriate sized pull box within 3 feet of the bend.

N. Flexible conduit shall not be used.

O. All conduit bends shall be smooth and continuous. Conduit bend radius shall be at least 10 times the internal diameter of the conduit.

P. “LB”s shall not be used.

Q. All conduits shall be reamed, swabbed and dried prior to any cable installation.

R. Cap or plug all conduit after drying to prevent water and debris entering conduit.

S. Install plastic or nylon pull cord/s within all installed conduit, leaving 10’ of slack at each handhole or pull box.

T. Metallic conduit shall be bonded to a ground on one or both ends in accordance with local and national codes.

U. Complete pathway installation before starting conductor installation.

V. Arrange stub-ups so curved portions of bends are not visible above finished slab.

W. Conduit shall stub above slab/grade minimum 4”.

X. Support conduit and pull boxes within 12 inches of changes in direction. Utilize long radius ells for all optical-fiber cables.

Y. Conceal rigid conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

Z. Support conduit within 12 inches of enclosures to which attached.

AA. Pathways Embedded in Slabs:

1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure pathways to reinforcement at maximum 10-foot intervals.
2. Arrange pathways to cross building expansion joints at right angles with expansion fittings. Comply with requirements for expansion joints specified in this article.
3. Arrange pathways to keep a minimum of 1 inch of concrete cover in all directions.
4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
5. Change from nonmetallic conduit and fittings to GRC and fittings before rising above floor.

BB. Stub-ups to Above Recessed Ceilings:

1. Use EMT, IMC, or RMC for pathways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

CC. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.

DD. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.

EE. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.

FF. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus one additional quarter-turn.

GG. 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.

HH. Cut conduit perpendicular to the length. For conduits of 2-inch trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.

II. All field cut conduit ends shall be properly reamed in accordance with industry best practices.

JJ. Install pull rope/tape in empty pathways. 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. Secure pull rope/tape, so it cannot fall into conduit. Cap pathways designated as spare alongside pathways in use.

KK. Install pathway-sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, 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 pathway-sealing fittings according to NFPA 70.

LL. Install devices to seal pathway interiors at accessible locations. Locate seals, so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service pathway enters a building or structure.
3. Where otherwise required by NFPA 70.

MM. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.

3.3 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.
2. Trench bottom shall be calculated so that topmost conduit edge is no less than 18” below finished grade.
3. Install backfill as specified.
4. 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.
5. Duct banks with greater than 1 level shall have conduit spacers to maintain proper spacing and support per manufacturers requirements.
6. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
7. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete around conduit for a minimum of 12 inches on each side of the coupling.
    b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.

8. Warning tape with trace wire: Bury warning planks approximately 12 inches above direct-buried conduits, but a minimum of 6 inches below grade. Align tape along centerline of conduit.
9. Underground Warning Tape: Comply with requirements in Section 270553 "Identification for Communications Systems."

3.4 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 with bottom below frost line, 24” depth of frost line 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 enclosure.

F. Field cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 PROTECTION

A. Protect coatings, finishes, and cabinets from damage or deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

SECTION 271000

STRUCTURED CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. ANSI/TIA Telecommunications Commercial Building Wiring Standards, current editions.

C. NFPA-70, National Electrical Code. (Check with the AHJ for the edition being used.)

D. BICSI, Telecommunications Distribution Methods Manual, current edition.

E. BICSI, Information Transport Systems Installation Methods Manual, current edition.

F. BICSI, Customer-Owned Outside Plant Design Reference Manual, current edition.

G. Cherokee Nation Government Information Technology Network Construction Standards and Requirements Manual, current edition.

1.2 SUMMARY

A. Section Includes:

1. Backboards
2. Backbone cabling
3. Horizontal cabling
4. Entrance protection
5. Boxes, enclosures, and cabinets
6. Power strips
7. Uninterruptible power supply (UPS)
8. 19-inch freestanding/wall mounted equipment cabinets/racks
9. Ladder cable tray/wire mesh basket tray

B. Related Requirements:

1. Section 270500 "Common Work Results for Communications".
2. Section 270536 “Cable Trays for Communications Systems”.
3. Section 274116 “Integrated Audio-Video Equipment”.
4. Section 281300 “Access Control Systems”.
5. Section 282300 “Video Surveillance Systems”.
6. ANSI/TIA Telecommunications Commercial Building Wiring Standards, current editions.
7. NFPA-70, National Electrical Code. (Check with the AHJ for the edition being used.)
8. BICSI, Telecommunications Distribution Methods Manual, current edition.
9. BICSI, Information Transport Systems Installation Methods Manual, current edition.
10. BICSI, Customer-Owned Outside Plant Design Reference Manual, current edition.

11. CN GOVIT Network Construction Standards and Requirements Manual.
12. If a conflict exists and cannot be remediated by the above referenced codes, standards, and the Cherokee Nation Information Technology Network Construction Standards and Requirements Manual, CNI GOVIT will have overall authority for the resolution.

1.3 DEFINITIONS

A. Access Provider: An operator that provides a circuit path or facility between the service provider and user. An access provider can also be a service provider.

B. BICSI: Building Industry Consulting Service International.

C. CNGIT - Cherokee Nation Information Technology Government Network Group.

D. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

E. EMI: Electromagnetic interference.

F. F/FTP: Overall foil screened cable with foil screened twisted pair.

G. F/UTP: Overall foil screened cable with unscreened twisted pair.

H. IDC: Insulation displacement connector.

I. Modular jack: Also commonly called an "outlet," it is the fixed, female connector.

J. LAN: Local area network.

K. MPTL: Modular Plug Terminated Link. Also commonly called a “plug” or "connector," it is the removable, male telecommunications connector. Formerly known as “direct connect.”

L. Plug: Also commonly called a "connector," it is the removable, male telecommunications connector.

M. PBB: Primary bonding busbar. A busbar placed in a convenient and accessible location and bonded, by means of the telecommunications bonding conductor, to the building’s service equipment (power) ground (formerly known as the telecommunications main grounding busbar).

N. RBB: Rack bonding busbar. A busbar within a cabinet, frame, or rack.

O. RBC: Rack bonding conductor. Bonding conductor from the rack or rack bonding busbar to the telecommunications equipment bonding conductor.

P. RCDD: Registered Communications Distribution Designer.

Q. Screen: A metallic layer, either a foil or braid, placed around a pair or group of conductors.

R. SBB: Secondary bonding busbar. Formerly known as the telecommunications grounding busbar (TGB).

S. Service Provider: The operator of a telecommunications transmission service delivered through access provider facilities.

T. Shield: A metallic layer, either a foil or braid, placed around a pair or group of conductors.

U. S/FTP: Overall braid screened cable with foil screened twisted pair.

V. TBC: Telecommunication Bonding Conductor. The TBC bonds the PBB to the service equipment (power) ground. Formerly known as the Bonding Conductor for Telecommunications (BCT).

W. TEBC: Telecommunications Equipment Bonding Conductor. A conductor that connects the primary bonding busbar, secondary bonding busbar or supplementary bonding network to equipment racks or cabinets, rack bonding busbars or rack bonding conductors.

X. UTP: Unscreened/unshielded twisted pair.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Equipment shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

B. General Performance: Backbone and horizontal cabling system shall comply with transmission standards in TIA-568.1-E, when tested according to test procedures of this standard, and the requirements of TIA-568.4-D.

C. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings from an applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

D. Telecommunications Pathways and Spaces: Comply with TIA-569-E.

E. Grounding: Comply with TIA-607-D.

F. Backbone cabling subsystem description.

1. Copper backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.
2. Copper backbone cabling cross-connects may be in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of the copper backbone cabling.
3. Optical fiber backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.
4. Coaxial cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.
5. Backbone cabling cross-connects may be in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of the backbone cabling.

G. Horizontal cabling subsystem description.

1. Horizontal cable cabling system shall provide interconnections between Distributor A, Distributor B, or Distributor C, and the equipment outlet, otherwise known as "Cabling Subsystem 1," in the telecommunications cabling system structure. Cabling system consists of horizontal cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for horizontal-to-horizontal cross-connection.
2. Optical fiber horizontal cabling system shall provide interconnections between Distributor A, Distributor B, or Distributor C and the equipment outlet, otherwise known as "Cabling Subsystem 1" in the telecommunications cabling system structure. Cabling system consists of horizontal cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for horizontal-to-horizontal cross-connection.
3. TIA-568.1-E requires that a minimum of two equipment outlets be installed for each work area.
4. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications equipment outlet.
5. Bridged taps and splices shall not be installed in the horizontal cabling.
6. A work area is approximately 100 sq. ft. and includes the components that extend from the equipment outlets to the station equipment.

7. The maximum allowable horizontal cable length is 295 feet. This maximum allowable length does not include an allowance for the length of 16 feet to the workstation equipment or in the horizontal cross-connect.

1.5 ACTION SUBMITTALS

A. Submit all applicable, current manufacturer certificate(s) showing contractor is certified by the cabling manufacturer and can provide the necessary warranty required by the contract documents.

B. Provide manufacturer cut sheets for each piece of equipment specified. Include the manufacturer name, model number and description of each listed component. If the data sheet includes multiple part numbers or models, the Contractor will indicate which model is being submitted by marking the appropriate model number with a cloud or box.

C. Submit for approval, details of all materials, equipment, and systems to be furnished. Work shall not proceed without the Owner and/or the construction manager's approval of the submitted items. Digital copies in PDF format of the following shall be submitted:

1. Submittals for individual systems and equipment assemblies that consist of more than one item or component shall be made for the system or assembly. Partial submittals will not be considered, reviewed, or stored, and such submittals will not be returned except at the request and expense of the contractor.

D. Any materials and equipment listed that are not in accordance with specification requirements may be rejected.

E. The approval of material and equipment systems is a general approval subject to the Drawings, specifications, and verification of all measurements at the job. Approval does not relieve the contractor from the responsibility of errors. The contractor shall carefully check and correct all documentation prior to submission for approval.

F. Product data for the following:

1. Backbone cabling.
2. Horizontal cabling.
3. Power strips.
4. Uninterruptible power supply.
5. 19-inch freestanding equipment racks/cabinets.
6. Ladder cable tray/wire mesh basket tray.

1.6 INFORMATIONAL SUBMITTALS

A. Structured Cabling System (SCS) sub-contractor is defined as an employer of workers trained and approved by manufacturer.

B. The sub-contractor will utilize the authorized manufacturer components and distribution channels in provisioning this project. Submit authorized manufacturer factory training certificates.

C. Communications systems specified shall be installed under the direction of a qualified sub-contractor. Qualification requirements shall include submittal by the contractor to the Owner of the following:

1. List of previous projects (3) of this scope, size, and nature; including names and sizes of projects, description of work, time of completion and names of contact persons for reference.
2. Shall provide current certificates that they are manufacturer-authorized for work to be performed and able to offer an extended manufacturer's warranty for work performed in the state where the Work is being performed.
3. Sub-contractor must employ at least one (1) full-time Registered Communications Distribution Designer (RCDD) and provide a certificate showing their current registration.
4. Qualification Data: Current certificates from the manufacturer for installer, installation supervisor, and field inspector.

D. As-Built Data: Plans showing as-built locations of structured cabling infrastructure and pathways, including the following:

1. Main cable routing from each telecommunications room.
2. Network outlet locations, to include wireless access points, Access Control and Video Surveillance devices, and surveillance cameras.
3. Rack elevations of equipment racks/cabinets.
4. Plan views of each telecommunications room.
5. Location of each firestop system penetration.

E. Source quality-control reports.

F. Product Certificates: For each type of product.

G. Source quality-control reports.

H. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For voice/data and cabling to include in operation, and maintenance manuals. Requirements of this section shall be provided in addition to items specified by other specification sections.

B. Closeout submittals will be submitted under this section with the following provisions.

1. Maintenance Data: Include manufacturer's operating instructions, original copies of all software, recommended maintenance required and maintenance intervals.
2. A complete parts list.
3. Record Drawings shall show the following:

a. Update the original submittals of the floor plans. Relocate any device that may have been moved or altered during the life span of the project.

Devices shall include all cable pathways, outlets and other devices included in the telecommunications system.

b. Each device shall be labeled as per the direction of the Owner representative.

c. Update the line diagram Drawings provided during the submittal phase that indicated device locations back to the MDF/IDF. This will include any changes to the port locations, quantities, or locations, etc.

d. Title blocks used on all Drawings will be that of the contractor and shall include the following:

1) Company name
2) Company address and phone number for service
3) Date on the Drawings will match the date of acceptance for warranty purposes.
4) Do not use the A/E tile block, copyright date, signature, or seals for any reason.

4. Drawing documentation will be in the following format:

a. One (1) copy transmitted to the General Contractor through their approved transmittal process.

1) Drawings will be in both CAD (DWG) and PDF format, and the sub-contractor will include all files on each drive.
2) Provide all PDF Drawings in black and white.
3) One “E” size laminated drawing mounted to the wall in each Distributor Room, A, B, C or D.

5. Drawings shall be provided to the A/E for review and acceptance prior to the Owner’s final acceptance of the project.

a. The Drawings will be reviewed with the A/E and the Owner prior to the final acceptance process. Drawings rejected for any reason will delay the final acceptance process until resolved.

C. Completed record drawing will be required for use during the final acceptance process of the construction project. Failure to produce the record drawing during this process will result in a delay in the final acceptance to the project.

D. Passing test results for every copper cable/conductor and every fiber strand which was furnished as part of the product. Tested items marked with an (*) shall not be acceptable.

E. Testing equipment utilized for all cable testing shall be calibrated within the past 12 months by the manufacturer and have the latest version of software installed.

1.8 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. Adapters/cassettes/connecting blocks/: One of each type.
2. Faceplates: One of each type.
3. Jacks: Ten of each type.
4. Multiuser Telecommunications Outlet Assemblies: One of each type.
5. Patch-Panel Units: One of each type.
6. Plugs: Ten of each type.

1.9 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of cabling administration drawings, and field testing program development by an RCDD.
2. Installation Supervision: Installation shall be under the direct supervision of Technician or Level 2 Installer, who shall always be present when Work of this Section is performed at Project site.
3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
4. Firestopping: Installer shall be certified by the fire stop system manufacturer.

B. Testing Agency Qualifications: Testing agency must have personnel certified by BICSI on staff.

1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test each strand on the reel before installation and compare it to factory test results.
2. Test each pair of twisted pair cable for open and short circuits.
3. Test optical fiber cable to determine the continuity of the strand end to end. Use optical fiber flashlight or optical loss test set.

B. Return and do not install damaged materials from the site.

1.11 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry.

B. Field Measurements and Conditions: In addition to the provisions of the Conditions of the Contract, verify dimensions and obtain field measurements prior to producing shop Drawings and ordering products. Verify field conditions and condition of adjoining Work before proceeding with Work specified in this Section.

1.12 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

1.13 WARRANTY

A. Manufacturer’s Warranty:

1. Contractor shall provide a 25–year manufacturer’s warranty on all copper and fiber links and/or channels.
2. Manufacturer’s warranty shall meet the following criteria:

    a. A 25–year guarantee that the installed cabling system will pass the Commercial Building Telecommunications Standards cited in this document.
    b. This warranty will cover all registered channels.

        1) This warranty may be invoked only if entire channel links are comprised of continuous manufacturer components and cable, including patch cords.

    c. The telecommunications Contractor will correct any problems and malfunctions that are warranty–related issues without charge for the entire warranty period.
    d. If the manufacturer warranty is needed by the Owner within the warranted period and the original installer is no longer in business, manufacturer shall find a substitute manufacturer certified contractor and assume costs to fulfill the obligations of the warranty.
    e. Upon acceptance of the warranty paperwork and test results from the Contractor, manufacturer will mail a notification letter to the installer and a notification letter with warranty certificate to the Owner.
    f. The warranty period shall commence following the final acceptance of the project by the Owner and written confirmation of warranty from manufacturer.

B. Testing and Inspection of Communications Equipment

1. Provide tests specified below, in accordance with:

2. TIA-568.2-D and TIA-568.2-D-2 for copper cabling when applicable under individual items of material, equipment, and Work specified in this Specification.

