SECTION 00 0101
PROJECT TITLE PAGE

MASTER SPECIFICATIONS

FOR

FACILITIES IDIQ BASE CONTRACT

USDA FOREST SERVICE

2800 NORTH OCOEE STREET
CLEVELAND, TENNESSEE, 37312

DATE: MARCH 8, 2023

END OF SECTION

SECTION 00 0103

PROJECT DIRECTORY

PART 1 GENERAL

1.02 SECTION INCLUDES

A. Identification of project team members and their contact information.

1.03 OWNER:

A. Name: USDA Forest Service
   1. Address Line 1: 1720 Peachtree St. NW.
   2. Address Line 2: Suite 200.
   3. City: Atlanta.
   4. State: Georgia.
   5. Zip Code: 30309.

B. Primary Contact: All correspondence from the Contractor to the Architect will be through this party, unless alternate arrangements are mutually agreed upon at preconstruction meeting.
   1. Contact: Forest Facilities Engineer / Program Manager
   2. Address Line 1: 2800 N Ocoee St.
   3. City: Cleveland.
   4. State: TN
   5. Zip Code: 37312.
   6. Phone: 423-476-6700

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 00 0110

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SECTION 00 5000
CONTRACTING FORMS AND SUPPLEMENTS

PART 1 GENERAL

1.01 AGREEMENT AND CONDITIONS OF THE CONTRACT

A. See Section 00 7200 - General Conditions for the General Conditions.

B. The Agreement is based on AIA A101-2007.

1.02 FORMS

A. Use the following forms for the specified purposes unless otherwise indicated elsewhere in Contract Documents.

B. Bond Forms:
   1. Bid Bond Form: AIA A310.

C. Post-Award Certificates and Other Forms:
   1. Submittal Transmittal Letter Form: AIA G810.
   2. Certificate of Insurance Form: ACORD Certificate of Insurance 25.
   3. Application for Payment Forms: AIA G702 with AIA G703 (for Contractors).

D. Closeout Forms:
   1. Certificate of Substantial Completion Form: AIA G704-2000.

1.03 REFERENCE STANDARDS

A. AIA A101-2007 - Standard Form of Agreement Between Owner and Contractor where the basis of Payment is a Stipulated Sum; 2007.

B. AIA A310 - Bid Bond; 2010.

C. AIA G702 - Application and Certificate for Payment; 1992.

D. AIA G703 - Continuation Sheet; 1992.

E. AIA G704-2000 - Certificate of Substantial Completion; 2000.

F. AIA G810 - Transmittal Letter; 2001.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 2500
SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Procedural requirements for proposed substitutions.

1.02 RELATED REQUIREMENTS

A. Section 01 3000 - Administrative Requirements: Submittal procedures, coordination.

B. Section 01 6000 - Product Requirements: Fundamental product requirements, product options, delivery, storage, and handling.

1.03 DEFINITIONS

A. Substitutions: Changes from Contract Documents requirements proposed by Contractor to materials, products, assemblies, and equipment.

1.04 REFERENCE STANDARDS

A. CSI/CSC Form 1.5C - Substitution Request (During the Bidding/Negotiating Stage); Current Edition.

B. CSI/CSC Form 13.1A - Substitution Request (After the Bidding/Negotiating Phase); Current Edition.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. A Substitution Request for products, assemblies, materials, and equipment constitutes a representation that the submitter:
   1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
   2. Agrees to provide the same warranty for the substitution as for the specified product.
   3. Agrees to provide same or equivalent maintenance service and source of replacement parts, as applicable.
   4. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.
   5. Waives claims for additional costs or time extension that may subsequently become apparent.

B. A Substitution Request for specified installer constitutes a representation that the submitter:
   1. Has acted in good faith to obtain services of specified installer, but was unable to come to commercial, or other terms.

C. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.

D. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.
   1. Forms indicated in the Project Manual are adequate for this purpose, and must be used.

E. Limit each request to a single proposed substitution item.
   1. Submit an electronic document, combining the request form with supporting data into single document.

3.02 SUBSTITUTION PROCEDURES DURING PROCUREMENT

A. Submittal Time Restrictions:
   1. Instructions to Bidders specifies time restrictions and the documents required for submitting substitution requests during the bidding period.

B. Submittal Form (before award of contract):

1. Submit substitution requests by completing CSI/CSC Form 1.5C - Substitution Request. See this form for additional information and instructions. Use only this form; other forms of submission are unacceptable.

3.03 SUBSTITUTION PROCEDURES DURING CONSTRUCTION

A. Submittal Form (after award of contract):
   1. Submit substitution requests by completing CSI/CSC Form 13.1A - Substitution Request (After Bidding/Negotiating). See this form for additional information and instructions. Use only this form; other forms of submission are unacceptable.

B. 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.

C. 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. When acceptance will require revisions to Contract Documents.

3.04 RESOLUTION

3.05 ACCEPTANCE

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

3.06 CLOSEOUT ACTIVITIES

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

END OF SECTION

SECTION 01 3000
ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General administrative requirements.

B. Electronic document submittal service.

C. Preconstruction meeting.

D. Site mobilization meeting.

E. Progress meetings.

F. Construction progress schedule.

G. Contractor's daily reports.

H. Progress photographs.

I. Coordination drawings.

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

K. Number of copies of submittals.

L. Requests for Interpretation (RFI) procedures.

M. Submittal procedures.

1.02 RELATED REQUIREMENTS

A. Section 00 7200 - General Conditions: Dates for applications for payment.

B. Section 01 3216 - Construction Progress Schedule: Form, content, and administration of schedules.

C. Section 01 6000 - Product Requirements: General product requirements.

D. Section 01 7000 - Execution and Closeout Requirements: Additional coordination requirements.

E. Section 01 7800 - Closeout Submittals: Project record documents; operation and maintenance data; warranties and bonds.

1.03 REFERENCE STANDARDS

A. AIA G716 - Request for Information; 2004.

B. AIA G810 - Transmittal Letter; 2001.

1.04 GENERAL ADMINISTRATIVE REQUIREMENTS

A. Comply with requirements of Section 01 7000 - 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 ELECTRONIC DOCUMENT SUBMITTAL SERVICE

A. All documents transmitted for purposes of administration of the contract are to be in electronic (PDF, MS Word, or MS Excel) format, as appropriate to the document, and transmitted via an Internet-based submittal service that receives, logs and stores documents, provides electronic stamping and signatures, and notifies addressees via email.
   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 service.
   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 of the service 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. Paper document transmittals will not be reviewed; emailed electronic documents will not be reviewed.
   7. All other specified submittal and document transmission procedures apply, except that electronic document requirements do not apply to samples or color selection charts.

B. Cost: The cost of the service is to be paid by Contractor; include the cost of the service in the Contract Sum.

C. Submittal Service: The selected service is:
   1. Procore: www.procore.com.
   2. E-Builder: www.e-builder.net.

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

3.02 PRECONSTRUCTION MEETING

A. Schedule meeting after Notice of Award.

B. Attendance Required:
   1. Owner.
   2. Architect.
   3. Contractor.

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.

3.03 SITE MOBILIZATION MEETING

A. Schedule meeting at the Project site prior to Contractor occupancy.

B. Attendance Required:
   1. Contractor.
   2. Owner.
   3. Contractor's superintendent.
   4. Major subcontractors.

C. Agenda:
   1. Use of premises by Owner and Contractor.
   2. Owner's requirements.
   3. Construction facilities and controls provided by Owner.
   4. Temporary utilities provided by Owner.
   5. Survey and building layout.
   6. Security and housekeeping procedures.
   7. Schedules.
   8. Application for payment procedures.
   9. Procedures for testing.
   10. Procedures for maintaining record documents.
   11. Requirements for start-up of equipment.
   12. Inspection and acceptance of equipment put into service during construction period.

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. Attendance Required:
   1. Contractor.
   2. Owner.
   3. Architect.
   4. Contractor's superintendent.
   5. Major subcontractors.

B. 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.

C. 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.

3.05 CONSTRUCTION PROGRESS SCHEDULE

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

B. 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.

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

D. 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. List of separate contractors at Project site.
   5. Major equipment at Project site.
   6. Material deliveries.
   7. Safety, environmental, or industrial relations incidents.
   8. Meetings and significant decisions.
   9. 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.
   10. Testing and/or inspections performed.
   11. Signature of Contractor's authorized representative.

3.07 PROGRESS PHOTOGRAPHS

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

B. Photography Type: Digital; electronic files.

C. Provide photographs of site and construction throughout progress of work produced by an experienced photographer, acceptable to Architect.

D. In addition to periodic, recurring views, take photographs of each of the following events:
   1. Final completion, minimum of ten (10) photos.

E. Take photographs as evidence of existing project conditions as follows:
   1. Interior views: _____
   2. Exterior views: _____
   3. Uncovered elements not noted in Contract Drawing that effect work..

F. Views:
   1. Provide non-aerial photographs from multiple views at each specified time, until date of Substantial Completion.
   2. Provide factual presentation.
   3. 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 COORDINATION DRAWINGS

A. Provide information required by Project Coordinator for preparation of coordination drawings.

3.09 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 acceptable to Owner.
   a. Use AIA G716 - Request for Information .
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 - 01 6000 - 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. Note dates of when each request is made, and when a response is received.
   3. Highlight items requiring priority or expedited response.

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

3.10 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 - 01 3216 - 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.

3.11 SUBMITTALS FOR REVIEW

A. When the following are specified in individual sections, submit them for review:
   1. Product data.
   2. Shop drawings.
   3. Samples for selection.
   4. Samples for verification.

B. Submit to Architect for review for the limited purpose of checking for compliance with information given and the design concept expressed in Contract Documents.

C. Samples will be reviewed for aesthetic, color, or finish selection.

D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 01 7800 - Closeout Submittals.

3.12 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.

3.13 SUBMITTALS FOR PROJECT CLOSEOUT

A. Submit Correction Punch List for Substantial Completion.

B. Submit Final Correction Punch List for Substantial Completion.

C. When the following are specified in individual sections, submit them at project closeout in compliance with requirements of Section 01 7800 - Closeout Submittals:
   1. Project record documents.
   2. Operation and maintenance data.
   3. Warranties.
   4. Bonds.
   5. Other types as indicated.

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

3.14 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. 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.

3.15 SUBMITTAL PROCEDURES

A. General Requirements:
   1. Use a single transmittal for related items.
   2. Transmit using approved form.
      a. Use Form AIA G810.
   3. Sequentially identify each item. For revised submittals use original number and a sequential numerical suffix.
   4. Identify: Project; Contractor; subcontractor or supplier; pertinent drawing and detail number; and specification section number and article/paragraph, as appropriate on each copy.
   5. 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.
   6. 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 Electronic Document Submittal Service website.

7. Schedule submittals to expedite the Project, and coordinate submission of related items.
   a. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor.
   b. For sequential reviews involving Architect's consultants, Owner, or another affected party, allow an additional 7 days.
   c. For sequential reviews involving approval from authorities having jurisdiction (AHJ), in addition to Architect's approval, allow an additional 30 days.
8. Identify variations from Contract Documents and product or system limitations that may be detrimental to successful performance of the completed work.
9. Provide space for Contractor and Architect review stamps.
10. Distribute reviewed submittals. Instruct parties to promptly report inability to comply with requirements.
11. 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.
12. 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. 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.

3.16 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

SECTION 01 3216
CONSTRUCTION PROGRESS SCHEDULE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Preliminary schedule.

B. Construction progress schedule, bar chart type.

1.02 REFERENCE STANDARDS

A. AGC (CPSM) - Construction Planning and Scheduling Manual; 2004.

B. M-H (CPM) - CPM in Construction Management - Project Management with CPM; 2015.

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.

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

D. Provide legend for symbols and abbreviations used.

3.03 BAR CHARTS

A. Include a separate bar for each major portion of Work or operation.

B. Identify the first work day of each week.

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.

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 01 3553
SECURITY PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Security measures including formal security program, entry control, personnel identification, guard service, and miscellaneous restrictions.

1.02 RELATED REQUIREMENTS

A. Section 01 5000 - Temporary Facilities and Controls: Temporary lighting.

1.03 SECURITY PROGRAM

A. Protect Work, existing premises and Owner's operations from theft, vandalism, and unauthorized entry.

B. Initiate program in coordination with Owner's existing security system at project mobilization.

C. Maintain program throughout construction period until Owner acceptance precludes the need for Contractor security.

1.04 ENTRY CONTROL

A. Restrict entrance of persons and vehicles into Project site and existing facilities.

B. Allow entrance only to authorized persons with proper identification.

C. Maintain log of workers and visitors, make available to Owner on request.

1.05 RESTRICTIONS

A. Do no work on weekends or other times that interfere with Owner's operation..

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 4000
QUALITY REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Submittals.

B. Quality assurance.

C. References and standards.

D. Testing and inspection agencies and services.

E. Contractor's construction-related professional design services.

F. Control of installation.

G. Mock-ups.

H. Tolerances.

I. Defect Assessment.

1.02 RELATED REQUIREMENTS

A. Document 00 7200 - General Conditions: Inspections and approvals required by public authorities.

B. Section 01 2100 - Allowances: Allowance for payment of testing services.

C. Section 01 3000 - Administrative Requirements: Submittal procedures.

D. Section 01 4216 - Definitions.

E. Section 01 6000 - Product Requirements: Requirements for material and product quality.

1.03 REFERENCE STANDARDS

A. IAS AC89 - Accreditation Criteria for Testing Laboratories; 2020.

1.04 DEFINITIONS

A. Contractor's Professional Design Services: Design of some aspect or portion of the project by party other than the design professional of record. Provide these services as part of the Contract for Construction.

1.05 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:

1.06 SUBMITTALS

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

1.07 QUALITY ASSURANCE

A. Testing Agency Qualifications:
   1. Prior to start of work, 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. Qualification Statement: Provide documentation showing testing laboratory is accredited under IAS AC89.

B. Designer Qualifications: Where professional engineering design services and design data submittals are specifically required of Contractor by Contract Documents, provide services of a

Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

C. Contractor's Quality Control (CQC) Plan:
   1. Prior to start of work, submit a comprehensive plan describing how contract deliverables will be produced. Tailor CQC plan to specific requirements of the project. Include the following information:
      a. Management Structure: Identify personnel responsible for quality. Include a chart showing lines of authority.
      b. Management Approach: Define, describe, and include in the plan specific methodologies used in executing the work.
         1) Management and control of documents and records relating to quality.
         2) Communications.
         3) Coordination procedures.
         4) Resource management.
         5) Process control.
         6) Inspection and testing procedures and scheduling.
         7) Control of noncomplying work.
         8) Tracking deficiencies from identification, through acceptable corrective action, and verification.
         9) Control of testing and measuring equipment.
         10) Project materials certification.
         11) Managerial continuity and flexibility.
      c. Owner will not make a separate payment for providing and maintaining a Quality Control Plan. Include associated costs in Bid price.
      d. Acceptance of the plan is required prior to start of construction activities not including mobilization work. Owner's acceptance of the plan will be conditional and predicated on continuing satisfactory adherence to the plan. Owner reserves the right to require Contractor to make changes to the plan and operations, including removal of personnel, as necessary, to obtain specified quality of work results.

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. Obtain copies of standards where required by product specification sections.

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

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

F. 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 01 2100; see Section 01 2100 and applicable sections for description of services included in allowance.

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

PART 3 EXECUTION

2.01 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.

2.02 MOCK-UPS

A. Tests shall be performed under provisions identified in this section and identified in the respective product specification sections.

B. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.

C. Architect will use accepted mock-ups as a comparison standard for the remaining Work.

D. Where mock-up has been accepted by Architect and is specified in product specification sections to be removed, protect mock-up throughout construction, remove mock-up and clear area when directed to do so by Architect.

2.03 TOLERANCES

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

B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

2.04 TESTING AND INSPECTION

A. Testing Agency Duties:
   1. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
   2. Perform specified sampling and testing of products in accordance with specified standards.
   3. Promptly notify Architect and Contractor of observed irregularities or non-compliance of Work or products.
   4. Perform additional tests and inspections required by Architect.
   5. Submit reports of all tests/inspections specified.