3. TIA-568.3-D and TIA-568.3-D-1 for fiber optic cabling when applicable under individual items of material, equipment, and Work specified in this Specification.

    a. Furnish all test equipment and instruments required for the tests.
    b. Responsible, qualified employees of the contractor in the presence of the Owner or an authorized representative shall perform the cable testing.

C. Perform end-to-end tests of all permanent links.

PART 2 - PRODUCTS

2.1 BACKBOARDS

A. Backboards: Plywood, A/C rated, fire-retardant treated, 3/4 by 48 by 96 inches.

B. Provide and install a minimum of one (1) sheet, or as depicted on T Series Drawings, whichever is greater.

C. Backboard Paint: Pre-painted to match wall paint color.

D. Paint plywood on all six sides. Fire rating stamp shall be taped off during painting and remved so that stamp remains visible for inspection.

E. Plywood to be mounted with bottom edge no lower than (NLT) 6" AFF when mounted Vertically and NLT 36" if mounted Horizontally.

2.2 GENERAL CABLE CHARACTERISTICS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with the applicable standard and NFPA 70 for the following types:

1. Communications Plenum Rated: Type CMP complying with UL 1685.
2. Communications Plenum Rated: Type CM, Type CMG, Type CMP, Type CMR, or Type CMX in metallic conduit installed according to NFPA 70, Article 300.22, "Wiring in Ducts, Plenums, and Other Air-Handling Spaces."
3. Communications, Non-plenum: Type CMR complying with UL 1666.
4. Communications Non-plenum: Type CMP or Type CMR in listed plenum or riser communications raceway.
5. Communications Non-plenum: Type CMP or Type CMR in metallic conduit installed according to NFPA 70, Article 300.22, "Wiring in Ducts, Plenums, and Other Air-Handling Spaces."

B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings rom an applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

C. RoHS compliant.

2.3 COPPER BACKBONE CABLING

A. NOT USED

2.4 TWISTED PAIR CABLE HARDWARE

A. Description: Hardware designed to connect and terminate twisted pair copper communications cable.

B. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Panduit
2. Refer to Appendix A for current part numbers.

C. General Requirements for Cable Connecting Hardware:

1. Twisted pair cable hardware shall meet the performance requirements of Category 6 and 6A.

    a. Wiring pinout scheme shall be T568B.
2. Comply with TIA-568.2-D, IDC type, with modules designed for punch-down caps or tools.
3. Cables shall be terminated with connecting hardware of same category or higher.
4. Source Limitations: Obtain twisted pair cable hardware from sole source from single manufacturer or from same manufacturer as twisted pair cable, from sole source.

D. Connecting Blocks: 110-style IDC for Category 6 and 6A. Provide blocks for the number of cables terminated on the block, plus 25 percent spare, integral with connector bodies, including plugs and jacks where indicated.

E. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.

1. Number of Terminals per Field: One for each conductor in assigned cables.

F. Patch Panel: Modular panels housing numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.

1. Features:

    a. T568A and T568B wiring labels.
    b. Labeling areas adjacent to conductors.
    c. Replaceable connectors.
    d. 24 or 48 ports.

2. Construction: 16-gauge steel and mountable on 19-inch equipment racks.
3. Number of Jacks per Field: One for each four-pair conductor group of indicated cables, plus spares and blank positions adequate to suit specified expansion criteria.

G. Plugs and Plug Assemblies:

1. Male; eight position eight conductor; color-coded modular telecommunications connector designed for termination of a single four-pair 100-ohm unshielded or shielded twisted pair cable.
2. Standard: Comply with TIA-568.2-D.
3. Marked to indicate transmission performance.

H. Jacks and Jack Assemblies:

1. Female; eight position; modular; fixed telecommunications connector designed for termination of a single four-pair 100-ohm unshielded or shielded twisted pair cable.
2. Designed to snap-in to a patch panel or faceplate.
3. Standard: Comply with TIA-568.2-D.
4. Marked to indicate transmission performance.

I. Patch Cords: Factory-made, four-pair cables; terminated with an eight-position modular plug at each end.

1. 7’ patch cords for floor mounted racks.
2. 1’ patch cords for wall mounted cabinets.
3. Provide patch cords with bend-relief-compliant boots to ensure Category 6 and Category 6A performance.
4. Provide patch cords with latch guards to protect against snagging.
5. Provide patch cords with color-coded boots for circuit identification.

J. Faceplates:

1. Two, Four, or Six port, vertical single gang faceplates with windows and clear plastic covers designed to mount to single gang wall boxes.
2. Plastic Faceplate: High-impact plastic. Coordinate color with Section 262726 "Wiring Devices."
3. Metal Faceplate: Stainless steel, complying with requirements in Section 262726 "Wiring Devices."
4. For use with snap-in jacks accommodating any combination of twisted pair, optical-fiber, and coaxial work-area cords.

    a. Flush-mount jacks, positioning the cord at a 90-degree angle.

K. Legend:

1. Machine printed, in the field, using adhesive-tape label.
2. Snap-in, clear-label covers and machine-printed paper inserts.

2.5 FIBER OPTIC BACKBONE CABLING

A. NOT USED

2.6 COPPER HORIZONTAL CABLING

A. Horizontal cable cabling system shall provide interconnections between Distributor A, Distributor B, or Distributor C, and the equipment outlet, otherwise known as "Cabling Subsystem 1," in the telecommunications cabling system structure. Cabling system consists of horizontal cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for horizontal-to-horizontal cross-connection.

1. TIA-568.1-E requires that a minimum of two equipment outlets be installed for each work area.
2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications equipment outlet.
3. Bridged taps and splices shall not be installed in the horizontal cabling.

B. A work area is approximately 100 sq. ft. and includes the components that extend from the equipment outlets to the station equipment.

C. The maximum allowable horizontal cable length is 295 feet. This maximum allowable length does not include an allowance for the length of 16 feet to the workstation equipment or in the horizontal cross-connect.

2.7 CATEGORY 6 and CATEGORY 6A TWISTED PAIR CABLE

A. Description: Four-pair, balanced-twisted pair cable, with internal spline, certified to meet transmission characteristics of:

1. Category 6 cable at frequencies up to 250MHz.
2. Category 6A cable at frequencies up to 500MHz.

B. Manufacturers: Panduit.

1. Refer to Appendix A for current part numbers.

C. Standard: Comply with TIA-568.2-D for Category 6 and Category 6A cables.

D. Conductors: 100-ohm, 23 AWG solid copper.

E. Shielding/Screening: Unshielded twisted pair (UTP).

F. Cable Rating: Plenum.

G. Jacket:

1. Network/work area outlets: Blue thermoplastic.
2. Above ceiling devices (cameras, waps, etc): Blue thermoplastic.
3. TV: Blue thermoplastic.

2.8 TWISTED PAIR CABLE HARDWARE

A. Description: Hardware designed to connect and terminate twisted pair copper communications cable.

1. Refer to Appendix A for current part numbers.

B. Manufacturers: Panduit

C. General Requirements for Twisted Pair Cable Hardware:

1. Comply with the performance requirements of Category 6 and Category 6A.
2. Comply with TIA-568.2-D, IDC type, with modules designed for punch-down caps or tools.
3. Cables shall be terminated with connecting hardware of same category or higher.

D. Source Limitations: Obtain twisted pair cable hardware from sole source from single manufacturer.

E. Connecting Blocks:

1. 110-style IDC for Category 6.
2. 110-style IDC for Category 6A.

F. Provide blocks for the number of cables terminated on the block, plus 25 percent spare, integral with connector bodies, including plugs and jacks where indicated.

G. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.

1. Number of Terminals per Field: One for each conductor in assigned cables.

H. Patch Panel: Modular panels housing numbered jack units with IDC-type connectors at each jack location for permanent termination of pair groups of installed cables.

1. Features:

a. T568A and T568B wiring labels.
b. Labeling areas adjacent to conductors.
c. Replaceable connectors.
d. 24 or 48 ports.

2. Construction: 16-gauge steel and mountable on 19-inch equipment racks.
3. Number of Jacks per Field: One for each four-pair cable indicated.

I. Patch Cords: Factory-made, four-pair cables in 1, 3 and 5 foot lengths; terminated with an eight-position modular plug at each end.

1. Patch cords shall have bend-relief-compliant boots to ensure performance. Patch cords shall have latch guards to protect against snagging.

2. Patch cords shall be color-coded for circuit identification:

    a. Network – Blue
    b. Security – Yellow
    c. AV – Violet
    d. Special – Black

J. Plugs and Plug Assemblies:

1. Male; eight position; color-coded modular telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
2. Standard: Comply with TIA-568.2-D.
3. Marked to indicate transmission performance.

K. Jacks and Jack Assemblies:

1. Female; eight position; modular; fixed telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.

    a. Network – Blue
    b. Security – Yellow
    c. AV – Blue
    d. Special – Blue

2. Designed to snap-in to a patch panel or faceplate.
3. Standard: Comply with TIA-568.2-D.
4. Marked to indicate transmission performance.

L. Faceplate:

1. Two, Four, or Six port, vertical single gang faceplates designed to mount to single gang wall boxes.
2. Plastic Faceplate: High-impact plastic. Coordinate color with Section 262726 "Wiring Devices."
3. Metal Faceplate: Stainless steel, complying with requirements in Section 262726 "Wiring Devices."
4. For use with snap-in jacks accommodating any combination of twisted pair and optical fiber work area cords.

    a. Flush mounting jacks, positioning the cord at a 90-degree angle.

M. Legend:

1. Machine printed, in the field, using adhesive-tape label.
2. Snap-in, clear-label covers and machine-printed paper inserts.

2.9 POWER DISTRIBUTION UNITS AND TRANSFER SWITCHES

A. Comply with requirements in Section 270500 "Common Work Results for Communications".

B. Power Strips: Comply with UL 1363.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Rack mounting, with detachable or integral flanges.
3. Height: 1 RU.
4. Housing: Metal.
5. Six, 15-A, 120-V ac, NEMA WD 6, Configuration 5-15R receptacles.
6. 10’ Power cord with L5-20P.
7. LED indicator lights for power and protection status.
8. LED indicator lights for reverse polarity and open outlet ground.
9. Circuit Breaker and Thermal Fusing: When protection is lost, circuit opens and cannot be reset.
10. Circuit Breaker and Thermal Fusing: Unit continues to supply power if protection is lost.
11. Close-coupled, direct plug-in line cord.
12. Rocker-type on-off switch illuminated when in on position.
13. Surge Protection: UL 1449, Type 3.

    a. Maximum Surge Current, Line to Neutral: 27 kA.
    b. Protection modes shall be line to neutral, line to ground, and neutral to ground.
    c. UL 1449 Voltage Protection Rating for line to neutral and line to ground shall be 600 V and 500 V for neutral to ground.

2.10 UNINTERRUPTIBLE POWER SUPPLY

A. Comply with requirements in Section 270500 "Common Work Results for Communications."

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

1. APC.

C. UPS: Verify rack load with Owner for properly sized supply.

1. Rack mounted.
2. Height: 1RU.
3. Housing: Metal.
4. NEMA input connection: will depend on the battery size.
5. Rear-facing receptacles.
6. 120V nominal output voltage.
7. 50/60Hz output frequency.
8. Output connections:

a. Six (6) NEMA 5-15R, battery backup.
b. Two (2) NEMA 5-20R, battery backup.

2.11 19-INCH EQUIPMENT CABINET

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

1. Chatsworth – Part Number 11900-724

B. General Requirements:
1. Material: Aluminum.
2. Finish: Manufacturer's standard, baked-polyester powder coat.
3. Color: Black.

C. Wall-Mounted Racks:

1. Overall Height: 24 inches.
2. Overall Depth: 24 inches.
3. Number of Rack Units per Rack: 12.
   a. Numbering: Every rack unit, on interior of rack.
4. Threads: 12-24.
5. Top shall have provisions for attaching to cable tray or ceiling.
6. Self-leveling.
7. All cabinets keyed alike.

2.12 LADDER CABLE TRAY

A. Manufacturer: Chatsworth Products, Inc.

1. Universal cable runway: Refer to Appendix A for current part numbers.
2. Provide accessories per manufacturer’s instructions.

2.13 WIRE-MESH CABLE TRAY

A. NOT USED

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

A. Contact telecommunications service provider and arrange for installation of demarcation point, protected entrance terminals, and a housing when so directed by service provider.

B. Comply with requirements in Section 270500 "Common Work Results for Communications Systems" for materials and installation requirements for underground, buried or aerial pathways.

3.2 INSTALLATION PRACTICES

A. Comply with NECA 1, NECA 301, and ANSI/BICSI NI-19.

B. Comply with BICSI's "Telecommunications Distribution Methods Manual" for layout of communications equipment spaces.

C. Comply with BICSI's "Information Technology Systems Installation Methods Manual" for installation of equipment in communications equipment spaces.

D. Coordinate layout and installation of communications equipment in racks and in room. Coordinate service entrance configuration with service provider. Coordinate electrical requirements for UPS with the Electrical Consultant.

1. Comply with TIA-568.1-E, TIA-568.2-D and TIA-568.3-D.
2. Comply with BICSI ITSIMM, Ch. 6, "Cable Termination Practices."
3. Cable may be terminated on connecting hardware that is rack or cabinet mounted.
4. Meet jointly with systems providers, equipment suppliers, and Owner to exchange information and agree on details of equipment configurations and installation interfaces.
5. Record agreements reached in meetings and distribute them to other participants.
6. Adjustments to locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize configurations and space requirements of communications equipment requires approval from the Architect.
7. Adjustments to configurations and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in equipment room requires approval from the Architect.
8. Install 110-style IDC termination hardware unless otherwise indicated.
9. Do not untwist twisted pair cables more than 1/2 inch from the point of termination to maintain cable geometry.
10. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
11. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
12. Install lacing bars to restrain cables, prevent straining connections, and prevent bending cables to smaller radii than minimums recommended by manufacturer.
13. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section Use lacing bars and distribution spools.
14. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
15. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
16. Pulling Cable: Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems," "Pulling and Installing Cable" Section. Monitor cable pull tensions.

E. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend twisted pair cabling, not in a wireway or pathway, a minimum of 8 inches above ceilings by cable supports not more than 60 inches apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

F. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Coil cable 6 feet long not less than 12 inches in diameter below each feed point.

G. Group connecting hardware for cables into separate logical fields.

H. Separation from EMI Sources:

1. Comply with recommendations from BICSI's "Telecommunications Distribution Methods Manual" and TIA-569-E for separating unshielded copper communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.

4. Separation between communications cables in grounded metallic raceways, power lines, and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.

5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.

I. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

J. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

3.3 BACKBOARDS

A. Installed as depicted on T Series drawings.

B. Secured to wall with toggle bolts along outside edge spaced every 24” inches and 2 inches inboard of edge.

C. Mount with bottom most edge at 24” above finished floor surface.

3.4 RACKS AND WIRE MANAGERS

A. Installation of Racks and Wire Mangers.

1. Secure rack/s to floor utilizing four drop-in anchors, flat washer, and hex nut at each corner in accordance with manufacturers direction.
2. Secure Rack to Runway Kit to top of rack and install brackets to secure ladder tray at elevation as depicted in the T Series Drawings.

B. Installation of wall mounted racks.
1. Secure rack to wall with toggle bolts at each corner in accordance with manufacturers requirements.
2. Install at elevation as depicted in the T Series Drawings.

C. Installation to free standing cabinets.
1. Secure cabinet to adjacent cabinets in accordance with manufacturer recommendations.
2. Install as depicted in the T Series Drawings.

D. Installation of wall/pole mounted cabinet.
1. Secure cabinet to wall with toggle bolts at each corner in accordance with manufacturers requirements.
2. Secure cabinet to pole utilizing 1-5/8-inch uni-strut and threaded rod, flat washers, and hex nuts as depicted in T Series drawings.
3. Install at elevation as depicted in the T Series Drawings.

E. Cable Pathway.
1. Conduit, installed by Div. 26.
2. All conduits shall have reamed edges or E.C. shall install nylon bushings.
3. Nylon bushings provided by Div. 26.
4. Cable tray and J-hook cable delivery system provided and installed by the Communications System Contractor.
5. Conduits must be free of debris prior to placing cable.

6. Cable that is placed in conduits with debris will be replaced at Contractor's sole expense.
7. Change of direction of cables from a cable bundle shall not be accomplished by the use of a Velcro strap.
8. Cable bundles shall always exit cable tray with the use of "waterfalls" or "cable drop" assembly.
9. Cable turning vertically over right angles or wire basket shall be deemed to be in violation of bend radius requirements.
10. Cable bundles shall be supported via J-hooks attached to the existing building structure and framework at a maximum of four (4) foot intervals.
11. Cables shall not be supported, rest on, or touch any part of the building except for approved structured cabling support/suspension devices.
12. Pathways shall not be attached to lift out ceiling grid supports or laid directly on the ceiling grid or tiles.
13. Pathways shall not be attached to or supported by any other system supports. e.g. Fire sprinkler pipe supports, HVAC duct supports, lighting or ceiling grid supports, etc.

F. Installation of cable ladder tray.
1. Install ladder as depicted in T Series Drawings.
2. Install ladder along wall utilizing triangle wall brackets of appropriate width.
3. Brackets shall be installed with no more than 5' between brackets.
4. Install wall angle bracket at each point where ladder meets walls at 90°.
5. Provide radius drop/rise as depicted.
6. Install Rack to Runway bracket with appropriate Elevation Kit, at all rack and cabinet locations.
7. Install ladder junction kits at all connection points.
8. Ground ladder assembly utilizing Adjustable Cable Runway Binding Strap as required by applicable codes and standards.
9. Install Protective End Caps for Runway on all exposed ladder rail ends.

G. Installation of mesh cable basket.
1. Install appropriate height Rack to Runway bracket for each rack and cabinet depicted.
2. Install basket as depicted in T Series drawings.
3. Mesh basket shall be supported at increments no greater than 5'.
4. Where adjacent to wall, basket shall be supported via wall end brackets, wall angle bracket per manufacturer's requirements.
5. Where in corridors or rack/cabinet rows, overhead basket shall be supported via trapeze structure, consisting of two 3/8-inch threaded rods, appropriate length 1-5/8 inch uni-strut, flat washers and hex nuts.
6. Flat washers and hex nuts shall be installed below each tier of cable basket to provide vertical adjustment/leveling.
7. When installed with multiple tiers maintain minimum 6" clearance between top edge of lower tier to bottom of upper tier.
8. Overhead basket horizontal and vertical transitions shall be formed in accordance with manufacturers requirements. Pre-made fittings are acceptable.
9. Provide and install appropriate number of splice washer kits per manufacturers requirements to maintain UL listed bonded assembly ratings.

H. J-HOOKS
1. Description: Prefabricated sheet metal cable supports for telecommunications cable.
2. Provide J-Hook cable pathways based on mounting type and cable count.
   a. Pathways with less than 19 cables = 2-inch
   b. Pathways with at least 20 but not more than 50 = 4-inch.
   c. Pathways with 51 or greater shall be in mesh basket.

I. HORIZONTAL CATEGORY CABLING
1. Contractor will supply horizontal cables to connect each information outlet to the backbone subsystem on the same floor.
2. Each run of cable between the patch panel termination and the information outlet will be continuous without any joints or splices.
3. The 4-pair UTP cables will be run using a star topology format from the administration subsystem (MDF/IDF) to every individual Telecommunication Outlet.
4. The length of each individual run of horizontal cable from the administration subsystem (MDF or IDF) on each floor to the Telecommunication Outlet will not exceed 295 ft (90 m).
5. The Contractor shall adhere to the manufacturers' requirements for pulling tension of all cables.
6. Plastic tie wraps are not permitted in the pathway for structured cable. All cables bundled by plastic tie wraps during any phase of the installation will be replaced at Contractor's expense.
7. Contractor will coordinate with electrical contractor for final pathway support to include but not limited to, sleeves, conduits through exposed ceiling spaces etc.
8. Cables will not be attached to lift out ceiling grid supports or laid directly on the ceiling grid or tiles.
9. Cables will not be attached to or supported by fire sprinkler heads or delivery systems, or any environmental sensor located in the ceiling air space including duct work.
10. During initial cable installation, or "rough-in," cable shall be protected.
11. Cable shall not be left exposed on the floor.
12. Cable shall be protected with open-top boxes, properly used slings, and approved barricades.
13. Cable shall not be suspended by tie wraps or any other means which cause cable deformation.
14. Use wide-based support systems appropriate to bundle size to support cable during rough-in phase.
15. Contractor is required to coordinate placement of cables in locations and at construction phases to avoid paint on the cables. Coordination shall be with the General Contractor. Painting cabling is considered a field modification by the manufacturer and alters the fire rating of the cable jacket. Cables coated with paint shall be replaced at Contractor's sole expense if coordination has not occurred.
16. Contractor shall not install cable in any conduit prior to the installation of conduit bushings.
17. Contractor shall coordinate the acquisition and installation of conduit bushings with electrical contractor.

18. Any anticipated delay of cable installation because of conduit or conduit bushing installation shall immediately be brought to the attention of the General Contractor.
19. Contractor will observe the recommended bending radius and pulling strength requirements of the 4-pair UTP cable during handling and installation.
20. Bends which deform the cable jacket must be avoided. Violation of bend radius shall be remedied with the replacement of the cable at the Contractor's sole expense.
21. Cables pathways leaving J-hooks to conduit stub outs shall be a gradual sweep.
22. In suspended ceiling and raised floor areas where duct, cable trays or conduit are not available, the Contractor will bundle, in bundles of 24 or less, station wiring with Velcro straps snug, but not deforming the cable geometry.
23. Cable bundles will be supported via "J" hooks and/or saddles/slings attached to the existing building structure and framework at a maximum of five (5) foot intervals.
24. The contractor will not install any cable pathways above an electrical room.
25. Cable runs shall not be parallel to electrical pathways without proper separation.
26. In suspended ceiling and raised floor areas where walker duct, cable trays or conduit are not available, the Contractor will bundle station wiring with hook-and-loop (Velcro) cable straps at appropriate distances.
27. The cable bundling will be supported via J-hooks attached to the existing building structure and framework.
28. Each J-hook shall contain only one type of transmission media.
29. Cables shall not be support by ductwork.
30. Cables shall not wrap around, or in general, touch building structural systems.
31. Conduit runs installed by the contractor should not exceed 100 feet or contain more than two 90-degree bends without utilizing appropriately sized pull boxes.
32. Station cables and tie cables installed within ceiling spaces will be routed through these spaces at right angles to electrical power circuits.
33. All outlets must be protected from construction related dust by using dust-proof barriers. Outlets not protected will be replaced at Contractor's expense.
34. 35" sservice loops will be installed at the work area outlet above the conduit stub-up in a J-hook and configured in an industry standards compliant arrangement at all locations except AP locations.
35. Provide 12" service loop at AP locations.

J. Group connecting hardware for cables into separate logical fields.

K. Separation from EMI Sources:

1. Comply with recommendations from BICSI's "Telecommunications Distribution Methods Manual" and TIA-569-E for separating unshielded copper communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.

4. Separation between communications cables in grounded metallic raceways, power lines, and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.

5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.

L. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

M. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

N. FIBER OPTIC CABLING

1. NOT USED

3.5 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Visually inspect jacket materials for NRTL certification markings. Inspect cabling terminations in equipment rooms for compliance with color-coding for pin assignments and inspect copper cabling connections for compliance with TIA-568.1-E.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment, and patch cords, and labeling of all components.
3. Test cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
4. Provide testing with Fluke Networks instruments that have the latest edition of software installed and that have been calibrated by the manufacturer within the last 12 months.
5. Copper Cable Tests:

    a. Test instruments shall meet or exceed applicable requirements in TIA-568.2-D. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy

(Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

b. Fluke tests results shall be sent to the manufacturer for warranty purposes.

6. Optical Fiber Cable Tests:

a. Test instruments shall meet or exceed applicable requirements in TIA-568.1-E. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

b. Link End-to-End Attenuation Tests:

1) Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in one direction according to TIA-526-14-B, Method B, One Reference Jumper.

2) Attenuation test results for backbone links shall be less than 2.0 db. Attenuation test results shall be less than those calculated according to equation in TIA-568.1-E.

B. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similarly to Table 10.1 in BICSI's "Telecommunications Distribution Methods Manual," or shall be transferred from the instrument to the computer, saved as text files, printed, and submitted.

C. Remove and replace cabling where test results indicate that they do not comply with specified requirements.

D. End-to-end cabling will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.6 SLEEVE AND SLEEVE SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Comply with requirements in Section 270500 "Common Work Results for Communications."

3.7 FIRESTOPPING

A. Comply with requirements in Section 078400 "Penetration Firestopping."

B. Comply with TIA-569-E, Annex A, "Firestopping."

C. "Firestopping Practices" chapter.

3.8 IDENTIFICATION

A. Comply with requirements in Section 270500 "Common Work Results for Communications Systems".

SECTION 271000

STRUCTURED CABLING

END OF SECTION 271000

Appendix A – Materials List

Product Category	Part Number	Manufacturer	Part Description
Copper Cabling Products			
	PUP6AHD04BU-G	Panduit	Vari-Matrix High Density Cat 6A Cable, Plenum, Blue color
	PUP6AHD04WH-G	Panduit	Vari-Matrix High Density Cat 6A Cable, Plenum, White color
	PUP6AHD04OR-G	Panduit	Vari-Matrix High Density Cat 6A Cable, Plenum, Orange color
	PUR6AV04BU-G	Panduit	Vari-Matrix cable, Cat 6A, Riser, Blue color
	PUR6AV04WH-G	Panduit	Vari-Matrix cable, Cat 6A, Riser, White color
	PUR6AV04OR-G	Panduit	Vari-Matrix cable, Cat 6A, Riser, Orange color
	CJ6X88TGBU	Panduit	Cat 6A RJ45 jack, blue color
	CJ6X88TGOR	Panduit	Cat 6A RJ45 jack, orange color
	CJ6X88TGIW	Panduit	Cat 6A RJ45 jack, off white color
	CJ6X88TGYL	Panduit	Cat 6A RJ45 jack, yellow color
	CJ6X88TGBU-24	Panduit	Cat 6A RJ45 jack, blue color, 24 pack
	CJ6X88TGOR-24	Panduit	Cat 6A RJ45 jack, orange color, 24 pack
	CJ6X88TGIW-24	Panduit	Cat 6A RJ45 jack, off white color, 24 pack
	CJ6X88TGYL-24	Panduit	Cat 6A RJ45 jack, yellow color, 24 pack
	FP6X88MTG	Panduit	Cat 6A RJ45 plug, TG field terminable
	UTP6AX7BU	Panduit	Cat 6A UTP patch cord, 7 ft, Blue color
	UTP28X10BU	Panduit	Cat 6A 28 AWG UTP patch cord, 10 ft, Blue color
	UTP6AX7WH	Panduit	Cat 6A UTP patch cord, 7 ft, Off White color
	UTP28X10WH	Panduit	Cat 6A 28 AWG UTP patch cord, 10 ft, Off White
	UTP6AX7YL	Panduit	Cat 6A UTP patch cord, 7 ft, Yellow color
	UTP6AX20YL	Panduit	Cat 6A UTP patch cord, 20 ft, Yellow color
	UTP28X10YL	Panduit	Cat 6A 28 AWG UTP patch cord, 10 ft, Yellow
	UTP28X10OR	Panduit	Cat 6A 28 AWG UTP patch cord, 10 ft, Orange
	PFO6X04BL-CEG	Panduit	Shielded F/UTP Cable, Cat 6A, OSP, Black color
	8136100	General	Shielded F/UTP Cable, Cat 6A, OSP, Black color
	CFPL2IWY	Panduit	Mini-Com Classic Series Faceplate w/ label, accepts up to 2 Mini-Com modules, off white color

Product Category	Part Number	Manufacturer	Part Description
	CFPL3IWY	Panduit	Mini-Com Classic Series Faceplate w/ label, accepts up to 3 Mini-Com modules, off white color
	CFPL4IWY	Panduit	Mini-Com Classic Series Faceplate w/ label, accepts up to 4 Mini-Com modules, off white color
	CFP1IW	Panduit	Mini-Com Classic Series Faceplate w/ label, accepts up to 1 Mini-Com modules, off white color
	CMBIW-X	Panduit	Mini-Com blank module
	CBIW	Panduit	Single gang faceplate frame accepts two 1/2 size module inserts or three 1/3 size module inserts.
	CHS2IW-X	Panduit	Two module space, 1/2 size, sloped insert accepts two Mini-Com modules
	CHB2IW-X	Panduit	1/2 Blank Insert
	KWPY	Panduit	Stainless steel phone plate
	Vendor specific	Panduit	Mini-Com Snap -On Modular furniture faceplates
	CBXQ2IW-A	Panduit	Surface Mount Box with label, accepts up to 2 Mini-Com modules, Off White color
	CBXQ4IW-A	Panduit	Surface Mount Box with label, accepts up to 4 Mini-Com modules, Off White Color
	CBXQ6IW-A	Panduit	Surface Mount Box with label, accepts up to 6 Mini-Com modules, Off White Color
	CPPL24WBLY	Panduit	Mini-Com Patch Panel, Flat, 1 RU, 24 ports
	CPPL48WBLY	Panduit	Mini-Com Patch Panel, Flat, 2 RU, 48 ports
	CPPLA24WBLY	Panduit	Mini-Com Patch Panel, Angled, 1 RU, 24 ports
	CPPLA48WBLY	Panduit	Mini-Com Patch Panel, Angled, 2 RU, 48 ports
	SRB19DSBL	Panduit	19” Deep Strain Relief Bar
For switch mapping	**CPP48FMVNSWBLY**	Panduit	48-Port, 2 RU Patch Panel with Vertical Numbering
For switch mapping	**UTP28SP8INBU**	Panduit	Category 6A Performance, 28AWG, UTP Patch Cord, CM/LSZH, Blue, 8in
Fiber Cabling Products			
	FODPZY**	Panduit	Fiber Distribution Cable, OM4, Plenum, **=fibers
	FOPPZ24Y	Panduit	Fiber Interlocking Armor Cable, OM4, P, **=fibers
	FSDP9Y**	Panduit	Fiber Distribution Cable, OS2, Plenum, **=fibers

Product Category	Part Number	Manufacturer	Part Description
	FSPP9Y**	Panduit	Fiber Interlocking Armor Cable, OS2, P, **=fibers
	FLCSMCXAQY	Panduit	LC OptiCam® OM3/OM4 50/125µm MM simplex connector, aqua
	FLCSSCBUY	Panduit	LC OptiCam® SM, 9um, simplex connector, blue
	FAP6WAQDLC **FAP12WAQDLC**	Panduit	Opticom® OM3/4 LC Fiber adapter panels, 6 & 12 ports
	FAP6WBUDLCZ **FAP12WBUDLCZ**	Panduit	Opticom® OS2 LC Fiber adapter panels, 6 & 12 ports
	FZ2ERQ1Q1SNM* **	Panduit	OM4, LC push pull to LC push pull patch cord, 16mm jacket, riser (OFNR) rated, Standard IL; ***=length in meters
	FCE1U, FCE2U, FCE4U	Panduit	Opticom® Rack Mount Fiber Enclosure, 1,2, or 4 RU; Holds up to 4/8/12 FAPs
	FLEX1U06, FLEX2U06, FLEX4U06	Panduit	HD Flex Fiber Enclosure, 1 RU, 2 RU & 4 RU
	FHSXO-12-10P, FHSZO-12-10P, FHS9N-12-10P	Panduit	HD Flex Fiber Splice Cassette with 12-pigtails, OM3, OM4 & SM
Racks, Cabinets and Cable Management			
	R2PS	Panduit	2-Post Steel Rack
	R4P	Panduit	4-Post Steel Rack
	4220W	Dell	4-Post Rack Enclosure
	PR2VD06 (Dual-sided)	Panduit	PatchRunner 2 Vertical Cable Manager. 6” wide, 7 ft, Black with door(s)
	PR2VD08 (Dual-sided)	Panduit	PatchRunner 2 Vertical Cable Manager. 8” wide, 7 ft, Black with door(s)
	PR2VD10 (Dual-sided)	Panduit	PatchRunner 2 Vertical Cable Manager. 10” wide, 7 ft, Black with door(s)
	PR2VD12 (Dual-sided)	Panduit	PatchRunner 2 Vertical Cable Manager. 12” wide, 7 ft, Black with door(s)
	PR2VEP	Panduit	PatchRunner 2 End Panel
	NM1 (Dual-sided)	Panduit	Panduit NetManager High Capacity Horizontal Cable Manager, 1RU, Black