B. 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.

C. 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.

D. Re-testing required because of non-compliance with specified requirements shall be performed by the same agency on instructions by Architect.

E. Re-testing required because of non-compliance with specified requirements shall be paid for by Contractor.

2.05 DEFECT ASSESSMENT

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

END OF SECTION

SECTION 01 4216
DEFINITIONS

PART 1 GENERAL

1.01 SUMMARY

A. This section supplements the definitions contained in the General Conditions.

B. Other definitions are included in individual specification sections.

1.02 DEFINITIONS

A. Furnish: To supply, deliver, unload, and inspect for damage.

B. Install: To unpack, assemble, erect, apply, place, finish, cure, protect, clean, start up, and make ready for use.

C. Product: Material, machinery, components, equipment, fixtures, and systems forming the work result. Not materials or equipment used for preparation, fabrication, conveying, or erection and not incorporated into the work result. Products may be new, never before used, or re-used materials or equipment.

D. Project Manual: The book-sized volume that includes the procurement requirements (if any), the contracting requirements, and the specifications.

E. Provide: To furnish and install.

F. Supply: Same as Furnish.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 5000
TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Temporary utilities.

B. Temporary telecommunications services.

C. Temporary sanitary facilities.

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

E. Security requirements.

F. Vehicular access and parking.

G. Waste removal facilities and services.

H. Field offices.

1.02 RELATED REQUIREMENTS

A. Section 01 3553 - Security Procedures

B. Section 01 5100 - Temporary Utilities.

C. Section 01 5213 - Field Offices and Sheds.

D. Section 01 5500 - Vehicular Access and Parking.

E. Section 01 5813 - Temporary Project Signage.

1.03 TEMPORARY UTILITIES - SEE SECTION 01 5100

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.

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.

C. Locate and secure Temporary Sanitary Facilities from general public access. Provide signage to permanent sanitary facilities for public use.

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 INTERIOR ENCLOSURES

A. Provide temporary partitions and ceilings as necessary to separate work areas from Owner-occupied areas and public access, to prevent penetration of dust and moisture into Owner-occupied areas, and to prevent damage to existing materials and equipment.

1.08 SECURITY - SEE SECTION 01 3553

A. Coordinate with Owner's security program.

1.09 VEHICULAR ACCESS AND PARKING - SEE SECTION 01 5500

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

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

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

1.10 WASTE REMOVAL

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

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

C. 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.

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

1.11 PROJECT SIGNS - SEE SECTION 01 5813

1.12 FIELD OFFICES - SEE SECTION 01 5213

A. Coordinate with Owner: location and necessity of separate offices for the Contractor during the renovation. Coordinate use of existing conference rooms with Owner. Contractor shall provide written requests for use of any existing facilities at least 5 business days before intended use.

B. Contractor to make separate accomodations for Field Office and required meetings if coordination not possible with Owner or continued use of the facility.

1.13 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

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

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

C. Restore existing facilities used during construction to original condition.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 5100
TEMPORARY UTILITIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Temporary Utilities: Provision of electricity, lighting, heat, ventilation, and water.

1.02 RELATED REQUIREMENTS

A. Section 01 5000 - Temporary Facilities and Controls:

1.03 REFERENCE STANDARDS

A. 29 CFR 1926 - Safety and Health Regulations for Construction; Current Edition.

1.04 TEMPORARY ELECTRICITY

A. Cost: By Contractor.

B. Provide temporary electric feeder from existing building electrical service at location as directed.

C. Provide power outlets for construction operations, with branch wiring and distribution boxes located at each floor. Provide flexible power cords as required.

D. Provide main service disconnect and over-current protection at convenient location and meter.

E. Permanent convenience receptacles may be utilized during construction.

F. Provide adequate distribution equipment, wiring, and outlets to provide single phase branch circuits for power and lighting.

1.05 TEMPORARY LIGHTING FOR CONSTRUCTION PURPOSES

A. Provide and maintain LED, compact fluorescent, or high-intensity discharge lighting as suitable for the application for construction operations in accordance with requirements of 29 CFR 1926 and authorities having jurisdiction.

B. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps as required.

C. Maintain lighting and provide routine repairs.

1.06 TEMPORARY HEATING

A. Cost of Energy: By Contractor.

B. Provide heating devices and heat as needed to maintain specified conditions for construction operations.

1.07 TEMPORARY COOLING

A. Cost of Energy: By Contractor.

B. Provide cooling devices and cooling as needed to maintain specified conditions for construction operations.

C. Maintain maximum ambient temperature of 80 degrees F in areas where construction is in progress, unless indicated otherwise in specifications.

1.08 TEMPORARY VENTILATION

1.09 TEMPORARY WATER SERVICE

A. Cost of Water Used: By Contractor.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 5213
FIELD OFFICES AND SHEDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Temporary field offices for use of Contractor.

B. Maintenance and removal.

1.02 RELATED REQUIREMENTS

A. Section 01 5000 - Temporary Facilities and Controls:

1.03 USE OF EXISTING FACILITIES

A. Designated existing spaces may be used for field offices only with specific approval from the owner: _____.

PART 2 PRODUCTS

2.01 MATERIALS, EQUIPMENT, FURNISHINGS

A. Materials, Equipment, Furnishings: Serviceable, new or used, adequate for required purpose.

2.02 CONSTRUCTION

A. Portable or mobile buildings, or buildings constructed with floors raised above ground, securely fixed to foundations, with steps and landings at entrance doors.

2.03 ENVIRONMENTAL CONTROL

A. Heating, Cooling, and Ventilating: Automatic equipment to maintain comfort conditions.

2.04 CONTRACTOR OFFICE AND FACILITIES

A. Size: For Contractor's needs and to provide space for project meetings.

B. Furnishings in Meeting Area: Conference table and chairs to seat at least eight persons; racks and files for Contract Documents, submittals, and project record documents.

C. Equipment: Six adjustable band protective helmets for visitors, one 10 inch outdoor weather thermometer and other necessary protective gear for visitors. Contractor to coordinate requirements with the Owner..

PART 3 EXECUTION

3.01 PREPARATION

A. Fill and grade sites for temporary structures to provide drainage away from buildings.

3.02 INSTALLATION

A. Install office spaces ready for occupancy 15 days after date fixed in Notice to Proceed.

3.03 MAINTENANCE AND CLEANING

A. Weekly janitorial services for separate offices; periodic cleaning and maintenance for separate offices.

B. Daily cleaning and maintenance if existing Owner facilities are used.

C. Maintain approach walks free of mud, water, and snow.

3.04 REMOVAL

A. At completion of Work remove buildings, foundations, utility services, and debris. Restore areas.

END OF SECTION

SECTION 01 5500
VEHICULAR ACCESS AND PARKING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Access roads.

B. Parking.

C. Existing pavements and parking areas.

D. Permanent pavements and parking facilities.

E. Haul routes.

F. Maintenance.

G. Removal, repair.

H. Mud from site vehicles.

1.02 RELATED REQUIREMENTS

A. Section 01 5813 - Temporary Project Signage: Post Mounted and Wall Mounted Traffic Control and Informational Signs.

PART 2 PRODUCTS

PART 3 EXECUTION

3.01 PREPARATION

A. Clear areas, provide surface and storm drainage of road, parking, area premises, and adjacent areas.

3.02 ACCESS ROADS

A. Use of existing on-site streets and driveways for construction traffic is permitted.

B. Extend and relocate as work progress requires, provide detours as necessary for unimpeded traffic flow.

C. Location as approved by Owner.

D. Provide unimpeded access for emergency vehicles. Maintain 20 foot width driveways with turning space between and around combustible materials.

E. Provide and maintain access to fire hydrants free of obstructions.

3.03 PARKING

A. Use of designated areas of new parking facilities by construction personnel is permitted upon approval by Owner.

B. Arrange for temporary parking areas to accommodate use of construction personnel.

C. When site space is not adequate, provide additional off-site parking.

D. Locate as approved by Owner.

3.04 PERMANENT PAVEMENTS AND PARKING FACILITIES

A. Avoid traffic loading beyond paving design capacity. Tracked vehicles not allowed.

3.05 HAUL ROUTES

A. Confine construction traffic to designated haul routes.

B. Provide traffic control at critical areas of haul routes to regulate traffic, to minimize interference with public traffic.

3.06 MAINTENANCE

A. Maintain traffic and parking areas in a sound condition free of excavated material, construction equipment, products, mud, snow, and ice.

B. Maintain existing paved areas used for construction; promptly repair breaks, potholes, low areas, standing water, and other deficiencies, to maintain paving and drainage in original, or specified, condition.

3.07 REMOVAL, REPAIR

A. Remove temporary roads when permanent paving is usable.

B. Repair existing facilities damaged by use, to original condition.

C. Remove equipment and devices when no longer required.

D. Repair damage caused by installation.

3.08 MUD FROM SITE VEHICLES

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

END OF SECTION

SECTION 01 5713

TEMPORARY EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Prevention of erosion due to construction activities.

B. Prevention of sedimentation of waterways, open drainage ways, and storm and sanitary sewers due to construction activities.

C. Restoration of areas eroded due to insufficient preventive measures.

D. Performance bond.

E. Compensation of Owner for fines levied by authorities having jurisdiction due to non-compliance by Contractor.

1.02 RELATED REQUIREMENTS

A. Section 31 2200 - Grading: Temporary and permanent grade changes for erosion control.

B. Section 32 9223 - Sodding: Permanent turf for erosion control.

1.03 REFERENCE STANDARDS

A. ASTM D4355/D4355M - Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture, and Heat in a Xenon Arc-Type Apparatus; 2021.

B. ASTM D4491/D4491M - Standard Test Methods for Water Permeability of Geotextiles by Permittivity; 2021.

C. ASTM D4533/D4533M - Standard Test Method for Trapezoid Tearing Strength of Geotextiles; 2015.

D. ASTM D4632/D4632M - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles; 2015a.

E. ASTM D4751 - Standard Test Methods for Determining Apparent Opening Size of a Geotextile; 2021a.

F. ASTM D4873/D4873M - Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples; 2017 (Reapproved 2021).

G. EPA (NPDES) - National Pollutant Discharge Elimination System (NPDES), Construction General Permit; Current Edition.

H. FHWA FLP-94-005 - Best Management Practices for Erosion and Sediment Control; 1995.

I. USDA TR-55 - Urban Hydrology for Small Watersheds; USDA Natural Resources Conservation Service; 2015.

1.04 PERFORMANCE REQUIREMENTS

A. Comply with requirements of EPA (NPDES) for erosion and sedimentation control, as specified by the NPDES, for Phases I and II, and in compliance with requirements of Construction General Permit (CGP), whether the project is required by law to comply or not.

B. Also comply with all more stringent requirements of State of Tennessee Erosion and Sedimentation Control Manual.

C. Best Management Practices Standard: FHWA FLP-94-005.

D. Develop and follow an Erosion and Sedimentation Prevention Plan and submit periodic inspection reports.

E. Do not begin clearing, grading, or other work involving disturbance of ground surface cover until applicable permits have been obtained; furnish all documentation required to obtain applicable permits.

F. Provide to Owner a Performance Bond covering erosion and sedimentation preventive measures only, in an amount equal to 100 percent of the cost of erosion and sedimentation control work.

G. Timing: Put preventive measures in place as soon as possible after disturbance of surface cover and before precipitation occurs.

H. Storm Water Runoff: Control increased storm water runoff due to disturbance of surface cover due to construction activities for this project.
   1. Prevent runoff into storm and sanitary sewer systems, including open drainage channels, in excess of actual capacity or amount allowed by authorities having jurisdiction, whichever is less.
   2. Anticipate runoff volume due to the most extreme short term and 24-hour rainfall events that might occur in 25 years.

I. Erosion On Site: Minimize wind, water, and vehicular erosion of soil on project site due to construction activities for this project.
   1. Control movement of sediment and soil from temporary stockpiles of soil.
   2. Prevent development of ruts due to equipment and vehicular traffic.
   3. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.

J. Erosion Off Site: Prevent erosion of soil and deposition of sediment on other properties caused by water leaving the project site due to construction activities for this project.
   1. Prevent windblown soil from leaving the project site.
   2. Prevent tracking of mud onto public roads outside site.
   3. Prevent mud and sediment from flowing onto sidewalks and pavements.
   4. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.

K. Sedimentation of Waterways On Site: Prevent sedimentation of waterways on the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.
   1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.
   2. If sediment basins are used as temporary preventive measures, pump dry and remove deposited sediment after each storm.

L. Sedimentation of Waterways Off Site: Prevent sedimentation of waterways off the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.
   1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.

M. Open Water: Prevent standing water that could become stagnant.

N. Maintenance: Maintain temporary preventive measures until permanent measures have been established.

1.05 SUBMITTALS

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

B. Erosion and Sedimentation Control Plan:
   1. Include:
      a. Site plan identifying soils and vegetation, existing erosion problems, and areas vulnerable to erosion due to topography, soils, vegetation, or drainage.
      b. Site plan showing grading; new improvements; temporary roads, traffic accesses, and other temporary construction; and proposed preventive measures.

c. Where extensive areas of soil will be disturbed, include storm water flow and volume calculations, soil loss predictions, and proposed preventive measures.
d. Schedule of temporary preventive measures, in relation to ground disturbing activities.
2. Obtain the approval of the Plan by authorities having jurisdiction.
3. Obtain the approval of the Plan by Owner.

C. Certificate: Mill certificate for silt fence fabric attesting that fabric and factory seams comply with specified requirements, signed by legally authorized official of manufacturer; indicate actual minimum average roll values; identify fabric by roll identification numbers.

D. Inspection Reports: Submit report of each inspection; identify each preventive measure, indicate condition, and specify maintenance or repair required and accomplished.

PART 2 PRODUCTS

2.01 MATERIALS

A. Grass Seed For Temporary Cover: Select a species appropriate to climate, planting season, and intended purpose. If same area will later be planted with permanent vegetation, do not use species known to be excessively competitive or prone to volunteer in subsequent seasons.

B. Silt Fence Fabric: Polypropylene geotextile resistant to common soil chemicals, mildew, and insects; non-biodegradable; in longest lengths possible; fabric including seams with the following minimum average roll lengths:
1. Average Opening Size: 30 U.S. Std. Sieve, maximum, when tested in accordance with ASTM D4751.
2. Permittivity: 0.05 sec^-1, minimum, when tested in accordance with ASTM D4491/D4491M.
3. Ultraviolet Resistance: Retaining at least 70 percent of tensile strength, when tested in accordance with ASTM D4355/D4355M after 500 hours exposure.
4. Tensile Strength: 100 pounds-force, minimum, in cross-machine direction; 124 pounds-force, minimum, in machine direction; when tested in accordance with ASTM D4632/D4632M.
5. Elongation: 15 to 30 percent, when tested in accordance with ASTM D4632/D4632M.
6. Tear Strength: 55 pounds-force, minimum, when tested in accordance with ASTM D4533/D4533M.
7. Color: Manufacturer's standard, with embedment and fastener lines preprinted.

C. Silt Fence Posts: One of the following, minimum 5 feet long:
1. Steel U- or T-section, with minimum mass of 1.33 pound per linear foot.
2. Softwood, 4 by 4 inches in cross section.
3. Hardwood, 2 by 2 inches in cross section.

D. Concrete Blocks
1. 8-inch hollow CMU wrapped in silt fence fabric.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine site and identify existing features that contribute to erosion resistance; maintain such existing features to greatest extent possible.

3.02 PREPARATION

A. Schedule work so that soil surfaces are left exposed for the minimum amount of time.

3.03 SCOPE OF PREVENTIVE MEASURES

A. In all cases, if permanent erosion resistant measures have been installed temporary preventive measures are not required.

B. Linear Sediment Barriers: Made of silt fences.
1. Provide linear sediment barriers:
a. Along downhill perimeter edge of disturbed areas, including soil stockpiles.

b. Along the top of the slope or top bank of drainage channels and swales that traverse disturbed areas.
c. Along the toe of cut slopes and fill slopes.
d. Perpendicular to flow across the bottom of existing and new drainage channels and swales that traverse disturbed areas or carry runoff from disturbed areas; space at maximum of 200 feet apart.
e. Across the entrances to culverts that receive runoff from disturbed areas.

2. Space sediment barriers with the following maximum slope length upslope from barrier:
   a. Slope of Less Than 2 Percent: 100 feet..
   b. Slope Between 2 and 5 Percent: 75 feet.
   c. Slope Between 5 and 10 Percent: 50 feet.
   d. Slope Between 10 and 20 Percent: 25 feet.
   e. Slope Over 20 Percent: 15 feet.

C. Storm Drain Curb Inlet Sediment Trap: Protect each curb inlet using one of the following measures:
   1. Filter fabric wrapped around hollow concrete blocks blocking entire inlet face area; use one piece of fabric wrapped at least 1-1/2 times around concrete blocks and secured to prevent dislodging; orient cores of blocks so runoff passes into inlet.
   2. Straw bale row blocking entire inlet face area; anchor into pavement.

D. Storm Drain Drop Inlet Sediment Traps: As detailed on drawings.

E. Soil Stockpiles: Protect using one of the following measures:
   1. Cover with polyethylene film, secured by placing soil on outer edges.
   2. Cover with mulch at least 4 inches thickness of pine needles, sawdust, bark, wood chips, or shredded leaves, or 6 inches of straw or hay.

F. Temporary Seeding: Use where temporary vegetated cover is required.

3.04 INSTALLATION

A. Silt Fences:
   1. Store and handle fabric in accordance with ASTM D4873/D4873M.
   2. Where slope gradient is less than 3:1 or barriers will be in place less than 6 months, use nominal 16 inch high barriers with minimum 36 inch long posts spaced at 6 feet maximum, with fabric embedded at least 4 inches in ground.
   3. Where slope gradient is steeper than 3:1 or barriers will be in place over 6 months, use nominal 28 inch high barriers, minimum 48 inch long posts spaced at 6 feet maximum, with fabric embedded at least 6 inches in ground.
   4. Where slope gradient is steeper than 3:1 and vertical height of slope between barriers is more than 20 feet, use nominal 32 inch high barriers with woven wire reinforcement and steel posts spaced at 4 feet maximum, with fabric embedded at least 6 inches in ground.
   5. Install with top of fabric at nominal height and embedment as specified.
   6. Do not splice fabric width; minimize splices in fabric length; splice at post only, overlapping at least 18 inches, with extra post.
   7. Fasten fabric to wood posts using one of the following:
      a. Four nails per post with 3/4 inch diameter flat or button head, 1 inch long, and 14 gauge, 0.083 inch shank diameter.
      b. Five staples per post with at least 17 gauge, 0.0453 inch wire, 3/4 inch crown width and 1/2 inch long legs.
   8. Fasten fabric to steel posts using wire, nylon cord, or integral pockets.
   9. Wherever runoff will flow around end of barrier or over the top, provide temporary splash pad or other outlet protection; at such outlets in the run of the barrier, make barrier not more than 12 inches high with post spacing not more than 4 feet.

B. Temporary Seeding:
   1. When hydraulic seeder is used, seedbed preparation is not required.

2. When surface soil has been sealed by rainfall or consists of smooth undisturbed cut slopes, and conventional or manual seeding is to be used, prepare seedbed by scarifying sufficiently to allow seed to lodge and germinate.
3. If temporary mulching was used on planting area but not removed, apply nitrogen fertilizer at 1 pound per 1000 sq ft.
4. On soils of very low fertility, apply 10-10-10 fertilizer at rate of 12 to 16 pounds per 1000 sq ft.
5. Incorporate fertilizer into soil before seeding.
6. Apply seed uniformly; if using drill or cultipacker seeders place seed 1/2 to 1 inch deep.
7. Irrigate as required to thoroughly wet soil to depth that will ensure germination, without causing runoff or erosion.
8. Repeat irrigation as required until grass is established.

3.05 MAINTENANCE

A. Inspect preventive measures weekly, within 24 hours after the end of any storm that produces 0.5 inches or more rainfall at the project site, and daily during prolonged rainfall.

B. Repair deficiencies immediately.

C. Silt Fences:
1. Promptly replace fabric that deteriorates unless need for fence has passed.
2. Remove silt deposits that exceed one-third of the height of the fence.
3. Repair fences that are undercut by runoff or otherwise damaged, whether by runoff or other causes.

D. Clean out temporary sediment control structures weekly and relocate soil on site.

E. Place sediment in appropriate locations on site; do not remove from site.

3.06 CLEAN UP

A. Remove temporary measures after permanent measures have been installed, unless permitted to remain by Architect.

B. Clean out temporary sediment control structures that are to remain as permanent measures.

C. Where removal of temporary measures would leave exposed soil, shape surface to an acceptable grade and finish to match adjacent ground surfaces.

END OF SECTION

SECTION 01 5813
TEMPORARY PROJECT SIGNAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Project informational signs.

1.02 QUALITY ASSURANCE

A. Design sign and structure to withstand 50 miles/hr wind velocity.

PART 2 PRODUCTS

2.01 SIGN MATERIALS

A. Structure and Framing: New, wood, structurally adequate.

B. Sign Surfaces: Exterior grade plywood with medium density overlay, minimum 3/4 inch thick, standard large sizes to minimize joints.

C. Rough Hardware: Galvanized.

D. Lettering: Exterior quality paint, contrasting colors.

2.02 PROJECT INFORMATIONAL SIGNS

A. Painted informational signs, standard products; size lettering to provide legibility at 100 foot distance.

B. Provide at each field office, storage shed, and directional signs to direct traffic into and within site. Relocate as Work progress requires.

C. Provide signage clearly denoting areas of Construction from the general public access.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install project identification sign within 30 days after date fixed by Notice to Proceed.

B. Install sign surface plumb and level, with butt joints. Anchor securely.

3.02 MAINTENANCE

A. Maintain signs and supports clean, repair deterioration and damage.

3.03 REMOVAL

A. Remove signs, framing, supports, and foundations at completion of Project and restore the area.

END OF SECTION

SECTION 01 6000
PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General product requirements.

B. Re-use of existing products.

C. Transportation, handling, storage and protection.

D. Product option requirements.

E. Substitution limitations.

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

1.02 RELATED REQUIREMENTS

A. Section 01 2500 - Substitution Procedures: Substitutions made during procurement and/or construction phases.

B. Section 01 4000 - Quality Requirements: Product quality monitoring.

C. Section 01 7419 - 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 EXISTING PRODUCTS

A. Do not use materials and equipment removed from existing premises unless specifically required or permitted by Contract Documents.

B. Unforeseen historic items encountered remain the property of the Owner; notify Owner promptly upon discovery; protect, remove, handle, and store as directed by Owner.

2.02 NEW PRODUCTS

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

B. See Section 01 4000 - Quality Requirements, for additional source quality control requirements.

C. Use of products having any of the following characteristics is not permitted:
   1. Made of wood from newly cut old growth timber.
   2. Containing lead, cadmium, or asbestos.

D. Where other criteria are met, Contractor shall give preference to products that:
   1. If used on interior, have lower emissions, as defined in Section 01 6116.
   2. If wet-applied, have lower VOC content, as defined in Section 01 6116.
   3. Are extracted, harvested, and/or manufactured closer to the location of the project.
   4. Made inside the United State, or its territories

2.03 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.

B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.

C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

2.04 MAINTENANCE MATERIALS

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

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

PART 3 EXECUTION

3.01 SUBSTITUTION LIMITATIONS

A. See Section 01 2500 - 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 01 7419.

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. Store in a location and a manner that is reasonably separated from the general public.

L. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION

SECTION 01 7000
EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Examination, preparation, and general installation procedures.

B. Requirements for alterations work, including selective demolition.

C. Cutting and patching.

D. Cleaning and protection.

E. Starting of systems and equipment.

F. Demonstration and instruction of Owner personnel.

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

H. General requirements for maintenance service.

1.02 RELATED REQUIREMENTS

A. Section 01 3000 - Administrative Requirements: Submittals procedures, Electronic document submittal service.

B. Section 01 4000 - Quality Requirements: Testing and inspection procedures.

C. Section 01 5000 - Temporary Facilities and Controls: Temporary exterior enclosures.

D. Section 01 5000 - Temporary Facilities and Controls: Temporary interior partitions.

E. Section 01 5100 - Temporary Utilities: Temporary heating, cooling, and ventilating facilities.

F. Section 01 7419 - Construction Waste Management and Disposal: Additional procedures for trash/waste removal, recycling, salvage, and reuse.

G. Section 01 7800 - Closeout Submittals: Project record documents, operation and maintenance data, warranties, and bonds.

H. Section 07 8400 - Firestopping.

1.03 REFERENCE STANDARDS

A. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2022.

1.04 SUBMITTALS

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

B. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:
   1. Structural integrity of any element of Project.
   2. Integrity of weather exposed or moisture resistant element.
   3. Efficiency, maintenance, or safety of any operational element.
   4. Visual qualities of sight exposed elements.
   5. Work of Owner or separate Contractor.
   6. Include in request:
      a. Identification of Project.
      b. Location and description of affected work.
      c. Necessity for cutting or alteration.
      d. Description of proposed work and products to be used.
      e. Effect on work of Owner or separate Contractor.
      f. Written permission of affected separate Contractor.
      g. Date and time work will be executed.

C. Project Record Documents: Accurately record actual locations of capped and active utilities.

1.05 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,

B. For field engineering, employ a professional engineer of the discipline required for specific service on Project, licensed in the State in which the Project is located. Employ only individual(s) trained and experienced in establishing and maintaining horizontal and vertical control points necessary for laying out construction work on project of similar size, scope and/or complexity.

C. For design of temporary shoring and bracing, employ a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

1.06 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. Perform dewatering activities, as required, for the duration of the project.

D. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

E. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.
   1. Outdoors: Limit conduct of especially noisy exterior work to hour required by the City of Stockbridge.

F. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations. Comply with federal, state, and local regulations.

1.07 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 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.

B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.

C. Examine and verify specific conditions described in individual specification sections.

D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.

E. Verify that utility services are available, of the correct characteristics, and in the correct locations.

F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

3.02 PREPARATION

A. Clean substrate surfaces prior to applying next material or substance.

B. Seal cracks or openings of substrate prior to applying next material or substance.

C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.03 LAYING OUT THE WORK

A. Promptly notify Architect of any discrepancies discovered.

B. 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.

C. Periodically verify layouts by same means.

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

3.04 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.

3.05 ALTERATIONS

A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
   1. Verify that construction and utility arrangements are as indicated.
   2. Report discrepancies to Architect before disturbing existing installation.
   3. Beginning of alterations work constitutes acceptance of existing conditions.

B. Remove existing work as indicated and as required to accomplish new work.
   1. Remove items indicated on drawings.
   2. Relocate items indicated on drawings.
   3. Where new surface finishes are to be applied to existing work, perform removals, patch, and prepare existing surfaces as required to receive new finish; remove existing finish if necessary for successful application of new finish.
   4. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces as closely as possible.

C. Services (Including but not limited to HVAC and Electrical): Remove, relocate, and extend existing systems to accommodate new construction.
   1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components; if necessary, modify installation to allow access or provide access panel.
   2. Where existing systems or equipment are not active and Contract Documents require reactivation, put back into operational condition; repair supply, distribution, and equipment as required.
   3. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
      a. Disable existing systems only to make switchovers and connections; minimize duration of outages.
      b. Provide temporary connections as required to maintain existing systems in service.
   4. Verify that abandoned services serve only abandoned facilities.
   5. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification; patch holes left by removal using materials specified for new construction.

D. Protect existing work to remain.
   1. Prevent movement of structure; provide shoring and bracing if necessary.
   2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
   3. Repair adjacent construction and finishes damaged during removal work.

E. Adapt existing work to fit new work: Make as neat and smooth transition as possible.

F. Patching: Where the existing surface is not indicated to be refinished, patch to match the surface finish that existed prior to cutting. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.

G. Refinish existing surfaces as indicated:
   1. Where rooms or spaces are indicated to be refinished, refinish all visible existing surfaces to remain to the specified condition for each material, with a neat transition to adjacent finishes.
   2. If mechanical or electrical work is exposed accidentally during the work, re-cover and refinish to match.

H. Clean existing systems and equipment.

I. Remove demolition debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.

J. Do not begin new construction in alterations areas before demolition is complete.

K. Comply with all other applicable requirements of this section.

3.06 CUTTING AND PATCHING

A. Whenever possible, execute the work by methods that avoid cutting or patching.

B. See Alterations article above for additional requirements.

C. Perform whatever cutting and patching is necessary to:
   1. Complete the work.
   2. Fit products together to integrate with other work.
   3. Provide openings for penetration of mechanical, electrical, and other services.
   4. Match work that has been cut to adjacent work.
   5. Repair areas adjacent to cuts to required condition.
   6. Repair new work damaged by subsequent work.
   7. Remove samples of installed work for testing when requested.
   8. Remove and replace defective and non-complying work.

D. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.

E. Employ original installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.

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

G. Restore work with new products in accordance with requirements of Contract Documents.

H. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

I. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 07 8400, to full thickness of the penetrated element.

J. Patching:
   1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
   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 SYSTEM STARTUP

A. Coordinate schedule for start-up of various equipment and systems.

B. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.

C. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.

D. Verify that wiring and support components for equipment are complete and tested.

E. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.

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

3.10 DEMONSTRATION AND INSTRUCTION

A. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at scheduled time, at equipment location.

B. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

C. Provide a qualified person who is knowledgeable about the Project to perform demonstration and instruction of Owner's personnel.

3.11 ADJUSTING

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

3.12 FINAL CLEANING

A. Use cleaning materials that are nonhazardous.

B. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.

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

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

E. Clean filters of operating equipment.

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

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

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

3.13 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. Owner will occupy all of the building as specified in Section 01 1000.

F. 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.

G. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.

H. Notify Architect when work is considered finally complete and ready for Architect's Substantial Completion final inspection.

I. Complete items of work determined by Architect listed in executed Certificate of Substantial Completion.

3.14 MAINTENANCE

A. Provide service and maintenance of components indicated in specification sections.

B. Maintenance Period: As indicated in specification sections or, if not indicated, not less than one year from the Date of Substantial Completion or the length of the specified warranty, whichever is longer.

C. Examine system components at a frequency consistent with reliable operation. Clean, adjust, and lubricate as required.

D. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.

E. Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of the Owner.

END OF SECTION

SECTION 01 7419

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. Owner may decide to pay for additional recycling, salvage, and/or reuse based on Landfill Alternatives Proposal specified below.

E. Required Recycling, Salvage, and Reuse: The following may not be disposed of in landfills or by incineration:
   1. Aluminum and plastic beverage containers.
   2. Corrugated cardboard.
   3. Wood pallets.
   4. Clean dimensional wood.
   5. Land clearing debris, including brush, branches, logs, and stumps; see Section 31 1000 - Site Clearing for use options.
   6. Metals, including packaging banding, metal studs, sheet metal, structural steel, piping, reinforcing bars, door frames, and other items made of steel, iron, galvanized steel, stainless steel, aluminum, copper, zinc, lead, brass, and bronze.
   7. Glass.
   8. Plastic buckets.
   9. Paint.
   10. Plastic sheeting.

F. Contractor shall submit periodic Waste Disposal Reports; all landfill disposal, incineration, recycling, salvage, and reuse must be reported regardless of to whom the cost or savings accrues; use the same units of measure on all reports.

G. Contractor shall develop and follow a Waste Management Plan designed to implement these requirements.

H. 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.

I. 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 01 3000 - Administrative Requirements: Additional requirements for project meetings, reports, submittal procedures, and project documentation.