Product Category	Part Number	Manufacturer	Part Description
	NM2 (Dual-sided)	Panduit	Panduit NetManager High Capacity Horizontal Cable Manager, 2RU, Black
	XG64222BS0004	Panduit	FlexFusion Cabinet, 600mm x 42RU x 1200mm, Black, Hardware Mount Rail, Cool Boot-Ready Top Cap, Single Hinge Perforated Front Door, Split Perforated Rear Door, Standard Locks, Left and Right Side Panels, One Set Long Cable Mgmt. Fingers, Left PDU Bracket, Casters
	XG74222BS0004	Panduit	FlexFusion Cabinet, 700mm x 42RU x 1200mm, Black, Hardware Mount Rail, Cool Boot-Ready Top Cap, Single Hinge Perforated Front Door, Split Perforated Rear Door, Standard Locks, Left and Right Side Panels, One Set Long Cable Mgmt. Fingers, Left PDU Bracket, Casters
	XG84222BS0004	Panduit	FlexFusion Cabinet, 800mm x 42RU x 1200mm, Black, Hardware Mount Rail, Cool Boot-Ready Top Cap, Single Hinge Perforated Front Door, Split Perforated Rear Door, Standard Locks, Left and Right Side Panels, One Set Long Cable Mgmt. Fingers, Left PDU Bracket, Casters
Bonding and Grounding			
	RBRB19U	Panduit	Grounding busbar for threaded rails
	RGRB19CN	Panduit	Grounding busbar for cage nut mounting rails
	GB2B0312TPI-1	Panduit	Secondary Bonding Busbar, 1/4" by 2” by 12” (SBB)
	RGCBNJ660P22	Panduit	Rack bonding conductor (CBN jumper)
	GB4N0007TPI-1	Panduit	Primary Bonding Busbar, 1/4" by 4" by 12" (PBB)
	GPQC-1/0**	Panduit	Access Floor Grounding Clamps; ** = size
	RGESD2-1	Panduit	Electrostatic Discharge port kit for #12-24 tapped holes
	RGESD2B-1	Panduit	Electrostatic Discharge port kit for cage nut mounting rails
	REGESDWS	Panduit	Electrostatic Discharge protection wrist strap
	RGTBSG-C	Panduit	Green thread-forming bonding screw, #12-24 x 1/2", 100 pack
	CNBK	Panduit	Green bonding cage nut, #12-24 bonding cage nuts, 50 pack
	ACG24K	Panduit	Armored Fiber Bonding Kit

Product Category	Part Number	Manufacturer	Part Description
Fire Barriers			
	EZDP44	Specified Technologies (STI)	Fire Barrier CBL Pathway Single EZ Path W/WPLT Series 44
J-Hooks			
	JP75 Series	Panduit	J-Pro Cable Support System, .75”
	JP131 Series	Panduit	J-Pro Cable Support System, 1.3”
	JP2 Series	Panduit	J-Pro Cable Support System, 2”
	JP4 Series	Panduit	J-Pro Cable Support System, 4”
Above Floor Raceway			
	AFR4BCBL6	Panduit	Above Floor Raceway – 6 Foot Base and Cover, Black color
	AFR4CCBL	Panduit	Above Floor Raceway, Coupler Fitting, Black color
	AFR4TRT70BL	Panduit	Above Floor Raceway, Transition to T70 Fitting. Black color
	AFR4RABL	Panduit	Above Floor Raceway, Right Angle Fitting, Black color
	AFR4ECBL	Panduit	Above Floor Raceway, End Cap Fitting, Black color
	AFR4JB2SBL	Panduit	Above Floor Raceway, Junction Box, Black color
Other Cabling Accessories			
	HLS-15R0	Panduit	Tak-Ty® hook & loop strip roll, 15' length, .75 width, nylon loop, polyethylene hook, black.
	HLS-75R0	Panduit	Tak-Ty® hook & loop strip roll, 75' length, .75 width, nylon loop, polyethylene hook, black.
	TTR-35RX0	Panduit	Tak-Tape® Hook and Loop 35' Rolls, 10 Roll-pack, black.
	PSL-DCJB-C	Panduit	RJ45 Jack Block out Device, 100 block-outs (red) and 5 removal tools (black), polycarbonate.
	PSL-DCPL-C	Panduit	RJ45 Plug Lock-In Device, 100 devices (red) and 5 installation/removal tool (black), polycarbonate.

Product Category	Part Number	Manufacturer	Part Description
	PSL-USBA	Panduit	USB type A block-out device, 5 devices (red) and 1 removal tool (black), polycarbonate.
Ladder Rack Pathway			
	10250-724	Chatsworth	Universal cable runway, Black – 24-Inch-Wide Reference
	11301-702	Chatsworth	Butt Splice Kit, 2" Stringer, Black Reference
	10724-724	Chatsworth	Cable runway radius bend – 24inch Wide Reference
	11309-701	Chatsworth	Foot kit, cable runway Reference
	11421-724	Chatsworth	Wall angle support kit, cable runway – 24inch Wide Reference
	31470-712	Chatsworth	Cable runway standoff support kit Reference
	10506-702	Chatsworth	Cable runway elevation kit Reference
	11302-701	Chatsworth	Junction-splice kit Reference
	10723-724	Chatsworth	Cable runway radius bend Reference
	11959-724	Chatsworth	Corner Bracket 24-inch Radius, Reference
	11746-724	Chatsworth	Triangular Supports Bracket, steel Reference
	11310-003	Chatsworth	Threaded Ceiling Kit, Cable Runway
	11421-712	Chatsworth	Wall Angle Support Kit, Cable Runway
	10250-712	Chatsworth	Universal Cable Runway – 12 inch wide
	10723-712	Chatsworth	Cable Runway Radius Bend 90-Degree Outside Bend – 12 inch Wide
	10724-712	Chatsworth	Cable Runway Radius Bend 90-Degree Inside Bend – 12 inch Wide
	11301-702	Chatsworth	Butt-Splice Kit
	11298-701	Chatsworth	Heavy Duty Junction-Splice Kit
	10642-001	Chatsworth	Protective End Caps for Runway
	10622-010	Chatsworth	Standard Busbar 4"Wx1/4"HxlO"L
	40164-001	Chatsworth	#6AWG Ground Strap
	10250-718	Chatsworth	Universal Cable Runway

Product Category	Part Number	Manufacturer	Part Description
	10723-718	Chatsworth	Cable Runway Radius Bend 90 degree Outside Bend
	10724-718	Chatsworth	Cable Runway Radius Bend 90 degree Inside Bend
	11421-718	Chatsworth	Wall Angle Support Kit, Cable Runway
	11304-000	Chatsworth	Chatsworth J-bolt Kit
	11301-001	Chatsworth	Butt-Splice Kit
	10506-706	Chatsworth	Cable Runway Elevation Kit 6"
	11201-701	Chatsworth	Cable Runway Radius Drop Stringer
	12100-718	Chatsworth	Cable Runway Radius Drop Cross Member
Basket Tray Pathway	**Equivalents will be accepted.**		
	CF 54/300	Cablofil	2” deep, 12” wide, 10’ stick
	CF 54/450	Cablofil	2” deep, 18” wide, 10’ stick
	CF 54/600	Cablofil	2” deep, 24” wide, 10’ stick
	CF 105/300	Cablofil	4” deep, 12” wide, 10’ stick
	CF 105/450	Cablofil	4” deep, 18” wide, 10’ stick
	CF 105/600	Cablofil	4” deep, 24” wide, 10’ stick
	FAS P	Cablofil	Trapeze
	AS	Cablofil	Trapeze Clips
	CS	Cablofil	L Bracket
	CRP	Cablofil	Universal Wall Bracket
	ED 275	Cablofil	Universal Splice Bar
	SWK	Cablofil	¼ Hardware Bolts
	EZT 90 KIT	Cablofil	Hardware for 90’s

<END OF APPENDIX A>

SECTION 27 41 16

INTEGRATED AUDIO VISUAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Documents: Provisions of General Conditions, Supplementary Conditions, and the sections included under Procurement & Contract Requirements are included as part of this section as though bound herein.

C. Contractor responsible for coordinating all conduit, cable pathways and final power requirements.

1.2 SUMMARY

A. Section Includes

1. Integrated Audio-Video Equipment Hardware
2. Configuration Software
3. Control Interfaces
4. Power Supplies
5. Projection Screens
6. Television Displays

B. Related Requirements

1. Section 26 0100 Electrical Special Provisions
2. Section 26 0533 Raceways and Boxes
3. Section 26 2726 Wiring Devices
4. Section 27 0500 Common Work Results for Communications
5. Section 27 1000 Structured Cabling

1.3 DEFINITIONS

A. AVIXA: Trade association representing the professional audiovisual and information communications industries worldwide.

B. CTS: Certified Technology Specialist

C. EMI: Electromagnetic interference.

D. PBB: Primary bonding busbar. A busbar placed in a convenient and accessible location and bonded, by means of the telecommunications bonding conductor, to the buildings service equipment (power) ground (formerly known as the telecommunications main grounding busbar).

E. RBB: Rack bonding busbar. A busbar within a cabinet, frame, or rack.

F. RBC: Rack bonding conductor. Bonding conductor from the rack or rack bonding busbar to the telecommunications equipment bonding conductor.

G. Screen: A metallic layer, either a foil or braid, placed around a pair or group of conductors.

H. SBB: Secondary bonding busbar. Formerly known as the telecommunications

grounding busbar (SBB).

I. Shield: A metallic layer, either a foil or braid, placed around a pair or group of conductors.

J. S/FTP: Overall braid screened cable with foil screened twisted pair.

K. S/UTP: Overall braid screened cable with unscreened twisted pairs.

L. TBC: Telecommunication Bonding Conductor. The TBC bonds the PBB to the service equipment (power) ground. Formerly known as the bonding conductor for telecommunications.

M. TEBC: Telecommunications equipment bonding conductor. A conductor that connects the primary bonding busbar, secondary bonding busbar or supplementary bonding network to equipment racks or cabinets, rack bonding busbars or rack bonding conductors.

1.4 SUBMITTALS

A. Successful Contractor will submit a single electronic PDF copy of the submittal package within 20 days of written notification to proceed or other written documentation from the Architect or General Contractor. Documents will be organized into the following sections:

B. General

1. Provide submittals in accordance with Owner's approved construction schedule. Submittals shall consist of a cover page, table of contents (TOC), product data, prequalification certificate, shop drawings and warranty documents.
2. Partial submittals shall not be acceptable without prior approval by Owner.
3. The contract shall not be relieved from any contract-required responsibility by the Owner's approval of submittals.
4. Nothing in the specification shall relieve respondents of system package design responsibility, including, but not limited to, all equipment furnished under this contract. The successful respondent is, in all cases, solely responsible for the performance of the delivered system, and for furnishing complete system documentation for each and every part of the system.
5. No portion of the work shall commence, or equipment ordered until the Owner has approved the submittals.
6. All work to be performed in accordance with approved submittals.
7. Submit a detailed completion schedule with the submittals.
8. Provide submittals in accordance with Division 1 requirements and Owners approved construction schedule.
9. Submittals shall not be combined with additional scope awarded.

C. Pre-Installation Submittals: Contractor shall supply the following for review within 20 business days of contract award.

1. Configuration file for audio digital signal processors (DSP), drafted in DSP manufacturer’s provided software.
2. Processor power required of DSP shall not exceed 95% total processing capacity.
    a. If processing power required exceeds available processing power, Contractor shall immediately notify Owner during pre-installation phase.

3. Copy of manufacturer configuration software, or link to manufacturer website download page for accessing configuration software.
    a. Version: Submitted software shall be identical version used to create DSP configuration.
4. Layouts of physical and virtual user controls in graphical format. This shall include:
    a. Engraved buttons and overlays
    b. Machine-printed adhesive labels
    c. Graphical user interfaces for touch panels or web interfaces.

D. Submittal Requirements

1. Cover Page and Section 1 ─ Information, Pricing and Material
    a. Cover sheet containing the Company Name and/or logo, Title of submittal package, client name, and Contractor work address with a point of contact (POC) and phone number.
2. Table of Contents (TOC)
    a. Listing, in order, of all submittal documents.
3. Section 2 ─ Product Data
    a. Manufacturer's catalog information showing dimensions, colors, and configurations.
    b. Submittals will include all items called for in PART 2 – PRODUCTS of this document and the manufacturers cut sheets for each item listed in the specifications and the bill of materials.
    c. In cases of multiple product numbers on a single cut sheet, the Contractor will identify the proper part number with an arrow, check mark or highlight.
4. Section 3 ─ Pre-Qualification Certificate
    a. Contractor will submit the following documents with project proposal:
        1) A letter of approval from the manufacturer indicating completion of pre-qualification requirements.
        2) Training certificates for design, engineering and installation of the proposed products.
5. Section 4 ─ Warranty Documentation
    a. Warranty will be for one year from final acceptance of the final product.
    b. Complete documentation regarding the manufacturer's warranty will be submitted as part of the proposal. This will include, but is not limited to, a sample of the warranty that would be provided to the customer when the installation is complete and documentation of the support procedure for warranty issues.
6. Section 5 – Record Drawings
    a. Contractor shall provide record drawings for the submittal package that will be used throughout the inspection process and into substantial completion / final acceptance. Drawings will contain the Contractors own title block on the edge of the drawing and will include the company name, address, phone

number and date of the final drawings. Use of any part of the Architect title block is not acceptable at any time.

b. The drawings shall include the following information:

1) All shown drop locations shall be labeled in accordance with the specifications.
2) Provide the audio-visual equipment rack elevation details demonstrating the locations of the equipment, power raceways and thermal management.
3) All overhead rigging and installation details.
4) Required wood blocking details with dimensions.

7. Any and all changes to the scope of work during the project shall be included in the drawings upon completion of system(s) installation and will be used as part of the substantial completion process. Reference the section on close out documentation for additional information on the substantial completion process.

E. The Contractor shall provide all materials, equipment, labor and all other incidental materials and appliances necessary, as described herein and in the drawings, to provide complete turn- key and functional systems, regardless of any materials and/or equipment not listed or described in this specification and/or supplementary drawings.

F. Contractor shall provide system optimization services and shall complete an internal system commissioning. A commissioning plan shall be submitted in writing to the Owner and or Owner's representative for approval. Notify the Owner and or Owner's representative two weeks prior to the start of commissioning to allow for Owner representation to be present during all testing and commissioning. Final testing and commissioning shall be completed by Owner's representative.

G. General elements of the work shall consist of but not limited to following major items:

1. Submittal preparation and processing.
2. Any deviation from the manufacturer's installation instructions shall be requested prior to the work being done.
3. Any unapproved deviations will be corrected at the installer's sole expense
4. Procure all permits and licenses required to complete this installation.
5. Attend job construction and progress meetings.
6. Provide audio-visual cabling according to the correct application and environment(s).
7. Verify conditions and dimensions at the job site prior to installation.
8. Perform initial testing, programming and adjustments with written reports.
9. Preparation of Operational and Maintenance manuals and Project Record (as-built) documents.
10. Providing training for Owner.
11. Providing warranty service.
12. Remove all job specific created debris to approved collection points.

1.5 REFERENCES

A. Specifications, Standards and Codes: All work shall be in accordance with the current editions of the following:

1. AVIXA Rack Building for Audiovisual System 2019
2. AVIXA Cable Labeling for Audiovisual Systems
3. ANSI T1.404 (DS3) and CATV

Applications. 4. ANSI S4.48-1992

5. ANSI X3T9.5 TPPMD.
6. American Society of Testing and Materials (ASTM).
7. TIA (Telecommunications Industries Association &
8. EIA (Electronic Industries Alliance)
9. Building Industry Consulting Service International (BICSI) Telecommunications Distribution Methods Manual.
10. Federal Communications Systems (FCC).
11. Institute of Electrical and Electronics Engineers (IEEE).
12. National Electrical Code (NEC) (Latest revision and pertinent addendums).
13. National Electrical Manufacturer's Association (NEMA).
14. National Fire Protection Association (NFPA) Publications (Latest revisions and pertinent addendums).
15. "Basic Principles for suspended Loudspeaker Systems", Technical Notes Volume 1, Number 19, JBL Professional or latest edition.
16. "Handbook for Riggers" 1977 Revised Edition, Newberry, W.G., Calgary, Alberta Canada.
17. Underwriters Laboratory (UL)
18. Americans with Disabilities Act (ADA)
19. In the event of a conflict between documents referenced herein and the contents of this specification, the contents of this specification shall be considered the superseding document with the exception of the ADA, NFPA and NEC publications.

1.6 IT COORDINATION

A. Where connection between components or control features are accomplished over the Owner's LAN, Contractor shall coordinate with the Owners IT department for IP addresses, firewall access, and other issues pertaining to successful integration.

1.7 GENERAL REQUIREMENTS

A. This section covers the general requirements for the installation of the Integrated Audio-Video system by the Contractor.

INTEGRATED AUDIO VISUAL SYSTEMS

1. In the installation of this work, the Contractor shall comply in every way with the requirements of Owner's standards, local and state laws and ordinances, the National Board of Fire Underwriters, and the National Electrical Code. If, in the opinion of the Contractor, there is anything in the plans or specifications that will not strictly comply with the above laws, ordinances, and rules, the matter shall be referred to the attention of customer's representatives for a decision before proceeding with that part of the work. No change in the plans or in the Specifications shall be made without full consent in writing by the Owner's representative's engineer.
2. The Contractor shall obtain the customer's permission before proceeding with any work necessitating cutting into or through any part of building structures such as girders, beams, concrete or tile floors, partition ceilings.
3. The Contractor shall be responsible for and repair all damage to building due to carelessness of workers, and exercise reasonable care to avoid any damage to customer property. The Contractor will report to the customer representatives any damage to the building which may exist or may occur during the occupancy of the quarters.
4. Contractor shall provide components, wire, connectors, materials, parts, equipment and labor necessary for the complete installation of the system, in full accordance with the recommendations of the equipment manufacturers and the requirements, specifications and all applicable codes.
5. The Contractor shall be responsible for installation of proper grounding and bonding.
6. The Contractor shall take necessary steps to ensure that required firefighting apparatus is accessible always. Flammable materials shall be kept in suitable places outside the building.
7. The Contractor shall install the materials in accordance with the manufacturer's specifications.
8. Equipment shall be held firmly in place with manufacturer's recommendation and/or EIA standard types of mounting hardware. All equipment shall be installed to provide reasonable safety to the operator.
9. The Contractor shall promptly correct all defects for which the Contractor is responsible.
10. The Contractor shall insure that all records and reports, City relations, engineering, metering, inspections, testing, quality or service standards and safety measures comply with standards applicable for the State where the work is being performed.
11. The Contractor shall coordinate all work with the customer's assignee or as will be designated at a future date.
12. The Contractor shall remove all excess material and debris and return to original state of cleanliness. The Contractor shall maintain a work area free of debris, trash, empty cable reels, scrap wire, etc., and dispose of such items daily.
13. Upon completion of installation and prior to acceptance, all equipment shall be thoroughly cleaned and made free from extraneous bits of soldier, wire, etc. by the

Contractor. Contractor shall cleanup work area and remove ALL waste and trash. Debris resulting from the installation shall be removed from all areas and disposed of by the Contractor.

14. All work shall be done in a thorough and conscientious manner according to industry standards and shall be subject to inspection and acceptance.

15. The Contractor shall be certain that all installation work areas are secure and made safe in accordance with Occupational Safety and Health Administration (OSHA) regulations.

16. An appropriate installation schedule shall be developed by the Contractor and will be subject to approval by the customer's representatives. The construction schedule should include at least one installation supervisor, or lead technician, for on-site management of the project.

17. Prior to starting the installation, the assigned installation supervisor, or lead technician, shall participate in a walk-through of the project location with customer's engineers to review the installation documentation, verify that all construction necessary for the installation has been completed, and verify all installation methods and cable routes.

18. It shall be the responsibility of the installation Contractor to furnish any special installation equipment or tools necessary to properly complete the installation.

19. The Contractor shall not roll or store cable reels without an appropriate underlay.

20. The Contractor shall not place any distribution cabling alongside power lines, or share the same conduit, channel or sleeve with electrical apparatus.

21. The Contractor shall insure that the maximum pulling tensions of the specified distribution cables are not exceeded at any time during the placement facilities. Failure to follow the appropriate guidelines may require the Contractor to provide additional material and labor necessary to properly rectify the situation. This shall also apply to all damages sustained to the cables by the installation Contractor during the implementation.

22. Materials shall be consistent throughout the building. Where two or more units of the same class of equipment are required, these units shall be the product of a single manufacturer and shall be the same product with the same material, model, and manufacturer number.

    a. The wiring, materials, and equipment furnished for this request shall be essentially the standard product of the manufacturer.

23. All wiring, materials, and equipment must be listed and labeled by a nationally recognized testing laboratory.

24. All wiring, materials, and equipment must be suitable for the environment they are to be permanently installed in.

25. All equipment proposed by the Contractor must be new and unused. Equipment refers to all hardware, software, equipment, cabling, materials and incidentals etc.

26. Manufacturer's original box or shipping container from one (1) of every serialized

1.8 SUBMITTALS

A. Successful Contractor will submit a single electronic PDF copy of the submittal package within 20 days of written notification to proceed or other written documentation from the Architect or General Contractor. Documents will be organized into the following sections:

B. General

1. Partial submittals shall not be acceptable without prior approval by Architect.
2. The contract shall not be relieved from any contract-required responsibility by the Owner's approval of submittals.
3. Nothing in the specification shall relieve respondents of system package design responsibility, including, but not limited to, all equipment furnished under this contract. The successful respondent is, in all cases, solely responsible for the performance of the delivered system, and for furnishing complete system documentation for every part of the system.
4. No portion of the work shall commence, or equipment ordered until the Architect has approved the submittals.
5. All work to be performed in accordance with approved submittals.
6. Provide submittals in accordance with Division 00 and 01 requirements and Owner’s approved construction schedule.
7. Submittals shall not be combined with additional scope awarded or other sections.
8. No portion of the submittal package may be excluded without written permission by the Architect.

C. Submittal Requirements

1. Section 1 ─ Cover Sheet and Table of Contents
   a. Cover sheet containing the Company Name and/or logo, Title of submittal package, client name, and Contractor work address with a point of contact (POC) and phone number and name of submittal preparer.
   b. Table of Contents (TOC)
   c. Listing, in order, of all following submittal Sections.
2. Section 2 ─ Product Data
   a. Manufacturer’s catalog information showing dimensions, colors, and configurations.
   b. Submittals will include all items called for in PART 2 – PRODUCTS of this document and the manufacturers cut sheets containing make and model numbers for each item listed in the specifications and the bill of materials only. No lengthy installation or operation manuals will be accepted.
   c. The product data shall be divided by system(s) and in the order presented in this specification document.
   d. In cases of multiple product numbers on a single cut sheet, the Contractor will identify the proper part number with an arrow, check mark or highlight.

3. Section 3 ─ Pre-Qualification Certificate
    a. Contractor will submit the following documents with project proposal:
        1) A letter of approval from the manufacturer indicating completion of pre-qualification requirements.
        2) Training certificates for design, engineering and installation of the proposed products.
        3) Minimum AVIXA CTS certification for On Site Project Supervisor and Project Manager.
4. Section 4 ─ Warranty Documentation
    a. Installation warranty will be for one year from substantial completion of the project. Substantial Completion is the point of the completion of training.
    b. Complete documentation regarding the manufacturer's warranty will be submitted as part of the proposal. This will include, but is not limited to, a sample of the warranty that would be provided to the customer at substantial completion.
5. Section 5 – Record Drawings
    a. Contractor shall provide record drawings for the submittal package that will be used throughout the inspection process and into substantial completion / final acceptance. Drawings will contain the Contractors own title block on the edge of the drawing and will include the company name, address, phone number and date of the final drawings. Use of any part of the Architect title block is not acceptable at any time.
    b. The drawings shall include the following information:
        1) All shown audio-video drop locations shall be labeled and shown in accordance with the construction floor plans and reflective ceiling plans.
        2) Provide the audio-visual equipment rack elevation details demonstrating the locations of the equipment, power raceways and thermal management.
        3) All overhead rigging and installation details.
        4) Required support backing details with dimensions.
        5) Final conduit and cable pathways for coordination with E.C.
6. Section 6 – Technical Submittals
    a. Configuration file for audio digital signal processors (DSP), drafted in DSP manufacturer's provided software.
    b. Processor power required of DSP shall not exceed 95% total processing capacity.
        1) If processing power required exceeds available processing power, Contractor shall immediately notify Architect during pre-installation phase.
    c. Copy of manufacturer configuration software, or link to manufacturer

website download page for accessing configuration software.

1) Version: Submitted software shall be identical version used to create DSP configuration.

d. Layouts of physical and virtual user controls in graphical format. This shall include:

1) Engraved buttons and overlays

2) Machine-printed adhesive labels

3) Graphical user interfaces for touch panels or web interfaces.

7. Section 7 – Project Schedule

a. Contractor shall provide a work schedule detailing the points in which tasks are to begin and end, major milestones are to be completed as well as predecessors that are required in order for task to begin or be completed.

8. Any and all changes to the scope of work during the project shall be included in the drawings upon completion of system(s) installation and will be used as part of the substantial completion process. Reference the section on close out documentation for additional information on the substantial completion process.

1.9 QUALITY ASSURANCE

A. The Contractor is bound by the intent of these specifications to provide a complete and functional Integrated Audio-Video System as described herein which meets or exceeds all standard currently established for such systems, regardless of any errors or omissions.

1. ICS control functionality, verification of presets, volume controls, mute controls, etc.

2. Stable operation, completely free of feedbacks and distortion throughout entire range of available ICS controls.

3. Correct routing of all signals to intended destination.

4. Unity gain structure.

5. Output transducer (speaker protection processing functionality).

6. AEC functionality

7. Provide measurement test results per ANSI/InfoComm 1m-2009 ACU.

8. Outdoor sound system measurements shall be provided at a minimum of one measurement per 50 seats. Measurements shall be performed using pink noise test signal at a volume congruent with nominal system operation. Measurements shall indicate

a. Site plan map of seating areas and test locations.

b. Frequency response from 40Hz-16kHz in 1/3 octave resolution.

c. SPL (A weighted) of the test signal as measured form each location.

d. Weather condition at time of test; including temperature, humidity and average wind speeds.

9. Loudspeaker performance shall exhibit frequency response of +/-3dB from 40Hz to 8kHz throughout 70% of the listening area, and +/-6dB throughout remaining listening area.

B. Provide all necessary labor, materials, tools, transportation, services, ancillary items and coordination to furnish the Owner a complete turnkey system as described herein.

C. The Owner's representative will make regular progress inspections. The Contractor shall make their job supervisor available to assist during these visits.

D. The Contractor shall thoroughly familiarize themselves with the complete construction documents, to have visited all sites affecting the proposed work, studied bid package information and all necessary details of the complete set of drawings and specifications and to have included in the proposal an amount to cover all work.

E. The Contractor shall keep a complete set of drawings, specification, reviewed submittals and progress markups on the job site always. These documents shall be made available during Owner's representative site progress visits. Changes made during installation shall be noted on the project markup set.

F. Submission of bids shall be deemed evidence of Contractor’s knowledge, review and examination of the construction documents.

G. Provide a competent supervisor and supporting technical personnel with a minimum of AVIXA CTS certification and is acceptable to the General Contractor, Owner and Consultant during installation. Notify the Owner's representative in writing prior to any project supervisor replacement.

H. In the event of a conflict between documents referenced herein and the contents of this specification, the contents of this specification shall be considered the superseding document except for the NFPA publications, which shall have precedence.

1.10 PROJECT EXPERIENCE AND PERFORMANCE REQUIREMENTS

A. The Contractor must be an experienced A/V Contractor, that is primarily engaged in the business of A/V system integration.

B. The contractor must show proof that A/V System integration is the primary function of the company.

C. The Contractor shall show proof, as part of the bid, that it has been in the A/V system installation business for a period of not less than 3 years and has successfully, completed projects of similar size and scope.

D. The Contractor will provide proof that it supports a well-trained maintenance force in the area local to the project.

E. The Contractor must maintain a fully staffed installation and service facility equipped with appropriate test equipment for repair of systems such as those specified herein.

F. Provide a competent supervisor and supporting technical personnel with a minimum of

AVIXA CTS certification and is acceptable to the General Contractor, Owner and Architect during installation. Notify the Owner's representative in writing prior to any project supervisor replacement.

G. The Contractor shall be, or have direct relations through their subcontractors, an approved manufacturer's representative for all products they furnish and install.

H. References:

1. The Contractor shall submit the names, addresses and telephone numbers of the operating personnel who can be contacted regarding previous installed systems.

2. Submitting incomplete or inaccurate reference information can be a reason to disqualify bidding Contractor.

1.11 COOPERATION AND COORDINATION

A. Cooperate and coordinate as required with other Contractors who are responsible for work not included in this section.

B. Provide all information as required or requested by the Owner, Architect, Consultant or General Contractor for the project to be completed to the satisfaction of the Owner.

C. Notify general Contractor in a timely manner of system design or installation conflicts, which affect the intended use, or performance of the system.

D. Attend job construction and progress meetings that the Owner, GC, or Architect deems necessary.

1.12 QUALIFICATIONS

A. Manufacturer

1. Manufacturer will have a minimum of ten (10) years' experience in the manufacture of sound system products.

2. Maintain a 24-hour toll free telephone assistance line or online presence for customer and installer support.

B. Contractor

1. The Contractor shall be a business engaged primarily in Audio-Video integration.

2. The Contractor selected to provide the installation of this system will be certified by the manufacturing company in all aspects of design, installation and testing of the products described herein.

3. The Contractor will utilize the authorized manufacturer components in provisioning this Project.

4. Contractor will have a minimum of three (3) years of recent experience with the proposed manufacturers' products.

5. Contractor will have a minimum of five (5) years' experience with the design,

installation and project management of local sound systems.

6. Contractor will comply with all federal, state and local statutes regarding qualifications of firms.
7. The Contractor will be experienced in all aspects of this work and will be required to demonstrate direct experience on recent systems of similar type and size.
8. The Contractor will have personnel who are adequately trained in the usage of such tools and equipment.
9. Contractor must provide On Site Supervision and Project Management by person(s) with a minimum of AVIXA CTS certification.
10. The Contractor must have previously established offices located within 75 miles of the project location as the starting point.
11. The customer reserves the right to reject bid of any bidder who has previously failed to perform properly, or complete on time, contracts of a similar nature.