B. Section 01 5000 - Temporary Facilities and Controls: Additional requirements related to trash/waste collection and removal facilities and services.

C. Section 01 6000 - Product Requirements: Waste prevention requirements related to delivery, storage, and handling.

D. Section 01 7000 - Execution and Closeout Requirements: Trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.

E. Section 31 1000 - 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 01 3000 - Administrative Requirements, for submittal procedures.

B. Landfill Alternatives Proposal: Within 10 calendar days after receipt of Notice of Award of Bid, or prior to any trash or waste removal, whichever occurs sooner, submit a projection of trash/waste that will require disposal and alternatives to landfilling, with net costs.
   1. Submit to Architect for Owner's review and approval.
   2. If Owner wishes to implement any cost alternatives, the Contract Sum will be adjusted as specified elsewhere.
   3. Include an analysis of trash/waste to be generated and landfill options as specified for Waste Management Plan described below.
   4. Describe as many alternatives to landfilling as possible:
      a. List each material proposed to be salvaged, reused, or recycled.
      b. List the proposed local market for each material.
      c. State the estimated net cost resulting from each alternative, after subtracting revenue from sale of recycled or salvaged materials and landfill tipping fees saved due to diversion of materials from the landfill.

C. Once Owner has determined which of the landfill alternatives addressed in the Proposal above are acceptable, prepare and submit Waste Management Plan; submit within 10 calendar days after notification by Architect.

D. 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.

E. 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, 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, 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, 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.
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

2.01 PRODUCT SUBSTITUTIONS

A. See Section 01 6000 - Product Requirements for substitution submission procedures.

B. For each proposed product substitution, submit the following information in addition to requirements specified in Section 01 6000:
1. Relative amount of waste produced, compared to specified product.
2. Cost savings on waste disposal, compared to specified product, to be deducted from the Contract Sum.
3. Proposed disposal method for waste product.
4. Markets for recycled waste product.

PART 3 EXECUTION

3.01 WASTE MANAGEMENT PROCEDURES

A. See Section 01 3000 for additional requirements for project meetings, reports, submittal procedures, and project documentation.

B. See Section 01 5000 for additional requirements related to trash/waste collection and removal facilities and services.

C. See Section 01 6000 for waste prevention requirements related to delivery, storage, and handling.

D. See Section 01 7000 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 01 7800
CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Project record documents.

B. Operation and maintenance data.

C. Warranties and bonds.

1.02 RELATED REQUIREMENTS

A. Section 01 3000 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.

B. Section 01 7000 - Execution and Closeout Requirements: Contract closeout procedures.

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

D. 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. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Architect will review draft and return one copy with comments.
   2. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
   3. Submit one copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Architect comments. Revise content of all document sets as required prior to final submission.
   4. Submit two sets of revised final documents in final form within 10 days after final inspection.

C. Warranties and Bonds:
   1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
   2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
   3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to the Work:
   1. Drawings.
   2. Specifications.
   3. Addenda.
   4. Change Orders and other modifications to the Contract.
   5. Reviewed shop drawings, product data, and samples.
   6. Manufacturer's instruction for assembly, installation, and adjusting.

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. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
   1. Manufacturer's name and product model and number.
   2. Product substitutions or alternates utilized.
   3. Changes made by Addenda and modifications.

F. Record Drawings and Shop 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. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
   4. Field changes of dimension and detail.
   5. Details not on original Contract drawings.

3.02 OPERATION AND MAINTENANCE DATA

A. Source Data: For each product or system, list names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.

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

C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.

D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.03 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

A. For Each Product, Applied Material, and Finish:
   1. Product data, with catalog number, size, composition, and color and texture designations.
   2. Information for re-ordering custom manufactured products.

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.

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 original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

I. Additional Requirements: As specified in individual product specification sections.

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 three D side ring binders with durable plastic covers; 2 inch 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

SECTION 02 4100
DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Selective demolition of built site elements.

B. Selective demolition of building elements for alteration purposes.

1.02 RELATED REQUIREMENTS

A. Section 01 1000 - Summary: Limitations on Contractor's use of site and premises.

B. Section 01 5000 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.

C. Section 01 5713 - Temporary Erosion and Sediment Control.

D. Section 01 7000 - Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring.

E. Section 01 7419 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.

F. Section 02 6500 - Underground Storage Tank Removal.

G. Section 31 1000 - Site Clearing: Vegetation and existing debris removal.

H. Section 31 2200 - Grading: Topsoil removal.

I. Section 31 2200 - Grading: Fill material for filling holes, pits, and excavations generated as a result of removal operations.

J. Section 31 2323 - Fill: Fill material for filling holes, pits, and excavations generated as a result of removal operations.

K. Section 32 9300 - Plants: Pruning of existing trees and shrubs to remain.

1.03 REFERENCE STANDARDS

A. 29 CFR 1926 - Safety and Health Regulations for Construction; Current Edition.

B. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2022.

1.04 DEFINITIONS

A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.

B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.

C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.

D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.05 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones andtheir contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.06 PREDEMOLITON MEETINGS

A. Pre-demolition Conference: Conduct conference at Project site.
   1. Inspect and discuss condition of construction to be selectively demolished.
   2. Review structural load limitations of existing structure.
   3. Review and finalize selective demolition schedule and verify availability of materials,
   4. demolition personnel, equipment, and facilities needed to make progress and avoid delays.
   5. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
   6. Review areas where existing construction is to remain and requires protection.

1.07 SUBMITTALS

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

B. Site Plan: Showing:
   1. Areas for temporary construction and field offices.

C. Informational Submittals
   1. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property. Indicate proposed locations and construction of barriers.
   2. Schedule of Selective Demolition Activities: Indicate the following:
      a. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
      b. Interruption of utility services. Indicate how long utility services will be interrupted.
      c. Coordination for shutoff, capping, and continuation of utility services.
      d. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
   3. Pre-demolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, which might be misconstrued as damage caused by demolition operations.
   4. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

D. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

1.08 FIELD CONDITIONS

A. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

B. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

C. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
   1. Hazardous materials will be removed by Owner before start of the Work.
   2. If suspected hazardous materials are encountered, do not disturb; immediately notify Landscape Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

D. Storage or sale of removed items or materials on-site is not permitted.

E. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
   1. Maintain fire-protection facilities in service during selective demolition operations.

1.09 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties. Notify warrantor before proceeding.

1.10 COORDINATION

A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

1.11 QUALITY ASSURANCE

A. Demolition Firm Qualifications: Company specializing in the type of work required.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ASSE A10.6 and NFPA 241.

PART 3 EXECUTION

3.01 SCOPE

A. Remove paving and curbs as required to accomplish new work.

B. Remove all other paving and curbs as indicated on drawings.

C. Remove concrete slabs on grade as indicated on drawings.

D. Remove underground tanks.

E. Remove portions of existing buildings indicated in the Construction Documents.

F. Fill excavations, open pits, and holes in ground areas generated as result of work, or indicated in the drawings, as required so that required rough grade elevations do not subside within one year after completion.

3.02 GENERAL PROCEDURES AND PROJECT CONDITIONS

A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
   1. Obtain required permits.
   2. Comply with applicable requirements of NFPA 241.
   3. Use of explosives is not permitted.
   4. Provide, erect, and maintain temporary barriers and security devices.
   5. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
      a. Remove temporary barricades and protections where hazards no longer exist.
   6. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
   7. Do not close or obstruct roadways or sidewalks without permit.
   8. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
   9. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.

B. Do not begin removal until receipt of notification to proceed from Owner.

C. Do not begin removal until built elements to be salvaged or relocated have been removed.

D. Do not begin removal until vegetation to be relocated has been removed and specified measures have been taken to protect vegetation to remain.

E. Protect existing structures and other elements that are not to be removed.
   1. Provide bracing and shoring if necessary.
   2. Prevent movement or settlement of adjacent structures.
   3. Stop work immediately if adjacent structures appear to be in danger.

F. Minimize production of dust due to demolition operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

G. If hazardous materials are discovered during removal operations, stop work and notify Architect and Owner; hazardous materials include regulated asbestos containing materials, lead, PCB's, and mercury.

H. Perform demolition in a manner that maximizes salvage and recycling of materials.
   1. Comply with requirements of Section 01 7419 - Waste Management.
   2. Dismantle existing construction and separate materials.
   3. Set aside reusable, recyclable, and salvageable materials; store and deliver to collection point or point of reuse.

I. Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
   1. Proceed with selective demolition systematically.
   2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
   3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
   4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
   5. Maintain fire watch during and for at least 3 hours after flame-cutting operations.
   6. Maintain adequate ventilation when using cutting torches.
   7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
   8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
   9. Dispose of demolished items and materials promptly.

J. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

K. Removed and Salvaged Items:
   1. Clean salvaged items.
   2. Pack or crate items after cleaning. Identify contents of containers.
   3. Store items in a secure area until delivery to Owner.
   4. Transport items to Owner's storage area on-site.
   5. Protect items from damage during transport and storage.

L. Removed and Reinstalled Items: Clean and repair items to functional condition adequate for intended reuse.
   1. Pack or crate items after cleaning and repairing. Identify contents of containers.
   2. Protect items from damage during transport and storage.
   3. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

M. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and reinstalled in their original locations after selective demolition operations are complete. Contractor shall be responsible for any damage, repairs, or replacement of items scheduled to remain that are damaged at an additional cost to the Owner.

N. Partial Removal of Paving and Curbs: Neatly saw cut at right angle to surface.

O. Underground Storage Tanks: Remove and dispose of as specified in Section 02 6500.

3.03 EXISTING UTILITIES

A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.

B. Protect existing utilities to remain from damage.

C. Do not disrupt public utilities without permit from authority having jurisdiction.

D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.

E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.

F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.

G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.

3.04 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.

B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.

C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.

D. Asphalt Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.

3.05 SELECTIVE DEMOLITION FOR ALTERATIONS

A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
   1. Verify that construction and utility arrangements are as indicated.
   2. Report discrepancies to Architect before disturbing existing installation.
   3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.

B. Separate areas in which demolition is being conducted from other areas that are still occupied.
   1. Provide, erect, and maintain temporary dustproof partitions of construction. indicated on drawings .

C. Remove existing work as indicated and as required to accomplish new work.
   1. Remove rotted wood, corroded metals, and deteriorated masonry and concrete; replace with new construction specified.
   2. Remove items indicated on drawings.

D. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove existing systems and equipment as indicated.
   1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.
   2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
   3. Verify that abandoned services serve only abandoned facilities before removal.

4. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification.

E. Protect existing work to remain.
1. Prevent movement of structure; provide shoring and bracing if necessary.
2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
3. Repair adjacent construction and finishes damaged during removal work.
4. Patch as specified for patching new work.

3.06 DEBRIS AND WASTE REMOVAL

A. Remove debris, junk, and trash from site.

B. Remove from site all materials not to be reused on site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction and recycle or dispose of them; comply with requirements of Section 01 7419 - Waste Management.
1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

C. Leave site in clean condition, ready for subsequent work.

D. Clean up spillage and wind-blown debris from public and private lands.

3.07 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began

END OF SECTION

SECTION 03 0100
MAINTENANCE OF CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Cleaning of existing concrete surfaces.

B. Repair of exposed structural, shrinkage, and settlement cracks.

C. Resurfacing of concrete surfaces having spalled areas and other damage.

D. Scope of Work: As indicated on drawings.

1.02 SUBMITTALS

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

1.03 QUALITY ASSURANCE

1.04 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturers' instructions for storage, shelf life limitations, and handling of products.

PART 2 PRODUCTS

2.01 CLEANING MATERIALS

A. Detergent: Non-ionic detergent.

2.02 CEMENTITIOUS PATCHING AND REPAIR MATERIALS

A. Manufacturers:
   1. Adhesives Technology Corporation: www.atcepoxy.com.
   2. Kaufman Products Inc: www.kaufmanproducts.net.
   3. SpecChem, LLC: www.specchemllc.com.
   4. Or equal approved by Architect.
   5. Substitutions: See Section 01 6000 - Product Requirements.

B. Bonding Slurry: Water-based latex admixture complying with ASTM C1059/C1059M, combined with Portland cement and sand in accordance with admixture manufacturer's instructions.

C. Cementitious Resurfacing Mortar: One- or two-component, factory-mixed, polymer-modified cementitious mortar designed for continuous thin-coat application.

D. Cementitious Repair Mortar, Trowel Grade: One- or two-component, factory-mixed, polymer-modified cementitious mortar.
   1. In-place material resistant to freeze/thaw conditions.

E. Exterior Self-Leveling Concrete Topping: Portland cement-based; suitable as wear surface topping in exterior and wet locations as well as underlayment for applied materials.
   1. Compressive Strength: 4300 pounds per square inch, minimum, at 28 days, when tested in accordance with ASTM C109/C109M, air cured.
   2. Flexural Strength: 1000 pounds per square inch, minimum, at 28 days, when tested in accordance with ASTM C348.

2.03 EPOXY PATCHING AND REPAIR MATERIALS

A. Manufacturers:
   1. Dayton Superior Corporation: www.daytonsuperior.com.
   2. Euclid Chemical Company: www.euclidchemical.com.
   3. SpecChem, LLC: www.specchemllc.com.
   4. Or equal approved by Architect.
   5. Substitutions: See Section 01 6000 - Product Requirements.

B. Epoxy Repair Mortar: Epoxy resin mixed with aggregate and other materials in accordance with manufacturer's instructions for purpose intended; comply with pot life and workability limits.

2.04 ACCESSORIES

A. Portland Cement: ASTM C150/C150M, Type I, grey.

B. Sand: ASTM C33/C33M or ASTM C404; uniformly graded, clean.

C. Water: Clean and potable.

D. Reinforcing Steel: ASTM A615/A615M Grade 40 (40,000 psi) billet-steel deformed bars, unfinished.

E. Stirrup Steel: ASTM A1064/A1064M.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive work.

B. Beginning of installation means acceptance of substrate.

3.02 PREPARATION

A. Prepare concrete surfaces to be repaired according to ICRI 310.2R.

3.03 CLEANING EXISTING CONCRETE

A. Provide enclosures, barricades, and other temporary construction as required to protect adjacent work from damage.

B. Clean concrete surfaces of dirt or other contamination using the gentlest method that is effective.
   1. Try the gentlest method first, then, if not clean enough, use a less gentle method taking care to watch for impending damage.
   2. Clean out cracks and voids using same methods.

C. The following are acceptable cleaning methods, in order from gentlest to less gentle:
   1. Water washing using low-pressure, maximum of 100 psi, and, if necessary, brushes with natural or synthetic bristles.
   2. Adding detergent to washing water; with final water rinse to remove residual detergent.

D. Do not use any of the following cleaning methods, unless otherwise indicated:
   1. Brushes with wire bristles, grinding with abrasives, solvents, hydrochloric or muriatic acid, sodium hydroxide, caustic soda, or lye.
   2. Soap or detergent that is not non-ionic.
   3. Water washing pressure to over 100 psi.

3.04 CRACK REPAIR USING EPOXY ADHESIVE INJECTION

A. Repair exposed cracks.

B. Provide temporary entry ports spaced to accomplish movement of fluids between ports; no deeper than the depth of the crack to be filled or port size diameter no greater than the thickness of the crack. Provide temporary seal at concrete surface to prevent leakage of adhesive.

C. Inject adhesive into ports under pressure using equipment appropriate for particular application.

D. Begin injection at lower entry port and continue until adhesive appears in adjacent entry port. Continue from port to port until entire crack is filled.

E. Remove temporary seal and excess adhesive.

F. Clean surfaces adjacent to repair and blend finish.

3.05 CONCRETE SURFACE REPAIR USING CEMENTITIOUS MATERIALS

A. Clean concrete surfaces, cracks, and joints of dirt, laitance, corrosion, and other contamination using method(s) specified above and allow to dry.