1.13 BID

1. Contractor will be required to provide the following documents with the bid response. Training certificates for design, engineering and installation of the proposed product types.
2. The contractor must show proof that A/V System integration is the primary function of the company.
3. Contractor will provide a list of all current installations that will be ongoing during this project, and the manpower requirements for each of those installations.
4. The preferred Contractor will have a minimum of (3) three references. Contractors providing a reference with an invalid phone number will be considered as an incomplete response and may be disqualified.
5. Contractor will provide a sample of the warranty that would be provided to the customer when the installation is complete and documentation of the support procedure for warranty issues.
6. Contractor will submit a resume of qualification with the Contractor's bid proposal indicating the following:
    a. A technical resume of experience for the Contractor's Project Manager and on-site installation supervisor (Project Foreman) who will be assigned to this project. The project manager should have a minimum of 5 years' experience on projects of similar size and design. The Project Foreman will have a minimum of 3 years related project experience working crews of 4 or more personnel with a minimum of AVIXA CTS certification.
    b. A list of technical product training attended by the Contractor's personnel that will install the system.
    c. Any sub-Contractor, who will assist this section Contractor in performance of this work, will have the same training and certification as the Contractor. The use of Subcontractors is not prohibited for this project.

1.14 DELIVERY STORAGE AND HANDLING

A. Comply with requirements of Section 01 66 00 – Product Storage and Handling Requirements.

B. Deliver, Storage and Protection

1. Contractor shall verify all site conditions are suitable for delivery of product.

2. Deliver products in manufacturer's original, unopened, undamaged containers with labels intact.

3. Contractor shall provide all equipment and materials necessary for the delivery of materials safely and securely on site.

1.15 PROJECT CONDITIONS

A. Project Environmental Requirements.

B. Comply with requirements of referenced standards and recommendations of material manufacturers for environmental conditions before, during, and after installation.

PART 2 - PRODUCTS

2.1 PRODUCT SPECIFICATIONS

A. Hardware: Contractor shall supply equipment, accessories, cables, and connectors necessary for system to operate according to stated functional requirements, whether said products are listed.

B. Software: Contractor shall utilize Manufacturer’s official current version of configuration software.

C. Control Interfaces: Shall be labeled or configured with graphical user interface as appropriate.

D. Power Supplies: As required, Contractor shall provide necessary power supplies for amplifies requiring DC voltage to power Ethernet card when forced in standby mode.

E. Uninterruptible Power Supplies (UPS): Contractor shall provide a minimum of one UPS per audio-visual equipment rack for all pre-power amplifier equipment, whether specified or shown. Signal processing equipment and a minimal amount of audio amplifiers shall be connected to the UPS to allow for the Owner to announce emergency instructions of the audio-video system if desired.

2.2 GENERAL

A. Unless otherwise provided in the specifications, reference to any equipment, material, article, or patented process, by trade name, make or catalog number, shall be regarded as establishing a standard of quality and shall not be construed as limiting competition. If the respondent wished to make a substitution to the specifications, the respondent

shall furnish to the Engineer the name of the manufacturer, the model number, and other identifying data and information necessary to aid the Engineer in evaluating the substitution, and such substitution shall be subject to the Engineer's approval. Substitutions shall be approved only if determined by the Engineer to be equivalent to that specified. A proposal containing a substitution is subject to disqualification if the customer's representative does not approve the substitution. Quantities of products should be verified with drawings and any discrepancies reported to the Owner's representative in writing for resolution.

B. Unapproved product substitutions which have been provided and/or installed will be replaced with the specified products at Contractor's sole expense.

C. Furnish all accessories items necessary to integrate each piece of equipment into the system including rack mounts and other mounting devices, special connectors and interfaces.

D. Coordinate with architect the finish of all exposed items to blend with adjacent architectural elements of the building.

E. Major components of the system such as DSP, power amplifiers, mixer-preamplifiers, and tuners, shall have a device, whether internal or external, which provides protection against voltage spikes and current surges originating from commercial power sources.

2.3 MATERIALS

A. MULTIPURPOSE ROOM (106)

1. DISPLAYS (TV-65"):
   a. Acceptable Manufacturer: LG
   b. Acceptable Model: 65" UH5F-H
2. DISPLAY MOUNT:
   a. Acceptable Manufacturer: Chief
   b. Acceptable Model: MTM1U
3. VIDEO TELECONFERENCING SOUNDBAR (VTC)
   a. Acceptable Manufacturer: Jabra
   b. Acceptable Model: Panacast 50

2.2 WIRE AND CABLE

A. Minimum Specifications

1. All wire and cable shall be UL approved, meet all national, state and local codes, and manufacturers recommendations for connected components for its intended application.

2. Plenum Insulation shall be rated for a minimum of 300 volts and satisfy the Underwriters Laboratories (UL) listed fire rated cable insulation requirements in plenum areas.

3. Cable runs shall be continuous runs. Mid-span cable splicing is not acceptable.

4. Any pulling compound or lubricant used in cable installation shall not deteriorate the conductor or the insulation.

5. All cabling shall have machine generated labels self-laminating or wrap around. Handwritten labels shall not be accepted.

6. Under carpet wiring and flat wiring shall not be used.

7. Manufacturers recommended cabling supersedes wire specified below.

8. Contractor responsible for verifying all plenum rated spaces prior to installation. Provide Plenum rated cable as required.

9. Contractor to verify and provide cabling that is applicable to its installed environment.

10. All Pre-Amplifier audio cable shall be balanced unless otherwise noted.

11. NO CABLE TIES

B. HDBaseT AND AVoIP CABLES

1. CAT6 or better

2. Ensure that the cables pairs remain twisted together for canceling out Electromagnetic Interference (EMI) from the external sources are not exposed even partially, as it results in EMI issues.

3. Use cables that are resistive to bend loss if excessive bending of cables cannot be prevented due to installation constraints.

4. Avoid mounting the cabling components in places that block accessibility to other equipment (such as a power strip or fans) in and out of the racks.

5. Avoid:

    a. Applying extra twists.
    b. Pulling or stretching beyond the specified pulling load rate.
    c. Bending it beyond the specified bend radius, and not beyond 90º.
    d. Creating tension in the suspension runs.
    e. Stapling or applying pressure with the cable ties.

6. Avoid exposing cables to areas of condensation and direct sunlight.

7. The NEC (NFPA 70), Article 800.133 (2005 NEC) indicates the separation requirements. This section of the NEC specifies the following: Communication wires and cables shall be separated at least 50 mm (2 inches) from conductors of any electric, power, Class 1, non- power limited fire alarm, or medium-power network-powered broadband communication circuits. However, there are multiple exceptions to this generic rule, so refer to the NEC (NPFA 70) standard for more information.

C. ACCEPTABLE MANUFACTURERS

1. Belden
2. West Penn
3. Crestron
4. Extron
5. Liberty
6. Windy City Wire

D. JACKS, CONNECTORS AND WALLPLATES

1. All custom A/V panels shall be minimum 1/8" brushed aluminum with engraved paint filled legends unless otherwise noted.
2. All AV connectors shall be Neutrik or Switchcraft brand (non-crimp) or approved alternative.
3. All HDBaseT and AV/IP connectors shall be Leviton or approved alternative.

E. OTHER REQUIREMENTS

1. All materials and equipment proposed by the Contractor shall be new and unused. Equipment refers to all hardware, cabling, materials and incidentals, etc.
2. All equipment shall be installed per the manufacturer’s instructions.
3. All boxes should be stored until substantial completion.
4. System shall be complete and free from all hums, buzzes and defects.
5. Any alternates must be approved by the system designer prior to bid.

PART 3 - EXECUTION

3.1 INSTALLATION

A. This Section includes installation requirements of the Integrated Audio-Video. If you have any questions regarding the intent or application of any feature, submit these questions to the principal contact for this project, as indicated in Division 00. This section covers the general requirements for the installation of the equipment by the Contractor.

1. All work shall be done in a thorough and conscientious manner according to industry standards and shall be subject to inspection and acceptance.
2. The Contractor shall be certain that all installation work areas are secure and made safe in accordance with Occupational Safety and Health Administration (OSHA) regulations.
3. An appropriate construction schedule shall be developed by the Contractor and will be subject to approval by the customer’s representatives. The construction schedule should include at least one installation supervisor, or lead technician, for on-site management of the project.
4. Prior to starting the installation, the assigned installation supervisor, or lead technician, shall participate in a "walk-through" of the project location with the customer’s representatives to review the installation documentation, verify that all construction necessary for the installation has been completed, and verify all installation methods and cable routes.
5. The Contractor shall be responsible for completing a standardized report form addressing the weekly progress of the installation schedule.
6. The Contractor shall maintain conductor polarity identification at the main equipment room, backbone, and horizontal connections in accordance with industry practices.
7. The Contractor shall provide any necessary screws, anchors, clamps, tie wraps, distribution rings, miscellaneous grounding and support hardware, etc., necessary to facilitate the installation of the system.
8. The Contractor shall be responsible for labeling all cable, distribution frames, and outlet locations, according to industry standards.
9. It shall be the responsibility of the installation Contractor to furnish any special installation equipment or tools necessary to properly complete the installation.
10. The Contractor shall not roll or store cable reels without an appropriate underlay.
11. The Contractor shall not place any distribution cabling alongside power lines, or share the same conduit, channel or sleeve with electrical apparatus.
12. The Contractor shall insure that the maximum pulling tensions of the specified distribution cables are not exceeded at any time during the placement facilities. Failure to follow the appropriate guidelines may require the Contractor to provide additional material and labor necessary to properly rectify the situation. This shall also apply to any and all damages sustained to the cables by the installation Contractor during the implementation.

13. The Contractor shall plug conduits where cabling has been installed by the installation Contractor in the equipment rooms, backbone and other cable entrance locations with re- enterable duct seal of flame-retardant putty.

14. Materials shall be consistent throughout the building. Where two or more units of the same class of equipment are required, these units shall be the product of a single

    manufacturer and shall be the same product with the same material, model, and manufacturer number.

15. Wiring, materials, and equipment will be delivered and stored in a clean dry space. They will be properly packaged in factory fabricated type containers and protected from damaging fumes, construction debris and traffic until job completion.

16. The wiring, materials, and equipment furnished for this request shall be essentially the standard product of the manufacturer.

17. All installation techniques and fixtures shall result in ease of maintenance and ready access to all components for testing measurements. All external screws, nuts, and locking washers shall be stainless steel. No self-tapping screws shall be used unless specifically approved by the customer's representatives. All parts shall be made of corrosion resistant material, such as plastic, anodized aluminum or brass. All materials used in installation shall be resistant to fungus growth and moisture deterioration. An inert dielectric material shall separate dissimilar metals apt to corrode through electrolysis under the environmental operating conditions specified.

18. The Contractor will submit for approval, a detailed description of the procedures and equipment included for the complete operational installation.

B. Control Systems

1. Contractor shall meet with owner and whomever the Owner deems appropriate to discuss control features and navigation. Once agreement is received on the control navigation, the Contractor shall submit detailed documentation and GUI configuration and programming for approval. This process will continue until contractor obtains documented approval from the Owner for control design. Contractor shall provide reasonable hours for changes once the system is operational to ensure the Owner's satisfaction. The control software shall be delivered to the Owner upon substantial completion of the project.

C. Wiring Plan Requirements

1. Distribution of the cabling will be accomplished through cable trays, conduit raceways, ducts, core-holes, extended columns, false half columns and plenums. Cabling shall be run at right angles from cable trays. Horizontal cable segments will be placed in cable trays and with cable exits/entrances supported by distribution rings or J Hooks. Cable may not rest on ceiling tile, be supported on existing ducting, tied, or supported by fire alarm, security or electrical infrastructure nor interlaced with existing cable.

2. The Contractor shall be responsible for providing an approved ground at all equipment locations. The Contractor shall also be responsible for ensuring ground

continuity by properly bonding all appropriate cabling, closures, cabinets, service boxes, and frameworks. All grounds shall consist of minimum 12 AWG copper wire or larger as required by code and shall be supplied from an approved building ground and bonded to the main electrical ground.

3. Observe proper circuit and loudspeaker wiring polarity. Properly and clearly label connections and wires as to function and polarity. No cables will be wired with polarity reversal between connectors, at either end. Take care when wiring microphone cables to ensure that constant polarity is maintained.

D. Cable Management

1. Maintain segregation of cables. AC power cables or speaker cables should not be run parallel within close proximity to signal wires (within 2”), unless the wires are twisted.
2. Bend radius for twisted-pair cables is standardized at 12” (3” diameter).
3. Bundle cables within the guidelines of 2005 National Electrical Code (NEC) in Article 310.15(B)(2).

E. Rack Dressing

1. All Racks require Lacer Bars or Strips to provide clean cable management withing the rack.
2. All racks require the cable segregation of AC cables, Speaker Cables, low impedance balanced cabling and twisted pair cables.
3. All AV Racks should be assembled and tested at the Contractor’s facility and transported to the job site when possible.
4. No Cable Ties; Velcro only.

F. Identification, Labeling and Documentation

1. The Contractor shall label all termination devices, panels, enclosures and equipment rooms. The Contractor will mark each unit with permanently attached, self-laminating markings that will not impair the equipment or present a hazard to maintenance personnel.
2. Place wire identification numbers on each end of all conductors. Install markers to be readable from left to right or top to bottom. Wire numbers shall be computer printed. Handwritten labels are not acceptable.
3. Mark all spare conductors and coiled neatly located at the bottom of the equipment rack.

3.2 TESTING REQUIREMENTS

A. The Contractor shall perform sample tests in the presence of the customer’s representatives. Performing the testing procedures specified herein assures that the equipment and interconnection meets the performance characteristics specified. If testing indicates that the performance characteristics are not met, the test shall be

declared a failure. The communication equipment and interconnection cabling shall be modified and/or repaired accordingly. The failed test and any other test that may be affected by the modification and/or repair shall be rerun. After all components have been installed, the integrity of the equipment and interconnection cabling shall be verified.

B. If system test fails because of any component(s) in the system, the failed component(s) shall be corrected or substituted with other components and the tests shall be repeated. If a component has been modified because of the system test failure, a report shall be prepared and delivered to customer's representatives prior to retesting. The Contractor shall prepare and submit all test procedures and data forms for the post installation and system test to the customer's representatives.

C. The test report shall contain the description of all tests performed, the results obtained, and any required adjustments or modifications necessary because of testing and installation. This report shall reflect the as-built communication equipment and interconnection cabling. An authorized representative of the Contractor shall sign the test report. At least three copies of the test report shall be sent to the customer's representatives.

D. The test procedures shall have the Owner's representative's approval before the tests.

E. Contractor shall demonstrate to the Owner's representatives that the equipment operates as specified and that the tests meet performance requirements.

F. The Contractor shall ensure that the equipment is in first-class working condition and free of short circuits, ground loops, parasitic oscillations, excessive hum, RF interference, or instability of any form.

G. The Contractor shall test each operational component and adjust for equal sound levels at a given volume setting and replace defective items.

H. Contractor shall ensure that all loudspeaker and distributed audio systems described herein are balanced and optimized for maximum quality sound and coverage of listening areas.

3.3 TRAINING

A. System training shall be provided for the operator/user and technical staff.

1. Operator/user training shall be held at Owner's convenience and to the Owner's satisfaction.

2. Technical operation and maintenance training shall be held at Owner's convenience and to the Owner's satisfaction.

3. The Contractor shall provide documentation demonstrating the Owner and/or Owner's Representatives understand the operation and maintenance of the system.

B. Complete operation and maintenance manuals and preliminary as-built drawings shall be delivered to the Owner one week prior to training sessions.

C. Operator/user training shall minimally consist of:

1. Provide printed reference material for each trainee that documents and explains in

layman's terms:

a. System block diagram

b. Normal day-to-day operation

c. Operator selectable features

2. Provide a hands-on training with Q & A session

D. Technical Operations and Maintenance training shall consist of:

1. The technical explanation shall be sufficiently thorough that staff personnel shall be able to make any programming changes required, analyze malfunctions and make equipment substitutions or bypasses necessary to maintain system operation except for the malfunctioning equipment or circuits.

2. Provide printed reference material for each trainee that documents and explains in technical terms:

a. System block diagram with technical features

b. Technical operation, adjustments and programming

c. System features and programming

d. Review of as-built drawings.

3. Provide a hands-on training with Q & A session.

E. Contractor will provide a complete and comprehensive list of the maintenance schedule for all installed and/or provided equipment. The list shall be provided in both printed and Adobe Acrobat formats.