B. Apply coating of bonding agent to entire concrete surface to be repaired.

C. Fill voids with cementitious mortar flush with surface.

D. Apply repair mortar by steel trowel to a minimum thickness of 1/4 inch over entire surface, terminating at a vertical change in plane on all sides.

E. Trowel finish to match adjacent concrete surfaces.

END OF SECTION

SECTION 03 1000
CONCRETE FORMING AND ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Formwork for cast-in-place concrete, with shoring, bracing and anchorage.

B. Form accessories.

C. Form stripping.

1.02 RELATED REQUIREMENTS

A. Section 03 2000 - Concrete Reinforcing.

B. Section 03 3000 - Cast-in-Place Concrete.

1.03 REFERENCE STANDARDS

A. ACI 117 - Specifications for Tolerances for Concrete Construction and Materials; 2010 (Reapproved 2015).

B. ACI 301 - Specifications for Structural Concrete; 2016.

C. ACI 318 - Building Code Requirements for Structural Concrete; 2019, with Errata (2021).

D. ACI 347R - Guide to Formwork for Concrete; 2014, with Errata (2017).

E. PS 1 - Structural Plywood; 2009.

1.04 SUBMITTALS

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

B. Product Data: Provide data on void form materials and installation requirements.

1.05 QUALITY ASSURANCE

A. Designer Qualifications: Design formwork under direct supervision of a Professional Structural Engineer experienced in design of concrete formwork and licensed in the State in which the Project is located.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver prefabricated forms and installation instructions in manufacturer's packaging.

B. Store prefabricated forms off ground in ventilated and protected manner to prevent deterioration from moisture.

C. Protect plastic foam products from damage and exposure to sunlight.

PART 2 PRODUCTS

2.01 FORMWORK - GENERAL

A. Provide concrete forms, accessories, shoring, and bracing as required to accomplish cast-in-place concrete work.

B. Design and construct concrete that complies with design with respect to shape, lines, and dimensions.

C. Comply with applicable state and local codes with respect to design, fabrication, erection, and removal of formwork.

D. Comply with relevant portions of ACI 347R, ACI 301, and ACI 318.

2.02 WOOD FORM MATERIALS

A. Softwood Plywood: PS 1, B-B High Density Concrete Form Overlay, Class I.

2.03 REMOVABLE PREFABRICATED FORMS

A. Preformed Steel Forms: Minimum 16 gauge, 0.0598 inch thick, matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.

B. Preformed Plastic Forms: Thermoplastic polystyrene form liner, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.

C. Glass Fiber Fabric Reinforced Plastic Forms: Matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished concrete surfaces.

2.04 FORMWORK ACCESSORIES

A. Form Ties: Removable type, galvanized metal, fixed length, cone type, with waterproofing washer, free of defects that could leave holes larger than 1 inch in concrete surface.

B. Form Release Agent: Capable of releasing forms from hardened concrete without staining or discoloring concrete or forming bugholes and other surface defects, compatible with concrete and form materials, and not requiring removal for satisfactory bonding of coatings to be applied.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify lines, levels and centers before proceeding with formwork. Ensure that dimensions agree with drawings.

3.02 EARTH FORMS

A. Earth forms are not permitted.

3.03 ERECTION - FORMWORK

A. Erect formwork, shoring and bracing to achieve design requirements, in accordance with requirements of ACI 301.

B. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to overstressing by construction loads.

C. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.

D. Align joints and make watertight. Keep form joints to a minimum. Arrangements of panels shall be orderly and symmetrical, and use of small pieces shall be avoided. Forms shall be chamfered 1-inch for external corners of concrete, including top of walls, which will be exposed to view in the finished work.

E. Install void forms in accordance with manufacturer's recommendations. Protect forms from moisture or crushing.

F. Provide adequate formwork in its entirety. Forms shall safely support loads they will sustain and shall maintain their dimensional and surface correctness to produce members required by the Drawings. Form ties shall be spaced close enough to avoid bulges and variations in the required cross-sectional dimensions shown on the Drawings for the members being cast.

3.04 APPLICATION - FORM RELEASE AGENT

A. Apply form release agent on formwork in accordance with manufacturer's recommendations.

B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.

3.05 INSERTS, EMBEDDED PARTS, AND OPENINGS

A. Box out for chases, recesses or other openings required in the completed work.

B. Install all the items (sleeves, inserts, hangers, anchors, etc.) to be supported by theformwork as required by the work.

C. Install pipe sleeves, wall pipes and wall sleeves, as shown or specified, for all piping penetrating walls and slabs. The use of block-outs in walls is prohibited. Pipe sleeves shall be used in slabs for plumbing pipes and wiring conduits.

D. Provide a sufficient number of cleanout doors at the base of walls and piers to facilitate cleaning and the application of grout to the column bases.

E. The use of reinforcing steel partially embedded in concrete as toe pins or form spacers are prohibited.

3.06 FORM CLEANING

A. Clean forms as erection proceeds, to remove foreign matter within forms.

B. Clean and protect permanent insulated concrete foam panel formwork per manufacturer's recommendations.

C. Clean formed cavities of debris prior to placing concrete.
   1. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.
   2. During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out forms, unless formwork and concrete construction proceed within heated enclosure. Use compressed air or other means to remove foreign matter.

3.07 FORMWORK TOLERANCES

A. Variation from Plumb:
   1. For Exposed Corners, Construction and Expansion Joint Grooves and Other Conspicuous Lines:
      a. In any 20-Foot Height: 1/4-inch.
      b. Maximum for the Entire Height: 1/2-inch.

B. Variation from the Level or from the Grades Shown on the Drawings:
   1. In Tops of Slabs:
      a. In any 10-Foot Length: 1/4-inch.
      b. In any 20-Foot Length: 3/8-inch.
      c. Maximum for the Entire Length: 3/4-inch.

C. Variation of the Linear Lines from Established Position in Plan and Related Position of Walls:
   1. In any 20-Foot Length: 1/2-inch.
   2. Maximum for the Entire Length: 1-inch.

D. Variation in Thickness of Slabs and Walls: -1/4-inch, +1/2-inch.

3.08 FIELD QUALITY CONTROL

A. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and to verify that supports, fastenings, wedges, ties, and items are secure.

3.09 FORM REMOVAL

A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.

B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.

C. Store removed forms to prevent damage to form materials or to fresh concrete. Discard damaged forms.

END OF SECTION

SECTION 03 2000
CONCRETE REINFORCING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Reinforcing steel for cast-in-place concrete.

B. Supports and accessories for steel reinforcement.

1.02 RELATED REQUIREMENTS

A. Section 03 1000 - Concrete Forming and Accessories.

B. Section 03 3000 - Cast-in-Place Concrete.

1.03 REFERENCE STANDARDS

A. ACI 301 - Specifications for Structural Concrete; 2016.

B. ACI 318 - Building Code Requirements for Structural Concrete; 2019, with Errata (2021).

C. ACI SP-66 - ACI Detailing Manual; 2004.

D. ASTM A184/A184M - Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement; 2019.

E. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2020.

F. ASTM A706/A706M - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement; 2016.

G. ASTM A996/A996M - Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement; 2016.

H. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2018a.

I. CRSI (DA4) - Manual of Standard Practice; 2009.

J. CRSI (P1) - Placing Reinforcing Bars; 2011.

1.04 SUBMITTALS

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

B. Shop Drawings: Comply with requirements of ACI SP-66. Include bar schedules, shapes of bent bars, spacing of bars, and location of splices.
   1. Prepare shop drawings under seal of a Professional Structural Engineer experienced in design of work of this type and licensed in the State in which the Project is located.

C. Manufacturer's Certificate: Certify that reinforcing steel and accessories supplied for this project meet or exceed specified requirements.

D. Reports: Submit certified copies of mill test report of reinforcement materials analysis.
   1. Cost of tests shall be borne by the contractor.

1.05 QUALITY ASSURANCE

A. Perform work of this section in accordance with ACI 301.

1.06 STORAGE OF MATERIALS

A. Reinforcing steel not immediately placed in forms shall be protected from mud and excessive rust-producing conditions by storing in a well-drained area supported off the ground.

PART 2 PRODUCTS

2.01 REINFORCEMENT

A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi).

B. Reinforcing Steel: ASTM A706/A706M, deformed low-alloy steel bars.

C. Reinforcing Steel: Deformed bars, ASTM A996/A996M Grade 40 (280), Type A.

D. Steel Welded Wire Reinforcement (WWR): Galvanized, deformed type; ASTM A1064/A1064M.

E. Reinforcement Accessories:
   1. Tie Wire: Annealed, minimum 16 gauge, 0.0508 inch.
   2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.
      a. All chairs and bolsters on formwork shall be steel with plastic covered legs.
   3. Supports for reinforcing steel in concrete cast against earth shall be chairs with sand plates or precast concrete blocks with embedded tie wires.

2.02 FABRICATION

A. Fabricate concrete reinforcing in accordance with CRSI (DA4) - Manual of Standard Practice.

B. Welding of reinforcement is not permitted.

C. Field fabrication of reinforcing steel shall not be permitted.

PART 3 EXECUTION

3.01 PLACEMENT AND ANCHORAGE

A. Place, support and secure reinforcement against displacement. Do not deviate from required position.

B. Space metal chairs, bolsters, spacers and hangers in accordance with ACI 315.

C. Reinforcement, at the time concrete is placed, shall be free from rust scale or other coatings that will destroy or reduce bond. Bars with kinks or bends not shown on the plans shall not be used. A thin coating of firmly attached rust shall not be cause for rejection.

D. Reinforcement shall be accurately placed in accordance with the Drawings and shall be adequately secured in position with not less than 16-gauge annealed wire or suitable clips at intersections. Reinforcement shall be held securely at the required distance from the forms. Nails shall not be driven into outside forms to support reinforcement.

E. Install welded wire fabric reinforcement for concrete slabs on ground and as otherwise indicated. Support on concrete pads as specified. Pull-up of welded wire fabric during concreting is not allowed. Lap all joints not less than one cross wire space plus 2-inches or 6-inches, whichever is greater, and wire securely. Extend mesh to within 2-inches of sides and ends of slabs. Sheets that do not lay flat when in their intended position will be rejected. Tags designating the wire size and spacing shall be left on each sheet until ready for use. Tuck ends of welded mesh well down into edge of beams or walls. Do not leave unreinforced border strips. Welded wire fabric shall not contain loose rust.

F. Conduits: Where conduits are permitted in slabs, low conduit shall be wired to the upper side of bottom reinforcing and top conduit shall be wired to lower side of top steel. Where parallel conduits occur, they shall be separated by at least 2-inches clear.

3.02 QUALITY CONTROL

A. Tolerances
   1. Fabrication and placing tolerances shall conform to ACI 301.

B. Inspection of Steel Placement
   1. The Construction Manager shall be given at least 48 hours notice before any concrete is to be cast. Concrete shall not be cast until the Construction Manager has observed and given approval of the work to be cast including, but not limited to, the placement of all the reinforcing, accessories, forms and the surfaces to be cast against. Such observations are in the nature of assisting the Contractor to minimize errors and in no case will they serve to relieve the Contractor of the responsibility to provide the materials and workmanship required by the Contract Documents.

END OF SECTION

SECTION 03 3000
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.

B. Joint devices associated with concrete work.

C. Miscellaneous concrete elements, including equipment pads.

D. Concrete curing.

1.02 RELATED REQUIREMENTS

A. Section 03 1000 - Concrete Forming and Accessories: Forms and accessories for formwork.

B. Section 03 2000 - Concrete Reinforcing.

1.03 REFERENCE STANDARDS

A. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; 1991 (Reapproved 2009).

B. ACI 301 - Specifications for Structural Concrete; 2016.

C. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000 (Reapproved 2009).

D. ACI 305R - Guide to Hot Weather Concreting; 2010.

E. ACI 306R - Guide to Cold Weather Concreting; 2016.

F. ACI 308R - Guide to External Curing of Concrete; 2016.

G. ACI 318 - Building Code Requirements for Structural Concrete; 2019, with Errata (2021).

H. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2018.

I. ASTM C150/C150M - Standard Specification for Portland Cement; 2021.

J. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete; 2020.

K. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 2019.

L. ASTM C330/C330M - Standard Specification for Lightweight Aggregates for Structural Concrete; 2017a.

M. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2019.

N. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2019.

O. ASTM C685/C685M - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing; 2017.

P. ASTM C881/C881M - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete; 2020a.

Q. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete; 2016.

R. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures; 2020.

S. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete; 2012.

T. ASTM D2103 - Standard Specification for Polyethylene Film and Sheeting; 2015.

1.04 DEFINITIONS

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

B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.05 PREINSTALLATION MEETINGS

A. Pre-installation Conference: Conduct conference at Project site.
   1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
      a. Contractor's superintendent.
      b. Independent testing agency responsible for concrete design mixtures.
      c. Ready-mix concrete manufacturer.
      d. Concrete Subcontractor.
      e. Special concrete finish Subcontractor.
   2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semi-rigid joint fillers, forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, methods for achieving specified floor and slab flatness and levelness floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.06 SUBMITTALS

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

B. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.

C. Mix Design: Submit proposed concrete mix design.
   1. Indicate proposed mix design complies with requirements of ACI 301, Section 4 - Concrete Mixtures.
   2. Indicate proposed mix design complies with requirements of ACI 318, Chapter 5 - Concrete Quality, Mixing and Placing.

D. Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

E. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
   1. Location of construction joints is subject to approval of the Landscape Architect.

F. Samples: Submit samples of underslab vapor retarder to be used.

G. Samples: Submit two, 12 inch long samples of waterstops and construction joint devices.

H. Test Reports: Submit report for each test or series of tests specified.

1.07 QUALITY ASSURANCE

A. Perform work of this section in accordance with ACI 301 and ACI 318.

B. Follow recommendations of ACI 305R when concreting during hot weather.

C. Follow recommendations of ACI 306R when concreting during cold weather.

D. 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.

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

F. 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.

G. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M.

1.08 MOCK-UP

A. Construct and erect mock-up panel for architectural concrete surfaces indicated to receive special treatment or finish as result of formwork.
   1. Panel Size: Sufficient to illustrate full range of treatment.

B. Mock-up may remain as part of the Work after approval by Architect.

1.09 PRECONSTRUCTION TESTING

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

1.10 DELIVERY, STORAGE, AND HANDLING

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

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

PART 2 PRODUCTS

2.01 FORMWORK

A. Comply with requirements of Section 03 1000.

2.02 REINFORCEMENT MATERIALS

A. Comply with requirements of Section 03 2000.

2.03 CONCRETE MATERIALS

A. Cement: ASTM C150/C150M, Type I - Normal Portland type.
   1. Acquire cement for entire project from same source.

B. Slag Cement: ASTM C 989/C 989M, Grade 100 or 120.

C. Fine and Coarse Aggregates: ASTM C33/C33M. Class 3S coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
   1. Acquire aggregates for entire project from same source.
   2. Maximum Coarse-Aggregate Size: 1 inch (25 mm) nominal.
   3. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Fly Ash: ASTM C618, Class C or F.

E. Calcined Pozzolan: ASTM C618, Class N.

F. Silica Fume: ASTM C1240, proportioned in accordance with ACI 211.1.

G. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to concrete.

2.04 ADMIXTURES

A. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement. Use chemicals certified by manufacturer to be compatible with other admixtures. Do not use calcium chloride or admixtures containing calcium chloride.

B. High Range Water Reducing and Retarding Admixture: ASTM C494/C494M Type G.

C. High Range Water Reducing Admixture: ASTM C494/C494M Type F.

D. Water Reducing and Retarding Admixture: ASTM C494/C494M Type D.

E. Retarding Admixture: ASTM C494/C494M Type B.

F. Water Reducing Admixture: ASTM C494/C494M Type A.

G. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

H. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C 494/C494M, Type C.

I. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.

2.05 FIBER REINFORCEMENT

A. Carbon-Steel Fiber: ASTM A 820/A 820M, Type 1, cold-drawn wire, deformed, minimum of 1.5 inches (38 mm) long, and aspect ratio of 35 to 40.

B. Carbon-Steel Fiber: ASTM A 820/A 820M, Type 2, cut sheet, deformed, minimum of 1.5 inches (38 mm) long, and aspect ratio of 35 to 40.

C. Synthetic Micro-Fiber: Monofilament polypropylene micro-fibers engineered and designed for use in concrete, complying with ASTM C 1116/C 1116M, Type III, 1/2 to 1-1/2 inches (13 to 38 mm) long.

D. Synthetic Micro-Fiber: Fibrillated polypropylene micro-fibers engineered and designed for use in concrete, complying with ASTM C 1116/C 1116M, Type III, 1/2 to 1-1/2 inches (13 to 38 mm) long.

E. Synthetic Macro-Fiber: Polyolefin macro-fibers engineered and designed for use in concrete, complying with ASTM C 1116/C 1116M, Type III, 1 to 2-1/4 inches (25 to 57 mm) long.

2.06 VAPOR RETARDERS

A. Sheet Vapor Retarder: ASTM E 1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape.

B. Sheet Vapor Retarder: ASTM E 1745, Class B. Include manufacturer's recommended adhesive or pressure-sensitive tape.

C. Sheet Vapor Retarder: ASTM E 1745, Class C. Include manufacturer's recommended adhesive or pressure-sensitive joint tape.

D. Sheet Vapor Retarder: Polyethylene sheet, ASTM D 4397, not less than 10 mils (0.25 mm) thick.

E. Bituminous Vapor Retarder: 110-mil- (2.8-mm-) thick, semiflexible, seven-ply sheet membrane consisting of reinforced core and carrier sheet with fortified asphalt layers, protective weathercoating, and removable plastic release liner. Furnish manufacturer's accessories, including bonding asphalt, pointing mastics, and self-adhering joint tape.
   1. Water-Vapor Permeance: 0.0011 grains/h x sq. ft. x inches Hg (0.063 ng/Pa x s x sq. m); ASTM E 154.
   2. Tensile Strength: 140 lbf/inch (24.5 kN/m); ASTM E 154.
   3. Puncture Resistance: 90 lbf (400N); ASTM E 154.

2.07 BONDING AND JOINTING PRODUCTS

A. Epoxy Bonding System:
   1. Complying with ASTM C881/C881M and of Type required for specific application.

B. Reglets: Formed steel sheet, galvanized, with temporary filler to prevent concrete intrusion during placement.
   1. Size: not less than 0.022-inch- (0.55-mm-) thick.

C. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 or aromatic polyurea with a Type A shore durometer hardness range of 90 to 95 according to ASTM D 2240.

D. Bonding Agent: ASTM C 1059/C 1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.

E. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch (0.85 mm) thick, with bent tab anchors.

2.08 CURING MATERIALS

A. Evaporation Reducer: Liquid thin-film-forming compound that reduces rapid moisture loss caused by high temperature, low humidity, and high winds; intended for application immediately after concrete placement.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.

C. Curing Compound, Naturally Dissipating: Clear, water-based, liquid membrane-forming compound; complying with ASTM C309.

D. Moisture-Retaining Sheet: ASTM C171.

E. Polyethylene Film: ASTM D2103, 4 mil, 0.004 inch thick, white opaque color.

F. Water: Potable, not detrimental to concrete.

2.09 CONCRETE MIX DESIGN

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301 (ACI 301M).
   1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
   2. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
      a. Fly Ash: 25 percent.
      b. Combined Fly Ash and Pozzolan: 25 percent.
      c. Slag Cement: 50 percent.
      d. Combined Fly Ash or Pozzolan and Slag Cement: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
      e. Silica Fume: 10 percent.
      f. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
      g. Combined Fly Ash or Pozzolans, Slag Cement, and Silica Fume: 50 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.

B. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.

C. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended or required by manufacturer.
   1. Use water-reducing, high-range 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 admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a w/c ratio below 0.50.
4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

2.10 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Footings: 4000 psi minimum concrete.
1. Minimum Compressive Strength: As indicated at 28 days.
2. Maximum W/C Ratio: 0.40.
3. Slump Limit: 4 inches (100 mm) plus or minus 1 inch (25 mm).
4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch (38-mm) nominal maximum aggregate size.
5. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch (25-mm) nominal maximum aggregate size.

2.11 MIXING

A. On Project Site: Mix in drum type batch mixer, complying with ASTM C685/C685M. Mix each batch not less than 1-1/2 minutes and not more than 5 minutes.
1. For mixer capacity larger than 1 cu. yd. (0.76 cu. m), increase mixing time by 15 seconds for each additional 1 cu. yd. (0.76 cu. m).
2. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

B. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M, and furnish batch ticket information.
1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

C. Adding Water: If concrete arrives on-site with slump less than suitable for placement, do not add water that exceeds the maximum water-cement ratio or exceeds the maximum permissible slump.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify lines, levels, and dimensions before proceeding with work of this section.

3.02 PREPARATION

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301 (ACI 301M), tosupport 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 (ACI 117M).
1. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
2. Class A, 1/8 inch (3.2 mm) for smooth-formed finished surfaces.
3. Class B, 1/4 inch (6 mm)
4. Class C, 1/2 inch (13 mm)
5. Class D, 1 inch (25 mm) for rough-formed finished surfaces.

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

D. Construct forms for easy removal without hammering or prying against concrete surfaces.

E. 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.

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

G. 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.

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

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

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

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

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

3.03 INSTALLING REINFORCEMENT AND OTHER 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 303.
   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. Install dovetail anchor slots in concrete structures as indicated.

B. Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supportingreinforcement.
   1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

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

D. 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/D 1.4M, where indicated.

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

F. 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.

G. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M. Use epoxy-coated steel wire ties to fasten epoxy-coated steel reinforcement.

H. Zinc-Coated Reinforcement: Repair cut and damaged zinc coatings with zinc repair material according to ASTM A 780/A 780M. Use galvanized-steel wire ties to fasten zinc-coated steel reinforcement.

3.04 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 (10 deg C) 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 support weight of concrete in place until concrete has achieved 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 are not 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.

3.05 VAPOR-RETARDER INSTALLATION

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.

1. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended tape.

B. Bituminous Vapor Retarders: Place, protect, and repair bituminous vapor retarder according to manufacturer's written instructions.

3.06 PLACING CONCRETE

A. Place concrete in accordance with ACI 304R.

B. Before placing concrete ensure reinforcement, inserts, waterstops, embedded parts, and formed construction joint devices have been installed and inspected, and will not be disturbed during concrete placement.

C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.

D. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301 (ACI 301M).

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

E. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth not to 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 (ACI 301M).
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibratorsvertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) 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.

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

1. Consolidate concrete during placement operations, so 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. 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.

3.07 SLAB JOINTING

A. Locate joints as indicated on drawings. Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Anchor joint fillers and devices to prevent movement during concrete placement.

C. 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 (38 mm) into concrete.
   3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
   4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, andgirders and at the top of footings or floor slabs.
   5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
   6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
   7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

D. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
   1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch (3.2 mm). Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
   2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

E. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
   1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
   2. Terminate full-width joint-filler strips not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished concrete surface where joint sealants, specified in Section 321373 "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.

F. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.08 CONCRETE FINISHING

A. Repair surface defects, including tie holes, immediately after removing formwork.

B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

C. Finishing Floors and Slabs: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
   1. 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.
      a. Apply float finish to surfaces indicated to receive broom finish.
   2. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.
      a. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.09 MISCELLANEOUS CONCRETE ITEM INSTALLATION

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:
   1. Coordinate sizes, depths, and locations of concrete bases with actual equipment provided.

3.10 CURING AND PROTECTION

A. Comply with requirements of ACI 308R. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

C. 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 (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

D. Formed Surfaces: Cure by moist curing with forms in place for full curing period. If removing forms before end of curing period, continue curing for remainder of curing period.

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

F. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
   1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
      a. Water.
      b. Continuous water-fog spray.
      c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.
   2. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
      a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.

3. 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.

G.

3.11 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(s). 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 joints clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches (50 mm) deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.12 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 (1.18-mm) 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 (13 mm) in any dimension to solid concrete. Limit cut depth to 3/4 inch (19 mm). 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 matches surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
   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 (0.25 mm) 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 (6 mm) 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 (25 mm) 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 (19-mm) 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 (25 mm) 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.

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.

3.13 FIELD QUALITY CONTROL

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

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

C. Inspections:
1. Steel reinforcement placement.
2. Steel reinforcement welding.
3. Headed bolts and studs.
4. Verification of use of required design mixture.
5. Concrete placement, including conveying and depositing.
6. Curing procedures and maintenance of curing temperature.
7. Verification of concrete strength before removal of shores and forms from beams and slabs.
8. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172/C 172M shall be performed according to the following requirements:
   a. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
   b. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. (76 cu. m) or fraction thereof of each concrete mixture placed each day.
      1) When frequency of testing provides 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.
   c. Slump: ASTM C 143/C 143M; 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.
   d. Air Content: ASTM C 231/C 231M, pressure method, for normal-weight concrete; ASTM C 173/C 173M, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

e. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below or 80 deg F (27 deg C) and above, and one test for each composite sample.
f. Unit Weight: ASTM C 567/C 567M, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
g. Compression Test Specimens: ASTM C 31/C 31M.
h. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
i. Cast and field cure two sets of two standard cylinder specimens for each composite sample.

9. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
   a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
   b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
10. 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.
11. 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 (3.4 MPa).
12. Test results shall be reported in writing to Architect, 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.
13. 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.
14. 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/C 42M or by other methods as directed by Architect.
15. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
16. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

D. Measure floor and slab flatness and levelness according to ASTM E 1155 (ASTM E 1155M) within 48 hours of finishing.

E. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.

3.14 PROTECTION

A. Do not permit traffic over unprotected concrete floor surface until fully cured.

END OF SECTION

SECTION 04 0100
MAINTENANCE OF MASONRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Water cleaning of _____surfaces.

B. Repointing mortar joints.

C. Repair of damaged masonry.

1.02 RELATED REQUIREMENTS

A. Section 04 0511 - Mortar and Masonry Grout.

B. Section 32 1440 - Stone Paving

1.03 PRICE AND PAYMENT PROCEDURES

A. See Section 01 2200 - Unit Prices, for additional unit price requirements.

1.04 REFERENCE STANDARDS

A. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2016.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week prior to commencing work of this section.
   1. Require attendance of parties directly affecting work of this section.
   2. Review conditions of installation, installation procedures, and coordination with related work.

1.06 SUBMITTALS

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

B. Product Data: Provide data on cleaning solutions.

1.07 QUALITY ASSURANCE

A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.

B. Restorer: Company specializing in masonry restoration with minimum three years of experience.

1.08 MOCK-UP

A. Restore and repoint an existing masonry wall area sized 8 feet long by 6 feet high; include in mock-up area instances of mortar, accessories, wall openings, flashings, and masonry ties.

B. Clean a 10 ft by 10 ft panel of wall to determine extent of cleaning.

C. Restore and repoint an existing flagstone path area sized 8 feet long by the entire path width; include in mock-up area instances of mortar; reset flagstone flush with adjacent flagstone as necessary.

D. Acceptable panel and procedures employed will become the standard for work of this section.

1.09 FIELD CONDITIONS

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

PART 2 PRODUCTS

2.01 MORTAR MATERIALS

A. Mortar to match existing on site.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces to be cleaned are ready for work of this section.

3.02 PREPARATION

A. Protect surrounding elements from damage due to restoration procedures.

B. Carefully remove and store removable items located in areas to be restored, including fixtures, fittings, finish hardware, and accessories; reinstall upon completion.

C. Separate areas to be protected from restoration areas using means adequate to prevent damage.

D. Cover existing landscaping with tarpaulins or similar covers.

E. Mask immediately adjacent surfaces with material that will withstand cleaning and restoration procedures.

F. Close off adjacent occupied areas with dust proof and weatherproof partitions.

G. When using cleaning methods that involve water or other liquids, install drainage devices to prevent runoff over adjacent surfaces unless those surfaces are impervious to damage from runoff.

H. Do not allow cleaning runoff to drain into sanitary or storm sewers.

3.03 REPOINTING

A. Perform repointing prior to cleaning masonry surfaces.

B. Cut out loose or disintegrated mortar in joints to minimum 1/2 inch depth or until sound mortar is reached.

C. Use power tools only after test cuts determine no damage to masonry units will result.

D. Do not damage masonry units.

E. When cutting is complete, remove dust and loose material by brushing.

F. Premoisten joint and apply mortar. Pack tightly in maximum 1/4 inch layers. Form a smooth, compact concave joint to match existing.

G. Moist cure for 72 hours.

3.04 CLEANING EXISTING MASONRY

A. High Pressure Cold Water: Cold water blast with 400 psi pressure to _____masonry surfaces, at all locations, providing uniform finish.

3.05 AGING

A. Rub in new masonry work to match, as close as possible, adjacent original work.
   1. Use carbon black in small amounts, rubbing in well with burlap rags.

B. After each application, dust off surplus and wash down with low pressure hose. Allow surface to dry before proceeding with succeeding applications.

C. Continue process until acceptance.

3.06 CLEANING

A. Immediately remove stains, efflorescence, or other excess resulting from the work of this section.

B. Remove excess mortar, smears, and droppings as work proceeds and upon completion.

C. Clean surrounding surfaces.

END OF SECTION

SECTION 04 0511
MORTAR AND MASONRY GROUT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Mortar for masonry.

1.02 RELATED REQUIREMENTS

A. Section 04 0100 - Maintenance of Masonry: Bedding and pointing mortar for masonry restoration work.

B. Section 32 1440 - Stone Paving: Installation of flagstone pavers.

1.03 REFERENCE STANDARDS

A. ASTM C5 - Standard Specification for Quicklime for Structural Purposes; 2018.

B. ASTM C91/C91M - Standard Specification for Masonry Cement; 2018.

C. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2018.

D. ASTM C150/C150M - Standard Specification for Portland Cement; 2021.

E. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2018.

F. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019a.

G. ASTM C387/C387M - Standard Specification for Packaged, Dry, Combined Materials for Concrete and High Strength Mortar; 2017.

H. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry; 2020.

I. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2016.

1.04 SUBMITTALS

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

B. Product Data: Include design mix and indicate whether the Proportion or Property specification of ASTM C270 is to be used. Also include required environmental conditions and admixture limitations.

C. Samples: Submit two samples of mortar, illustrating mortar color and color range.

1.05 QUALITY ASSURANCE

A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Maintain packaged materials clean, dry, and protected against dampness, freezing, and foreign matter.

1.07 FIELD CONDITIONS

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

PART 2 PRODUCTS

2.01 MORTAR AND GROUT APPLICATIONS

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

B. Mortar Mix Designs: ASTM C270, Property Specification.
   1. Masonry below grade and in contact with earth - for flagstone paving: Type S.
   2. Exterior Repointing Mortar - for walls: Type N with maximum 2 percent ammonium stearate or calcium stearate per cement weight.

2.02 MATERIALS

A. Packaged Dry Material for Mortar for Unit Masonry: Premixed Portland cement, hydrated lime, and sand; complying with ASTM C387/C387M and capable of producing mortar of the specified strength in accordance with ASTM C270 with the addition of water only.
   1. Color: To match adjacent mortar color..

B. Packaged Dry Material for Mortar for Repointing: Premixed Portland cement, graded sand, and chemical admixtures complying with ASTM C91/C91M with the addition of water only.
   1. Color: To match adjacent mortar color.

C. Portland Cement: ASTM C150/C150M.

D. Masonry Cement: ASTM C91/C91M.

E. Hydrated Lime: ASTM C207, Type S.

F. Quicklime: ASTM C5, non-hydraulic type.

G. Mortar Aggregate: ASTM C144.

H. Water: Clean and potable.

2.03 MORTAR MIXING

A. Thoroughly mix mortar ingredients using mechanical batch mixer, in accordance with ASTM C270 and in quantities needed for immediate use.