3.4 ACCEPTANCE OF SYSTEMS

A. Specifications set forth for construction of the system have been devised to insure system compatibility and performance. Compliance to these specifications will be determined during periodic observances of construction. Repeated failure to comply with the specification will be considered before the initial acceptance phase of the plant commences.

B. Prior to Contractor performed final testing, deliver preliminary as-build documents to Owner for use in conducting testing observation.

C. Project Record Documentation

1. Upon completion of final engineering and incorporation of the Architect review comments, Contractor will provide to the Architect for its records the following close out documentation:

a. Record or As Build Drawings which shall include but not limited to:

1) Functional block diagrams for each Integrated Audio-Video System

2) All Integrated Audio-Video or Audio-Visual junction box locations

3) Audio Visual equipment rack locations

4) Rack elevations

a) Rack elevations shall show all components as installed under this contract.

b) Contractor will label each component describing the component. (Examples: Cafeteria Amplifier or Gymnasium DSP etc).

5) Floor plan drawings with device locations and associated assigned item number.

6) Mounting detail for equipment and hardware.

7) Schedule of all devices with associated panel termination, zoning, power circuits, etc.

8) Corrected product submittal information

b. A complete inventory list of installed products shall include:

1) Manufacture Name

2) Model Number

3) Serial Number

4) Room number and/or description of installed location

c. Operation and Maintenance Manuals shall include

1) Include detailed procedures for system operation that begin with startup procedures and continue through system shut down referenced in section 3.3 Training.

2) List of manufacture recommended maintenance and intervals with manufacture support contact information.

D. Drawings will contain the Contractors own title block on the edge of the drawing and will include the company name, address, phone number and date of the final drawings.

1. Use of any part of the Architect title block is not acceptable at any time.

E. Drawing documentation will be in the following format:

1. Two (2) electronic copies, one per flash drive shall be provided.

a. Drawings will be in both CAD (DWG) and PDF format and the Contractor will include all files on each drive.

b. File transfer is acceptable.

2. Drawings shall be provided to the architect two weeks prior to the final testing and commissioning of the system. Coordinate with the Owner during the pre-construction meeting for low voltage Contractors to schedule this delivery date.

3. The drawings will be reviewed on site with the architect and the Owner prior to the final acceptance process. Drawings rejected for any reason will delay the final acceptance process until resolved.

F. Testing Results

1. In addition to the project record drawings, the Contractor shall provide the testing information for all audio-visual cabling.

    a. Test results shall be provided to the architect two weeks prior to expected final acceptance of the system(s). Coordinate with the Owner during the pre-construction meeting for low voltage Contractors to schedule this delivery date.

    b. The drawings will be reviewed on site with the architect and the Owner prior to the final acceptance process. Test results rejected for any reason will delay the final acceptance process until resolved.

G. Once accepted by the architect and Owner all documentation / program code becomes the property of the Owner

H. Within ten days receipt of the final acceptance notice, the Owner's representatives shall schedule and perform the final inspection. When the work is found acceptable under the contract documents and the contract is fully performed, declare substantial completion of the project.

3.5 WARRANTY

A. The Contractor shall warrant and guarantee all work against defects in material, equipment or workmanship for one (1) year from the date of substantial completion of the entire project.

B. Upon receipt of written notice, Contractor shall remedy defects within thirty (30) days or the Owner shall correct the defects and the Contractor, or its surety shall be liable for expenses.

END OF
SECTION

SECTION 31 10 00

SITE CLEARING

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. Protecting existing trees, vegetation to remain.
2. Removing existing trees, vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Removing above- and below-grade site improvements.
6. Disconnecting, capping or sealing, and removing site utilities.
7. Temporary erosion and sedimentation control measures.

B. Related Sections include the following:

1. Division 1 Section "Temporary Facilities and Controls" for temporary utilities, temporary construction and support facilities, temporary security and protection facilities.
2. Division 1 Section "Temporary Tree and Plant Protection" for protecting trees remaining on-site that are affected by site operations.
3. Division 1 Section "Execution" for verifying utility locations and for recording field measurements.
4. Division 31 Section "Earth Moving" for soil materials, excavating, backfilling, and site grading.

1.3 DEFINITIONS

A. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of subsoil and weeds, roots, toxic materials, or other nonsoil materials.

B. Tree Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated.

1.4 MATERIAL OWNERSHIP

A. Except for stripped topsoil or other materials indicated to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.5 SUBMITTALS

A. Photographs or videotape, sufficiently detailed, of existing conditions of trees and plantings, adjoining construction, and site improvements that might be misconstrued as damage caused by site clearing.

B. Record drawings, according to Division 01 Section "Project Record Documents," identifying and accurately locating capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.6 QUALITY ASSURANCE

A. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.7 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
   1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
   2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

B. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.

C. Do not commence site clearing operations until temporary erosion and sedimentation control measures are in place.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. Satisfactory Soil Materials: Requirements for satisfactory soil materials are specified in Division 31 Section “Earth Moving.”

   1. Obtain approved borrow soil materials off-site when satisfactory soil materials are not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Locate and clearly flag trees and vegetation to remain or to be relocated.

C. Protect existing site improvements to remain from damage during construction.
   1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways. Refer to Stormwater Pollution Prevention Plan.

B. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

C. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 TREE PROTECTION

A. Do not excavate within tree protection zones, unless otherwise indicated.

B. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by Architect.

3.4 UTILITIES

A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.

1. Arrange with utility companies to shut off indicated utilities.
2. Owner will arrange to shut off indicated utilities when requested by Contractor.

B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Architect not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Architect's written permission.

3.5 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction.

1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
2. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
3. Remove rootballs. Remove roots, obstructions, and debris extending to a depth of 18 inches below exposed subgrade.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

3.6 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.

1. Remove subsoil and nonsoil materials from topsoil, including trash, debris, weeds, roots, and other waste materials.

C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Limit height of topsoil stockpiles to 72 inches.
2. Do not stockpile topsoil within tree protection zones.
3. Stockpile surplus topsoil to allow for respreading deeper topsoil.

3.7 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.
2. Paint cut ends of steel reinforcement in concrete to remain to prevent corrosion.

3.8 DISPOSAL

A. Disposal: Remove unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

END OF SECTION

SECTION 31 20 00

EARTH MOVING

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. Preparing subgrades for areas outside the building perimeter.
2. Subbase and base course for paving.
3. Subsurface drainage backfill for walls and trenches.
4. Excavating and backfilling for utility trenches.

B. Related Sections include the following:

1. Division 01 Section "Unit Prices" for unit-price rock excavation and authorized additional excavation provisions.
2. Division 01 Section "Temporary Facilities and Controls" for temporary controls, utilities, and support facilities.
3. Division 03 Section "Cast-in-Place Concrete" for granular course if placed over vapor retarder and beneath the slab-on-grade.
4. Division 31 Section "Site Clearing" for temporary erosion and sedimentation control measures, site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
5. Division 32 Section "Turf and Grasses" for finish grading, including preparing and placing topsoil and planting soil for lawns.

1.3 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Course placed between the subgrade and hot-mix asphalt or concrete paving.

C. Bedding Course: Course placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Soil imported from off-site for use as fill or backfill.

E. Drainage Course: Course supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and

dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.
2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Initial Backfill: Fill free of particles larger than 1 inch in any dimension, to a height of 12 inches over the utility pipe or conduit and as defined by utility trench detail on the plans.

I. Mass Rock Excavation: Consists of the removal and satisfactory disposal off site per applicable unit price of bedrock, rock in lenses, or boulders 1 cubic yard or larger composed of hard granite or similar material requiring the use of rock drills and specialized equipment for removal, and that is measured, in place, prior to removal. In the event rock as defined above is encountered, the contractor shall immediately notify the Geotech Engineer and the Architect. If requested, the contractor shall demonstrate that material cannot be removed by ripping with a D6T dozer or equal with a minimum of 210 HP and a minimum operating weight of 41,200 lbs. equipped with a single shank ripper with a minimum penetration force of 15,000 pounds, with a pry out force of 20,000 pounds, pulling a single-tooth ripper, with ripping performed in a crisscross pattern or against the natural bedding plane. The Contractor may be required to provide equipment specification data verifying the above minimum-rated equipment will be used for demonstration purposes. The equipment is to be in good repair and in proper working condition.
   1. If rock is encountered, the contract sum shall be adjusted in accordance with the unit prices submitted by the contractor and per agreed cost proposal provided by the contractor in bank form.
   2. Upon encountering rock, the contractor shall remove all overburden from the material and notify the Geotech Engineer and Architect that the material is ready for measurement. The Geotech Engineer will then determine if the material is qualified rock. Once the material is judged as qualified mass rock, the contractor's registered land surveyor shall survey, by cross section, the rock in place and submit the cross sections and calculations to the owner, architect, civil engineer, and geotechnical engineer for approval. All parties must agree on mass rock and confirm quantities prior to removal of rock.
   3. Any material moved or removed without the measurement and approval will be considered as earth excavation.
   4. Limit of payment shall be from top of rock to excavation requirements per specifications.

J. Trench Rock Excavation: Consists of the removal and satisfactory disposal off site of material composed of hard granite or similar material in trenches less than 10 feet wide that cannot be effectively removed using a 125-hp excavator with a pull of 36,500 pounds at the rate of 6 inches per 10 minutes or more or a backhoe equipped with a minimum ½ cubic yard heavy-duty trenching bucket placed on a machine capable of a lifting capacity of 7,500 pounds at a trench depth of 10 feet at the rate of 6 inches per 10 minutes or more, and that is measured, in place, prior to removal. In the event rock as defined above is encountered, the contractor shall immediately notify the Geotech Engineer and the Architect. The Contractor may be required to provide equipment specification data verifying that the above minimum-rated equipment will be used for demonstration purposes. The equipment is to be in good repair and in proper working conditions.
   1. If trench rock is encountered, the contract sum shall be adjusted in accordance with the unit prices submitted by the contractor and per agreed cost proposal provided by the contractor in bank form.
   2. Any material moved or removed without the measurement and approval will be considered as earth excavation.
   3. Upon encountering rock, the contractor shall remove all overburden from the material and

notify the Geotech Engineer and Architect that the material is ready for measurement. The Geotech Engineer will then determine if the material is qualified rock. Once the material is judged as qualified rock, the contractor's registered land surveyor shall survey, by cross section, the rock in place and submit the cross sections and calculations to the owner, architect, civil engineer, and geotechnical engineer for approval. All parties must agree on rock and confirm quantities prior to removal of rock.

4. The trench rock payment limit shall generally be per excavation requirements shown in specifications and plans.
5. For rock excavation, a trench shall be defined as a linear excavation that is 5 feet or less in width and 2 feet or greater in depth. All other rock excavation shall be considered general mass rock excavation.
6. Trenches that are located within the limits of mass rock removal shall be classified as mass rock.

K. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

L. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below base course, drainage fill, or topsoil materials.

M. Utilities: Underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Each type of plastic warning tape.
2. Controlled low-strength material, including design mixture.

B. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:

1. Classification according to ASTM D 2487 of each soil material proposed for fill and backfill.
2. Laboratory compaction curve according to ASTM D 698 for each soil material proposed for fill and backfill.

C. Preexcavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by earthwork operations. Submit before earthwork begins.

1.5 QUALITY ASSURANCE

A. Geotechnical Testing Agency Qualifications: An independent testing agency qualified according to ASTM E 329 to conduct soil materials and rock-definition testing, as documented according to ASTM D 3740 and ASTM E 548.

B. Preexcavation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient on site materials do not match the Geotech report for engineered fill. Geotech report for adjacent housing project was used.

B. Base Course: Naturally graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; conforming to ODOT Type “A” aggregate base.

C. Engineered Fill:

1. Engineered fill within the proposed building and pavement areas shall have the following properties:
    a. Material having a Plasticity Index (PI) less than or equal to 18 and a Liquid Limit (LL) less than 40
    b. Maximum dry density greater than 100 pcf
    c. Contains at least 15% fines (material passing the No. 200 sieve, based on dry weight)
    d. Maximum particle size of 3 inches
    e. Shall be free of any organics and frozen material
    f. Prior to any filling operations, samples shall be tested by and approved by the owner’s on-site geotechnical engineer.
2. Existing on-site fill soils can be used as fill in specific areas as specified in the geotechnical report.

D. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve. Or as defined by the utility trench details.

E. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and 0 to 5 percent passing a No. 4 sieve.

F. Sand: ASTM C 33; fine aggregate, natural, or manufactured sand.

2.2 CONTROLLED LOW-STRENGTH MATERIAL

A. Controlled Low-Strength Material: Low-density, self-compacting, flowable concrete material as follows:

1. Portland Cement: ASTM C 150, Type I, II or III.
2. Fly Ash: ASTM C 618, Class or F.
3. Normal-Weight Aggregate: ASTM C 33, 3/8-inch nominal maximum aggregate size.
4. Foaming Agent: ASTM C 869.
5. Water: ASTM C 94/C 94M.
6. Air-Entraining Admixture: ASTM C 260.

B. Produce conventional-weight, controlled low-strength material with 80-psi compressive strength when tested according to ASTM C 495.

2.3 ACCESSORIES

A. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape

manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:

1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

B. Preparation of subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface is specified in Division 31 Section "Site Clearing."

C. Protect and maintain erosion and sedimentation controls, which are specified in Division 31 Section "Site Clearing," during earthwork operations.

D. Provide protective insulating materials to protect subgrades and foundation soils against freezing temperatures or frost.

3.2 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
2. Install a dewatering system to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.

3.3 EXPLOSIVES

A. Explosives: No explosives are allowed.

3.4 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time

will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsuitable soil materials and rock, replace with approved engineered fill materials.
2. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:
   a. 24 inches outside of concrete forms other than at footings.
   b. 12 inches outside of concrete forms at footings.
   c. 6 inches outside of minimum required dimensions of concrete cast against grade.
   d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
   e. 6 inches beneath bottom of concrete slabs on grade.
   f. 6 inches beneath pipe in trenches.

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.7 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, unless otherwise indicated.

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

3.8 SUBGRADE INSPECTION

A. Notify Engineer and/or geotechnical testing agency when excavations have reached required subgrade.

B. If Engineer and/or geotechnical testing agency determines that unsuitable soil is present, continue excavation and replace with compacted backfill or fill material as directed and after approved by owner or architect.

C. Soft soils within the building and pavement areas shall be removed full-depth and replaced with properly compacted and approved lower plasticity engineered fill.

D. After stripping and completing any cuts and undercuts, the exposed subgrade shall be proofrolled. Proof-roll subgrade under the observation of the geotechnical engineer, with a loaded, tandem-axle dump truck weighing at least 25 tons, to locate any zones that are soft or unstable. The proofrolling should involve overlapping passes in mutually perpendicular directions. Where rutting or pumping is observed during proof-rolling, the unstable soils shall be over-excavated and replaced with low volume change soils.

E. Prior to proofrolling, the exposed soils shall be scarified to a minimum depth of 12 inches,

moisture conditioned to within a range of 1 percent below to 3 percent above the optimum moisture content and recompacted to at least 95% of the materials maximum dry density (ASTM D 698)

F. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.9 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Structural Engineer.

1. Fill unauthorized excavations under other construction or utility pipe as directed by Engineer.

3.10 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated on-site suitable soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.11 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, sub-drainage, damp-proofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities for Record Documents.
3. Testing and inspecting underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring and bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.12 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Place and compact initial backfill, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the utility pipe or conduit.

1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

D. Controlled Low-Strength Material: Place initial backfill of controlled low-strength material to a height of 12 inches over the utility pipe or conduit.

E. Backfill voids while installing and removing shoring and bracing.

F. Place and compact final backfill to final subgrade elevation.

G. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.13 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use engineered fill or on-site material.
2. Under walks and pavements, use engineered fill
3. Under steps and ramps, use engineered fill.
4. Under building slabs, use engineered fill.
5. Under footings and foundations, use engineered fill.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

D. Existing slopes steeper than 5 horizontal to 1 vertical (5:1) and located in fill areas shall be benched prior to fill placement. Benches shall be cut as the fill placement progresses and shall have a maximum bench height of 2 to 3 feet.