B. Maintain sand uniformly damp immediately before the mixing process.

C. Do not use anti-freeze compounds to lower the freezing point of mortar.

D. If water is lost by evaporation, re-temper only within two hours of mixing.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install mortar to requirements of section(s) in which masonry is specified.

B. Do not displace reinforcement while placing grout.

C. Remove excess mortar from grout spaces.

3.02 FIELD QUALITY CONTROL

A. An independent testing agency will perform field tests, in accordance with provisions of Section 01 4000 - Quality Requirements.

B. Test and evaluate mortar in accordance with ASTM C780 procedures.

END OF SECTION

SECTION 05 1200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Structural steel.
   2. Shrinkage-resistant grout.

B. Related Requirements:
   1. Section 05 1213 "Architecturally Exposed Structural Steel Framing" for additional requirements for architecturally exposed structural steel.
   2. Section 05 3100 "Steel Decking" for field installation of shear stud connectors through deck.

1.2 DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site .

1.4 ACTION SUBMITTALS

A. Product Data:
   1. Structural-steel materials.
   2. High-strength, bolt-nut-washer assemblies.
   3. Forged-steel hardware.
   4. Shop primer.
   5. Etching cleaner.
   6. Galvanized repair paint.
   7. Shrinkage-resistant grout.

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

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU or is accredited by the IAS Fabricator Inspection Program for Structural Steel (Acceptance Criteria 172).

B. Installer Qualifications: A qualified Installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category ACSE .

C. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with applicable provisions of the following specifications and documents:
   1. ANSI/AISC 303.
   2. ANSI/AISC 360.
   3. RCSC's "Specification for Structural Joints Using High-Strength Bolts."

B. Connection Design Information:
   1. Option 1: Connection designs have been completed and connections indicated on the Drawings.

2. Option 2: Fabricator's experienced steel detailer selects or completes connections in accordance with ANSI/AISC 303.
   a. Select and complete connections using schematic details indicated and ANSI/AISC 360 .
   b. Use Allowable Stress Design; data are given at service-load level.

C. Moment Connections: Type PR, partially restrained.

D. Construction: .

2.2 STRUCTURAL-STEEL MATERIALS

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

B. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than the following:
   1. W-Shapes: n/a percent.
   2. Channels, Angles -Shapes: n/a percent.
   3. Plate and Bar: 25 n/a percent.
   4. Cold-Formed Hollow Structural Sections: n/a percent.
   5. All Other Steel Materials: n/a percent.
   6. http://www.arcomnet.com/sustainable_design.aspx?topic=174: percent.
   7. Steel Pipe: n/a percent.

C. Channels, Angles : ASTM A36/A36M .

D. Plate and Bar: ASTM A36/A36M .

E. Steel Pipe: ASTM A53/A53M, Type E or Type S, Grade B.

F. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS AND CONNECTORS

A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.
   1. Direct-Tension Indicators: ASTM F959/F959M, Type 325-1, compressible-washer type with plain finish.

2.4 FORGED-STEEL STRUCTURAL HARDWARE

A. Clevises and Turnbuckles: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1035.

2.5 SHRINKAGE-RESISTANT GROUT

A. Metallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.

B. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.6 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.

2.7 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
   1. Joint Type: Snug tightened .

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

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

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

3.2 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.

B. Baseplates Bearing 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.
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 shrinkage-resistant 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 grouting.

C. Maintain erection tolerances of structural steel within ANSI/AISC 303.

3.3 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.

1. Joint Type: Snug tightened .

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

1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.

END OF SECTION 05 1200

SECTION 05 5000
METAL FABRICATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Shop fabricated steel and aluminum items.

B. Shop fabrication of window well cover.

C. Shop fabrication of stair and building railing.

1.02 SUBMITTALS

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

B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.

PART 2 PRODUCTS

2.01 MATERIALS - STEEL

A. Steel Sections: ASTM A36/A36M.

B. Steel Tubing: ASTM A501/A501M hot-formed structural tubing.

C. Plates: ASTM A283/A283M.

D. Mechanical Fasteners: Same material as or compatible with materials being fastened; type consistent with design and specified quality level.

2.02 MATERIALS - ALUMINUM

2.03 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.

B. Fabricate items with joints tightly fitted and secured.

C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

D. Furnish components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.04 FABRICATED ITEMS

A. Steel fabricated window wells covers, powder coated, see drawings.

B. Steel fabricated stair and building handrailings, power coated, see drawings.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Obtain approval prior to site cutting or making adjustments not scheduled.

END OF SECTION

SECTION 05 5213
PIPE AND TUBE RAILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Free-standing railings at steps and ramps.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Placement of anchors in concrete.

1.03 REFERENCE STANDARDS

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

B. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.

C. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2013.

D. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings; 2013.

E. ASTM E985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings; 2000 (Reapproved 2006).

1.04 COORDINATION

A. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

B. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

1.05 SUBMITTALS

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

B. Product Data: For the following:
   1. Manufacturer's product lines of mechanically connected railings.
   2. Railing brackets.

C. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories. Include plans, elevations, sections, details, and attachments to other work.

D. Samples: For each type of exposed finish required.
   1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
   2. Fittings and brackets.
   3. Assembled Sample of railing system, made from full-size components, including top rail, post, handrail, and infill. Sample need not be full height.
   4. Show method of connecting and finishing members at intersections.

E. Delegated-Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

F. Qualification Data: For testing agency.

G. Welding certificates.

H. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.

I. Product Test Reports: For pipe and tube railings, for tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

J. Evaluation Reports: For post-installed anchors, from ICC-ES.

1.06 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

1.08 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Steel Pipe and Tube Railings:
   1. Shop built pipe and tube railings.
   2. Source Limitations: Obtain each type of railing from single source from single manufacturer.
   3. Substitutions: See Section 01 6000 - Product Requirements.

2.02 RAILINGS - GENERAL REQUIREMENTS

A. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of applicable local code.

B. Distributed Loads: Design railing assembly, wall rails, and attachments to resist distributed force of 50 pounds per linear foot applied to the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935.

C. Concentrated Loads: Design railing assembly, wall rails, and attachments to resist a concentrated force of 200 pounds applied at any point on the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935.

D. Uniform and concentrated loads need not be assumed to act concurrently.

2.03 STEEL MATERIALS

A. Steel Tube Handrails: ASTM A500/A500M, Grade B cold-formed structural tubing, powdercoated black finish.

2.04 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

2.05 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. General: Fabricate railings to comply with at a minimum Americans with Disabilities Act 2010 requirements.

C. Fit and shop assemble items in largest practical sections, for delivery to site. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

D. Fabricate components with joints tightly fitted and secured.

E. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

F. Form work true to line and level with accurate angles and surfaces.

G. Fabricate connections that are exposed to weather in a manner that excludes water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

I. Connections: Fabricate railings with welded connections unless otherwise indicated.

J. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove flux immediately.
   4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

K. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
   1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.

L. Form Changes in Direction as Follows:
   1. As detailed.
   2. By bending

M. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

N. Close exposed ends of railing members with prefabricated end fittings.

O. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.

P. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

2.06 STEEL AND IRON FINISHES

A. Steel Tube Handrails: Powdercoated black finish.

B. Preparing Galvanized Railings for Shop Priming: After welding, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 INSTALLATION, GENERAL

A. Install in accordance with manufacturer's instructions.

B. Install components plumb and level, accurately fitted, free from distortion or defects, with tight joints.

C. Install railings in compliance with ADA Standards for accessible design at applicable locations.

D. Anchor railings securely to structure.

E. Fit exposed connections together to form tight, hairline joints.

F. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
   1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
   2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.

3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

G. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
   1. Coat, with a heavy coat of bituminous paint, concealed surfaces of aluminum that are in contact with grout, concrete, masonry, wood, or dissimilar metals.

H. Adjust railings before anchoring to ensure matching alignment at abutting joints.

I. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.03 RAILING CONNECTIONS

A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

B. Expansion Joints: Install expansion joints as needed to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches of attachment point.

3.04 ATTACHING RAILINGS

A. Attach railings to wall with wall brackets. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

B. Secure wall brackets and railing end flanges to building construction as follows:
   1. For wood use hanger or lag bolts set into studs or wood backing between studs. Coordinate with carpentry work to locate backing members.

3.05 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION

SECTION 06 1000
ROUGH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nonstructural dimension lumber framing.

B. Rough opening framing for doors, windows, and roof openings.

C. Sheathing.

D. Miscellaneous framing and sheathing.

E. Concealed wood blocking, nailers, and supports.

F. Miscellaneous wood nailers, furring, and grounds.

1.02 SUBMITTALS

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

B. Product Data: Provide technical data on insulated sheathing, wood preservative materials, and application instructions.

1.03 QUALITY ASSURANCE

A. Air Barrier Association of America (ABAA) Quality Assurance Program (QAP); www.airbarrier.org:
   1. Installer Qualification: Use accredited contractor, certified installers, evaluated materials, and third-party field quality control audit.
   2. Manufacturer Qualification: Use evaluated materials from a single manufacturer regularly engaged in air barrier material manufacture. Use secondary materials approved in writing by primary material manufacturer.

1.04 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
   1. Species: Southern Pine, unless otherwise indicated.
   2. If no species is specified, provide species graded by the agency specified; if no grading agency is specified, provide lumber graded by grading agency meeting the specified requirements.
   3. Grading Agency: Grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee at www.alsc.org, and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.

B. Provide wood harvested within a 500 mile radius of the project site.

2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

A. Grading Agency: Southern Pine Inspection Bureau, Inc; SPIB (GR).

B. Sizes: Nominal sizes as indicated on drawings, S4S.

C. Moisture Content: S-dry or MC19.

2.03 EXPOSED BOARDS

A. Submit manufacturer's certificate that products meet or exceed specified requirements, in lieu of grade stamping.

B. Moisture Content: Kiln-dry (15 percent maximum).

C. Surfacing: S4S.

D. Grade: No. 2, 2 Common, or Construction.

2.04 CONSTRUCTION PANELS

A. Subflooring: PS 2 type, rated Sheathing.
   1. Plywood Subflooring thickness to match existing conditions. Several different existing conditions may exist in the project.
   2. Bond Classification: Exterior.
   3. Span Rating: 48.
   4. Performance Category: 3/4 PERF CAT.

B. Wall Sheathing: Plywood, PS 1, Grade C-D, Exposure I.
   1. New wall sheathing to match existing conditions thickness, several different conditions exist in the project.

2.05 ACCESSORIES

A. Fasteners and Anchors:
   1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
   2. Drywall Screws: Bugle head, hardened steel, power driven type, length three times thickness of sheathing.
   3. Anchors: Toggle bolt type for anchorage to hollow masonry.

B. Termite-Resistant Sill Plate Barrier: Self-adhesive, film-backed barrier with release sheet; adheres to concrete substrates and blocks termite access.
   1. Thickness: 68 mil, 0.068 inch.
   2. Termite Resistance: 100 percent when tested in accordance with ICC-ES AC380.

C. Sill Flashing: See Section 07 6200.

D. Subfloor Adhesives: Waterproof, air cure type, cartridge dispensed; adhesives designed for subfloor applications and complying with either ASTM C557 or ASTM D3498.

E. Water-Resistive Barrier: See Section 07 2500.

F. Vapor Retarder: See Section 07 2600.

G. Air Barrier: See Section 07 2700.

2.06 FACTORY WOOD TREATMENT

A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.

PART 3 EXECUTION

3.01 PREPARATION

A. Where wood framing bears on cementitious foundations, install full width sill flashing continuous over top of foundation, lap ends of flashing minimum of 4 inches and seal.

B. Coordinate installation of rough carpentry members specified in other sections.

3.02 INSTALLATION - GENERAL

A. Select material sizes to minimize waste.

B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.03 BLOCKING, NAILERS, AND SUPPORTS

A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.

B. In framed assemblies that have concealed spaces, provide solid wood fireblocking as required by applicable local code, to close concealed draft openings between floors and between top story and roof/attic space; other material acceptable to authorities having jurisdiction may be used in lieu of solid wood blocking.

C. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.

D. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.

E. Provide the following specific nonstructural framing and blocking:
   1. Cabinets and shelf supports.
   2. Wall brackets.
   3. Handrails.
   4. Grab bars.
   5. Towel and bath accessories.
   6. Wall-mounted door stops.
   7. Wall paneling and trim.
   8. Joints of rigid wall coverings that occur between studs.

3.04 INSTALLATION OF CONSTRUCTION PANELS

A. Subflooring: Glue and nail to framing; staples are not permitted.

B. Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using nails, screws, or staples.
   1. Use plywood or other acceptable structural panels at building corners, for not less than 96 inches, measured horizontally.
   2. Place water-resistive barrier horizontally over wall sheathing, weather lapping edges and ends.

C. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches on center on all edges and into studs in field of board.
   1. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
   2. Install adjacent boards without gaps.

END OF SECTION

SECTION 06 2000
FINISH CARPENTRY

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Finish carpentry tems.

B. Wood door frames, glazed frames.

C. Wood casings and moldings.

D. Hardware and attachment accessories.

1.2 RELATED REQUIREMENTS

A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

B. Section 06 1000 - Rough Carpentry: Support framing, grounds, and concealed blocking.

1.3 REFERENCE STANDARDS

A. ANSI A135.4 - American National Standard for Basic Hardboard; 2004.

B. ANSI A208.1 - American National Standard for Particleboard; 2009.

C. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2009.

D. AWPA U1 - Use Category System: User Specification for Treated Wood; American Wood-Preservers' Association; 2010.

E. BHMA A156.9 - American National Standard for Cabinet Hardware; Builders Hardware Manufacturers Association; 2010 (ANSI/BHMA A156.9).

F. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood; Hardwood Plywood & Veneer Association; 2004.

G. NEMA LD 3 - High-Pressure Decorative Laminates; National Electrical Manufacturers Association; 2005.

H. PS 1 - Structural Plywood; 2007.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with plumbing rough-in, electrical rough-in, and installation of associated and adjacent components.

1.5 SUBMITTALS

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

B. Product Data:
   1. Provide instructions for attachment hardware and finish hardware.

C. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
   1. Provide the information required by AWI/AWMAC/WI Architectural Woodwork Standards.
   2. Include certification programlabel.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.

1.7 DELIVERY, STORAGE, ANDHANDLING

A. Protect work from moisture damage.

PART 2 PRODUCTS

2.1 FINISH CARPENTRY ITEMS

A. Quality Grade: Unless otherwise indicated provide products of quality specified by AWI/AWMAC/WI Architectural Woodwork Standards for Premium Grade.

B. Exterior Woodwork Items:
   1. Window Casings and Moldings: Softwood; prepare for paint finish.
   2. Soffits: Match Existing
   3. Fascia: “Hardi-Trim” Fiber Cement Boards by James Hardie Company
   4. Enclosing Soffit Spaces: As detailed.

C. Interior Woodwork Items:
   1. Moldings, Bases, Casings, and Miscellaneous Trim: Clear white pine; prepare for paint finish.
   2. Window Sills: Clear fir; prepare for transparent finish.
   3. Loose Shelving: Birch plywood; prepare for paint finish.

2.2 WOOD-BASED COMPONENTS

A. Wood fabricated from old growth timber is not permitted.

2.3 SHEET MATERIALS

A. Softwood Plywood Not Exposed to View: Any face species, veneer core; PS 1 Grade A-B; glue type as recommended for application.

B. Exterior Siding: 19/32 8" O.C. primed T1-11 Fir plywood siding (to match existing).

2.4 PLASTIC LAMINATE MATERIALS

A. Plastic Laminate: NEMA LD 3, HGS ; finish as selected .

B. Laminate Adhesive: Type recommended by laminate manufacturer to suit application;not containing formaldehyde or other volatile organic compounds.

2.5 WOOD TREATMENT

A. Factory-Treated Lumber: Comply with requirements of AWPA U1 - Use Category System for pressure impregnated wood treatments determined by use categories, expected service conditions, and specificapplications.