3.14 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within range of 1 percent below to 3 percent above the material's optimum moisture content, determined in accordance with ASTM D-698, (standard Proctor procedure).

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 3 percent and is too wet to compact to specified dry unit weight. Onsite CL (PI greater than 18%) and CL-CH shall have an optimum moisture content of 0 to 3% per Geotech report.

3.15 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 12 inches in depth for material compacted by heavy compaction equipment, and not more than 8 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698

1. Under structures, building slabs, steps, and pavements, scarify and recompact top 9 inches of existing subgrade and each layer of backfill or fill soil material at 98 percent.
2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each

layer of backfill or fill soil material at 95 percent.
3. Under lawn or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 85 percent.
4. For utility trenches in unpaved areas, compact each layer of initial and final backfill soil material at 85 percent. In paved areas, compact utility trench backfill at 95 percent.
5. Aggregate base course beneath pavement, compact to at least 98 percent.

3.17 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.
2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:

1. Lawn or Unpaved Areas: Plus or minus 1 inch.
2. Walks and Pavements: Plus or minus 1/2 inch. Areas must not exceed ADA slope requirements and tolerances will not be allowed to exceed these max slope requirements.

3.18 BASE COURSES

A. Place base course on subgrade free of mud, frost, snow, or ice.

B. On prepared subgrade, place base course under pavements and walks as follows:

1. Where indicated by onsite geotechnical testing company, install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
2. Shape base course to required crown elevations and cross-slope grades.
3. Place base course in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
4. Compact base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 98 percent of maximum dry unit weight according to ASTM D-698.

3.19 DRAINAGE COURSE

A. Place drainage course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:

1. Place drainage course in compacted thickness shown on plans in a single layer.
2. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry relative density according to ASTM D 698.

3.20 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.

B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.

C. Contact Engineer or onsite geotechnical testing agency for subgrade proofrolling.

D. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect and/or Structural Engineer.

E. Perform Atterberg limits tests on fly ash and cement kiln dust treated fill/backfill materials placed in the building area for the low volume change fill layer at frequency of at least 1 test per 5,000 SF of area with at least 2 test per lift. Intent or Atterberg limits testing is to determine if the soil has been effectively treated.

F. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:

1. Building and Foundation Areas: At subgrade and at each compacted fill and backfill layer, at least 1 test for every 2500 sq. ft. or less of building or foundation, but in no case fewer than 3 tests.
2. Pavement Backfill: At each compacted backfill layer, at least 1 test for every 5000 sq. ft. or less of pavement area, but no fewer than 3 tests.
3. Trench Backfill: At each compacted initial and final backfill layer, at least 1 test for each 150 feet or less of trench length, but no fewer than 2 tests.

G. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.21 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion prior to placement of subsequent base course, paving, or foundations above. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.23 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove waste material, including unsuitable soil, trash, and debris, and legally dispose of it off Owner's property.

B. Transport surplus engineered fill to designated storage areas on or off Owner's property.

END OF SECTION

SECTION 32 12 16

ASPHALT PAVING

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. Hot-mix asphalt paving.
2. Pavement-marking paint.

B. Related Sections include the following:

1. Division 31 Section "Earth Moving" for aggregate subbase and base courses and for aggregate pavement shoulders.
2. Division 32 Section "Concrete Paving Joint Sealants" for joint sealants and fillers at paving terminations.

1.3 DEFINITIONS

A. Hot-Mix Asphalt Paving Terminology: Refer to ASTM D 8 for definitions of terms.

B. DOT: Department of Transportation.

1.4 SYSTEM DESCRIPTION

A. Retain this Article if specifying state or local DOT standard paving mixes; delete if specifying paving mixes other than those of state or local DOT.

B. Provide hot-mix asphalt paving according to materials, workmanship, and other applicable requirements of standard specifications of state of Oklahoma DOT.

1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.

B. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.

C. Qualification Data: For manufacturer.

D. Material Test Reports: For each paving material.

E. Material Certificates: For each paving material, signed by manufacturers.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer.

1. Manufacturer shall be a paving-mix manufacturer registered with and approved by ODOT of the state in which Project is located.

B. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated, as documented according to ASTM E 548.

C. Regulatory Requirements: Comply with ODOT standard specifications for highway construction, latest addition.

D. Asphalt-Paving Publication: Comply with AI MS-22, "Construction of Hot Mix Asphalt Pavements," unless more stringent requirements are indicated.

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:

1. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
2. Review condition of subgrade and preparatory work.
3. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.
4. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Delete this Article if pavement-marking materials are not required.

B. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.

C. Store pavement-marking materials in a clean, dry, protected location within temperature range required by manufacturer. Protect stored materials from direct sunlight.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp or if the following conditions are not met:

1. Tack Coats: Minimum surface temperature of 60 deg F.
2. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
3. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.

B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for oil-based materials, 50 deg F for

water-based materials, and not exceeding 95 deg F.

PART 2 - PRODUCTS

2.1 AGGREGATES

A. Coarse Aggregate: ASTM D 692, per ODOT Standard Specifications, sound; angular crushed stone, crushed gravel, or properly cured, crushed blast-furnace slag.

B. Fine Aggregate: ASTM D 1073, per ODOT Standard Specifications, sharp-edged natural sand or sand prepared from stone, gravel, properly cured blast-furnace slag, or combinations thereof.

1. For hot-mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.

C. Mineral Filler: ASTM D 242, rock or slag dust, hydraulic cement, or other inert material.

2.2 ASPHALT MATERIALS

A. Asphalt Binder, Asphalt Cement and Tack Coat in accordance with ODOT standard specifications for highway construction.

B. Water: Potable.

2.3 AUXILIARY MATERIALS

A. Herbicide: Commercial chemical for weed control, registered by the EPA. Provide in granular, liquid, or wettable powder form.

B. Sand: ASTM D 1073, Grade Nos. 2 or 3.

C. Joint Sealant: ASTM D 3405, hot-applied, single-component, polymer-modified bituminous sealant.

D. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952E, Type II, with drying time of less than 45 minutes.

1. Color: As indicated.

E. Glass Beads: AASHTO M 247, Type 1.

F. Wheel Stops: Precast, air-entrained concrete, 3,000-psi minimum compressive strength, 4-1/2 inches high by 9 inches wide by 72 inches long. Provide chamfered corners and drainage slots on underside and holes for anchoring to substrate.

1. Dowels: Galvanized steel, 3/4-inch diameter, 12-inch minimum length.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material

from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

1. Sweep loose granular particles from surface of unbound-aggregate base course. Do not dislodge or disturb aggregate embedded in compacted surface of base course.

B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.

1. Mix herbicide with prime coat if formulated by manufacturer for that purpose.

C. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd.

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.2 HOT-MIX ASPHALT PLACING

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand in areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

1. Place hot-mix asphalt base course in lifts of 3” or less.
2. Place hot-mix asphalt surface course in single lift.
3. Spread mix at minimum temperature of 250 deg F, or higher temperature as required by the grade of asphalt cement used.
4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes, unless otherwise indicated.
5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.

1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete a section of asphalt base course before placing asphalt surface course.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.3 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions with same texture and smoothness as other sections of hot-mix asphalt course.

1. Clean contact surfaces and apply tack coat to joints.
2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
3. Offset transverse joints, in successive courses, a minimum of 24 inches.
4. Construct transverse joints as described in AI MS-22, "Construction of Hot Mix Asphalt Pavements."
5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive

displacement.

3.4 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or vibratory-plate compactors in areas inaccessible to rollers.

1. Complete compaction before mix temperature cools to 185 deg F, or higher temperature as required by the grade of asphalt cement used.

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. Average Density: 96 percent of reference laboratory density according to AASHTO T 245, but not less than 94 percent nor greater than 100 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.5 INSTALLATION TOLERANCES

A. Thickness: Compact each course to produce the thickness indicated within the following tolerances:

1. Base Course: Plus or minus 1/2 inch.
2. Surface Course: Plus 1/4 inch, no minus.

B. Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:

1. Base Course: 1/4 inch.
2. Surface Course: 1/8 inch.
3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

3.6 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

B. Allow paving to age for 30 days before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

1. Broadcast glass spheres uniformly into wet pavement markings at a rate of 6 lb/gal.

3.7 WHEEL STOPS

A. Securely attach wheel stops into pavement with not less than two galvanized steel dowels embedded at one-quarter to one-third points. Securely install dowels into pavement and bond to wheel stop. Recess head of dowel beneath top of wheel stop.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and to prepare test reports.

1. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from specified requirements.

B. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

C. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.

D. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

E. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to AASHTO T 168.

1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.
2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.
    a. One core sample will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than 3 cores taken.
    b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.

F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.9 DISPOSAL

A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.

1. Do not allow excavated materials to accumulate on-site.

END OF SECTION

SECTION 33 41 00

STORM DRAINAGE UTILITY PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes gravity-flow, nonpressure storm drainage outside the building, with the following components:

1. Drains & pipes

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene-monomer rubber.

B. LLPE: Linear low-density, polyethylene plastic.

C. PE: Polyethylene plastic.

D. PVC: Polyvinyl chloride plastic.

E. TPE: Thermoplastic elastomer.

1.4 PERFORMANCE REQUIREMENTS

A. Gravity-Flow, Nonpressure, Drainage-Piping Pressure Rating: 10-foot head of water. Pipe joints shall be at least silt tight, unless otherwise indicated.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Pipe and fittings
2. Concrete end sections

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic manholes, pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle manholes, catch basins, and stormwater inlets according to manufacturer's written rigging instructions.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, fitting, and joining materials.

2.2 PE PIPE AND FITTINGS

A. Corrugated PE Drainage Pipe and Fittings NPS 10 and Smaller: AASHTO M 252M, Type S, with smooth waterway for coupling joints.

1. Silt tight Couplings: PE sleeve with ASTM D 1056, Type 2, Class A, Grade 2 gasket material that mates with tube and fittings.

B. Corrugated PE Pipe and Fittings NPS 12 to NPS 48: AASHTO M 294M, Type S, with smooth waterway for coupling joints.

1. Silt tight Couplings: PE sleeve with ASTM D 1056, Type 2, Class A, Grade 2 gasket material that mates with pipe and fittings.

2.3 PVC PIPE AND FITTINGS

A. PVC Sewer Pipe and Fittings, NPS 18 (DN 375) and Smaller: ASTM D 3034, SDR 26 with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.

2.4 CPP PIPE AND FITTINGS

A. Sewer Pipe and Fittings: ASTM F2881, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals. Bell and spigot connections shall utilize a welded or integral bell and valley or inline gaskets meeting the watertight joint performance requirements of ASTM D3212.

1. HP Storm – Dual Wall – PP Pipe by ADS or approved equal

B. Polypropylene compound shall be impact modified copolymer meeting the material requirements of ASTM F2881, Section 5 and AASHTO M330, Section 6.1.

2.5 NONPRESSURE-TYPE PIPE COUPLINGS

A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

2.6 CONCRETE

A. General: Cast-in-place concrete according to ACI 318/318R, ACI 350R, and the following:

1. Cement: ASTM C 150, Type II.
2. Fine Aggregate: ASTM C 33, sand.
3. Coarse Aggregate: ASTM C 33, crushed gravel.
4. Water: Potable.

B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water-cementitious materials ratio.

1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

2.7 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

2.8 PIPING INSTALLATION

A. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

2.9 PIPE JOINT CONSTRUCTION

A. Basic pipe joint construction is specified in Division 33 Section "Common Work Results for Utilities." Where specific joint construction is not indicated, follow piping manufacturer's written instructions.

2.10 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318/318R.

2.11 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

1. Submit separate reports for each system inspection.
2. Defects requiring correction include the following:
    a. Alignment: Less than full diameter of inside of pipe is visible between structures.
    b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
    c. Crushed, broken, cracked, or otherwise damaged piping.
    d. Infiltration: Water leakage into piping.
    e. Exfiltration: Water leakage from or around piping.
3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Re-inspect and repeat procedure until results are satisfactory.

2.12 CLEANING

A. Clean interior of piping of dirt and superfluous materials.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.2 PIPING APPLICATIONS

A. Pipe couplings and special pipe fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.

1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping, unless otherwise indicated.
    a. Shielded flexible couplings for same or minor difference OD pipes.
    b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
    c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.
2. Use pressure-type pipe couplings for force-main joints.

B. Special Pipe Fittings: Use for pipe expansion and deflection. Pipe couplings and special pipe fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.

3.3 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed by tunneling, jacking, or a combination of both.

F. Install gravity-flow, nonpressure drainage piping according to the following:

1. Install piping pitched down in direction of flow, at minimum slope of 1 percent, unless otherwise indicated.
2. Install piping NPS 6 and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place concrete supports or anchors.
3. Install piping with 36-inch minimum cover.
4. Install piping below frost line.
5. Install PE corrugated sewer piping according to CPPA's "Recommended Installation Practices for Corrugated Polyethylene Pipe and Fittings."

6. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.
7. Install reinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."

3.4 PIPE JOINT CONSTRUCTION

A. Basic pipe joint construction is specified in Division 33 Section "Common Work Results for Utilities." Where specific joint construction is not indicated, follow piping manufacturer's written instructions.

B. Join gravity-flow, nonpressure drainage piping according to the following:

1. Join corrugated PE piping according to CPPA 100 and the following:
   a. Use silt tight couplings for Type 1, silt tight joints.
2. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric gasket joints.
3. Join PVC profile gravity sewer piping according to ASTM D 2321 for elastomeric-seal joints or ASTM F 794 for gasketed joints.
4. Join reinforced-concrete sewer piping according to ACPA's "Concrete Pipe Installation Manual" for rubber-gasket joints and proper tolerances for the Omni-flex gaskets.
5. Join dissimilar pipe materials with nonpressure-type flexible couplings.

C. Join dissimilar pipe materials with pressure-type couplings.

3.5 STORMWATER INLET AND OUTLET INSTALLATION

A. Construct inlet head walls, aprons, and sides of reinforced concrete, as indicated.

B. Construct riprap of broken stone, as indicated.

C. Install outlets that spill onto grade, anchored with concrete, where indicated.

D. Install outlets that spill onto grade, with flared end sections that match pipe, where indicated.

E. Construct energy dissipaters at outlets, as indicated.

3.6 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318/318R.

3.7 STORMWATER DISPOSAL SYSTEM INSTALLATION

A. Piping Systems: Excavate trenches of width and depth, and install piping system, filter fabric, and backfill according to piping manufacturer's written instructions.

3.8 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping in building's storm building drains specified in Division 22 Section "Facility Storm Drainage Piping."

1. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

B. Connect to sediment interceptors specified in Division 22 Section "Sanitary Waste Interceptors."

3.9 IDENTIFICATION

A. Materials and their installation are specified in Division 31 Section "Earth Moving." Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.

1. Use warning tape over piping and over edges of underground structures.

3.10 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

1. Submit separate reports for each system inspection.
2. Defects requiring correction include the following:
   a. Alignment: Less than full diameter of inside of pipe is visible between structures.
   b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
   c. Crushed, broken, cracked, or otherwise damaged piping.
   d. Infiltration: Water leakage into piping.
   e. Exfiltration: Water leakage from or around piping.
3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Re-inspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate report for each test.
5. Gravity-Flow Storm Drainage Piping: Test according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
   a. Exception: Piping with soiltight joints unless required by authorities having jurisdiction.
   b. Option: Test plastic piping according to ASTM F 1417.
   c. Option: Test concrete piping according to ASTM C 924.
   d. Ductile-Iron Piping: Test according to AWWA C600, "Hydraulic Testing" Section.
   e. PVC Piping: Test according to AWWA M23, "Testing and Maintenance" Chapter.

C. Leaks and loss in test pressure constitute defects that must be repaired.

D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.11 CLEANING

A. Clean interior of piping of dirt and superfluous materials. Flush with potable water as required.

END OF SECTION