2.6 FABRICATION

A. Shop assemble work for delivery to site, permitting passage through building openings.

B. Cap exposed plastic laminate finish edges with material of same finish and pattern.

C. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.

D. Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet (600 mm) from sink cut-outs.

2.7 SHOP FINISHING

A. Sand work smooth and set exposed nails and screws.

B. Apply wood filler in exposed nail and screw indentations.

C. On items to receive transparent finishes, use wood filler that matches surrounding surfaces and is of type recommended for the applicable finish.

D. Finish work in accordance with AWI/AWMAC/WI Architectural Woodwork Standards, Section 5 - Finishing for Grade specified and as follows:

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify adequacy of backing and support framing.

B. Verify mechanical, electrical, and building items affecting work of this section are placed and ready to receive this work.

3.2 INSTALLATION

A. Install work in accordance with AWI/AWMAC/WI Architectural Woodwork Standards requirements for gradeindicated.

B. Set and secure materials and components in place, plumb and level.

C. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch (1 mm). Do not use additional overlay trim to conceal larger gaps.

D. Follow manufacturers installation recommendations for Fiber Cement Trim items.

3.3 PREPARATION FOR SITE FINISHING

A. Set exposed fasteners. Apply wood filler in exposed fastener indentations. Sand work smooth.

B. Before installation, prime paint surfaces of items or assemblies to be in contact with cementitious materials.

3.4 TOLERANCES

A. Maximum Variation from True Position: 1/16 inch (1.5 mm).

B. Maximum Offset from True Alignment with Abutting Materials: 1/32 inch (0.7 mm).

END OF SECTION

SECTION 07 1300
SHEET WATERPROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Sheet Waterproofing:
   1. EPDM rubber sheet membrane.

1.02 ABBREVIATIONS

A. EPDM - Ethylene Propylene Diene Monomer.

1.03 REFERENCE STANDARDS

A. ASTM D4637/D4637M - Standard Specification for EPDM Sheet Used in Single-Ply Roof Membrane; 2015 (Reapproved 2021).

B. ASTM D6134/D6134M - Standard Specification for Vulcanized Rubber Sheets Used in Waterproofing Systems; 2007, with Editorial Revision (2019).

C. NRCA (WM) - The NRCA Waterproofing Manual; 2005.

1.04 SUBMITTALS

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

B. Product Data: Provide data for membrane.

C. Shop Drawings: Indicate special joint or termination conditions and conditions of interface with other materials.

1.05 FIELD CONDITIONS

1.06 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Contractor shall correct defective Work within a five year period after Date of Substantial Completion; remove and replace materials concealing waterproofing at no extra cost to Owner.

PART 2 PRODUCTS

2.01 WATERPROOFING APPLICATIONS

A. EPDM Rubber Sheet Membrane:
   1. Location: Basement walls.
   2. Vertical Surfaces: Adhesive bonded to substrate.
   3. Cover with drainage panel.

2.02 MEMBRANE MATERIALS

A. EPDM Rubber Sheet Membrane: Complies with ASTM D4637/D4637M, Type I unreinforced and with soil burial resistance requirement of ASTM D6134/D6134M.
   1. Thickness: 0.060 inch, minimum.
   2. Sheet Width: As large as is practical, with factory vulcanized splices.
   3. Field Seaming: Contact cement and lap edge sealant.
   4. Adhesives, Sealants, Tapes, and Accessories: As recommended by membrane manufacturer.
   5. Flashing: Cured EPDM rubber sheet.
   6. Products:
      a. Carlisle Coatings & Waterproofing Inc; Sure-Seal EPDM Membrane: www.carlisleccw.com.
      b. Substitutions: See Section 01 6000 - Product Requirements.

2.03 ACCESSORIES

A. Sealant for Cracks and Joints In Substrates: Resilient elastomeric joint sealant compatible with substrates and waterproofing materials.

B. Drainage Panel: Drainage layer with geotextile filter fabric on earth side.
   1. Composition: Dimpled polystyrene, polyethylene, polypropylene, or polymeric core; polypropylene or polyester filter fabric.
   2. Thickness: 1/4 inch.
   3. Products:
      a. Advanced Building Products, Inc; ABP AdvancedDrain Polymeric Drainage Mat: www.advancedbuildingproducts.com.
      b. Mar-flex Waterproofing & Building Products; ArmorDrain 110: www.mar-flex.com.
      c. W.R. Meadows, Inc; Mel-Drain 5012: www.wrmeadows.com.
      d. Substitutions: See Section 01 6000 - Product Requirements.

C. Adhesives: As recommended by membrane manufacturer.

D. Thinner and Cleaner: As recommended by adhesive manufacturer, compatible with sheet membrane.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify substrate surfaces are durable; free of matter detrimental to adhesion or application of waterproofing system.

3.02 PREPARATION

A. Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's instructions; vacuum substrate clean.

3.03 INSTALLATION - MEMBRANE

A. Install membrane waterproofing in accordance with manufacturer's instructions and NRCA (WM) applicable requirements.

B. Roll out membrane, and minimize wrinkles and bubbles.

C. Overlap edges and ends, minimum 3 inches, seal permanently waterproof by method recommended by manufacturer, and apply uniform bead of sealant to joint edge.

D. Reinforce membrane with multiple thickness of membrane material over joints, whether joints are static or dynamic.

E. Weather lap joints on sloped substrate in direction of drainage, and seal joints and seams.

F. Flexible Flashings: Seal items watertight that penetrate through waterproofing membrane with flexible flashings.

G. Seal membrane and flashings to adjoining surfaces.

3.04 INSTALLATION - DRAINAGE PANEL AND PROTECTION BOARD

A. Place drainage panel directly against membrane, butt joints, and position to encourage drainage downward; scribe and cut boards around projections, penetrations, and interruptions.

END OF SECTION

SECTION 07 2100
THERMAL INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Board insulation and integral vapor retarder at cavity wall construction, perimeter foundation wall, underside of floor slabs, over roof deck, over roof sheathing, and interior wall with facer providing exposed finish.

B. Batt insulation and vapor retarder in exterior wall, ceiling, and roof construction.

C. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.

1.02 REFERENCE STANDARDS

A. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2019.

B. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2017.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2018b.

D. ASTM E136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace At 750 Degrees C; 2016a.

1.03 SUBMITTALS

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

B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.

PART 2 PRODUCTS

2.01 APPLICATIONS

A. Insulation in Wood Framed Walls: Batt insulation with integral vapor retarder.

B. Insulation in Wood Framed Ceiling Structure: Batt insulation with separate vapor retarder.

C. Insulation Above Lay-In Acoustical Ceilings: Batt insulation with no vapor retarder.

2.02 FOAM BOARD INSULATION MATERIALS

A. Expanded Polystyrene (EPS) Board Insulation: Complies with ASTM C578.
   1. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
   2. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
   3. Products:
      a. Atlas Molded Products, a Division of Atlas Roofing Corporation; ThermalStar EPS Wall Insulation Board: www.atlasmoldedproducts.com.
      b. Diversifoam Products: www.diversifoam.com.
      c. InsulFoam LLC: www.insulfoam.com.
      d. Substitutions: See Section 01 6000 - Product Requirements.

2.03 BATT INSULATION MATERIALS

A. Where batt insulation is indicated, either glass fiber or mineral fiber batt insulation may be used, at Contractor's option.

B. Glass Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C665; friction fit.
   1. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any.

C. Mineral Fiber Batt Insulation: Flexible or semi-rigid preformed batt or blanket, complying with ASTM C665; friction fit; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.

1. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.
2. Products:
    a. Johns Manville; MinWool Sound Attenuation Fire Batts: www.jm.com.
    b. Knauf Insulation; EcoBatt Insulation: www.knaufinsulation.com.
    c. Thermafiber, Inc; SAFB: www.thermafiber.com.
    d. Substitutions: See Section 01 6000 - Product Requirements.

2.04 ACCESSORIES

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.

B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.02 BATT INSTALLATION

A. Install insulation and vapor retarder in accordance with manufacturer's instructions.

B. Install in exterior wall and roof spaces without gaps or voids. Do not compress insulation.

C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.

D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

E. At wood framing, place vapor retarder on warm side of insulation by stapling at 6 inches on center. Lap and seal sheet retarder joints over face of member.

F. Tape seal tears or cuts in vapor retarder.

G. Extend vapor retarder tightly to full perimeter of adjacent window and door frames and other items interrupting the plane of the membrane; tape seal in place.

END OF SECTION

SECTION 07 2119
FOAMED-IN-PLACE INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Foamed-in-place insulation.
   1. In attics and crawlspaces.

1.02 REFERENCE STANDARDS

A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2017.

B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2018b.

C. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials; 2021a.

D. FM 4880 - Approval Standard for Class 1 Fire Rating of Building Panels or Interior Finish Materials; 2015.

E. NFPA 275 - Standard Method of Fire Tests for the Evaluation of Thermal Barriers; 2017.

F. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2019.

G. UL 1040 - Standard for Safety Fire Test of Insulated Wall Construction; Current Edition, Including All Revisions.

H. UL 1715 - Standard for Safety Fire Test of Interior Finish Material; Current Edition, Including All Revisions.

1.03 SUBMITTALS

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

B. Product Data: Provide product description, insulation properties, and preparation requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Foamed-In-Place Insulation:
   1. BASF Corporation; WALLTITE US Series Closed Cell: www.spf.basf.com.
   2. Carlisle Spray Foam Insulation: www.carlislesfi.com.
   3. Henry Company: www.henry.com.
   4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 MATERIALS

A. Foamed-In-Place Insulation: Low-density, flexible, open or closed cell, water vapor permeable polyurethane foam; foamed on-site, using blowing agent of water or non-ozone-depleting gas.
   1. Regulatory Requirements: Comply with applicable code for flame and smoke, concealment, and fire protection requirements.
      a. Fire Protection: Provide 15-minute thermal barrier of 1/2 inch gypsum board or equivalent material complying with NFPA 275 test method, or foamed-in-place insulation either exposed or with covering that complies with FM 4880, NFPA 286, UL 1040, or UL 1715.
   2. Thermal Resistance: R-value of 3.0, minimum, per 1 inch thickness at 75 degrees F mean temperature when tested in accordance with ASTM C518.
   3. Air Permeance: 0.04 cfm per square foot, maximum, when tested at intended thickness in accordance with ASTM E2178 at 1.57 psf.
   4. Surface Burning Characteristics: Flame spread/Smoke developed index of 75/450, maximum, when tested in accordance with ASTM E84.

2.03 ACCESSORIES

A. Primer: As required by insulation manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify work within construction spaces or crevices is complete prior to insulation application.

B. Verify that surfaces are clean, dry, and free of matter that may inhibit insulation or overcoat adhesion.

3.02 APPLICATION

A. Apply insulation in accordance with manufacturer's instructions.

END OF SECTION

SECTION 07 2500
WEATHER BARRIERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Water-resistive barriers.

1.02 DEFINITIONS

A. Weather Barriers: Assemblies that form either water-resistive barriers, air barriers, or vapor retarders.

B. Water-Resistive Barrier: A material behind an exterior wall covering that is intended to resist liquid water that has penetrated behind the exterior covering from further intruding into the exterior wall assembly.

1.03 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2018b.

B. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.

C. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials; 2021a.

D. ICC-ES AC38 - Acceptance Criteria for Water-Resistive Barriers; 2016, with Editorial Revision (2019).

1.04 SUBMITTALS

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

B. Shop Drawings: Provide drawings of special joint conditions.

C. Manufacturer's Installation Instructions: Indicate preparation, installation methods, and storage and handling criteria.

1.05 FIELD CONDITIONS

A. Maintain temperature and humidity recommended by materials manufacturers before, during, and after installation.

PART 2 PRODUCTS

2.01 WATER-RESISTIVE BARRIER MATERIALS

A. Water-Resistive Barrier, Composite: Tear-resistant polyester sheet with UV-resistant acrylic coating.
   1. Air Permeance: 0.18 cfm/sq ft, maximum, when tested in accordance with ASTM E2178.
   2. Water Vapor Permeance: 200 perms, minimum, when tested in accordance with ASTM E96/E96M using Procedure A - Desiccant Method, at 73.4 degrees F.
   3. Ultraviolet (UV) and Weathering Resistance: Approved by manufacturer for up to 210 days of weather exposure.
   4. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, Class A when tested in accordance with ASTM E84.
   5. Water Resistance: Comply with applicable requirements in accordance with ICC-ES AC38.
   6. Seam and Perimeter Tape: As recommended by sheet manufacturer.
   7. Products:
      a. Dorken Systems Inc; DELTA-FASSADE S: www.dorken.com.
      b. W.R. Meadows; Sheet Waterproofing: www.wrmeadows.com.
      c. Tremco; TREMproof: www.tremcosealants.com.
      d. Substitutions: See Section 01 6000 - Product Requirements.

B. Drainable Barrier Sheet: Nonwoven and nonperforated polypropylene material with 1/16 inch gap created by spacers providing drainage space.

1. Width: 5 feet, minimum.
2. Water Vapor Permeance: 19 perms, minimum, when tested in accordance with ASTM E96/E96M using Procedure A - Desiccant Method, at 73.4 degrees F.
3. Ultraviolet (UV) and Weathering Resistance: Approved by manufacturer for up to 120 days of weather exposure.
4. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, Class A when tested in accordance with ASTM E84.
5. Seam and Perimeter Tape: As recommended by sheet manufacturer.

2.02 ACCESSORIES

A. Sealants, Tapes, and Accessories Used for Sealing Water-Resistive Barrier and Adjacent Substrates: As indicated or complying with water-resistive barrier manufacturer's installation instructions.

PART 3 EXECUTION

3.01 PREPARATION

A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.

3.02 INSTALLATION

A. Install materials in accordance with manufacturer's installation instructions.

B. Water-Resistive Barriers: Install continuous water-resistive barrier over surfaces indicated, with sheets lapped to shed water but with seams not sealed.

C. Mechanically Fastened Exterior Sheets:
1. Install sheets shingle-fashion to shed water, with seams aligned horizontal.
2. Overlap seams as recommended by manufacturer, 6 inches, minimum.
3. Overlap at outside and inside corners as recommended by manufacturer, 12 inches, minimum.
4. Install water-resistive barrier over jamb flashings.
5. Install head flashings under water-resistive barrier.
6. At framed openings with frames having nailing flanges, extend sheet into opening and over flanges; at head of opening, seal sheet over flange and flashing.

D. Openings and Penetrations in Exterior Water-Resistive Barriers:
1. Install flashing over sills, covering entire sill framing member, and extend at least 5 inches onto water-resistive barrier and at least 6 inches up jambs; mechanically fasten stretched edges.
2. At openings filled with frames having nailing flanges, seal head and jamb flanges using a continuous bead of sealant compressed by flange and cover flanges with sealing tape at least 4 inches wide; do not seal sill flange.
3. At openings filled with nonflanged frames, seal water-resistive barrier to each side of framing at opening using flashing at least 9 inches wide, and covering entire depth of framing.
4. At head of openings, install flashing under water-resistive barrier extending at least 2 inches beyond face of jambs; seal water-resistive barrier to flashing.
5. At interior face of openings, seal gaps between window and door frames and rough framing using appropriate joint sealant over backer rod.
6. Service and Other Penetrations: Form flashing around penetrating items and seal to surface of water-resistive barrier.

END OF SECTION

SECTION 07 4623
WOOD SIDING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Panel siding for walls.

B. Trim, flashings, accessories, and fastenings.

1.02 RELATED REQUIREMENTS

A. Section 07 6200 - Sheet Metal Flashing and Trim: Product requirements for metal flashings and trim associated with wood siding for placement by this section.

1.03 REFERENCE STANDARDS

A. WCLIB (GR) - Standard Grading Rules for West Coast Lumber No. 17; 2018.

1.04 SUBMITTALS

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

B. Product Data: Provide manufacturer's data on materials, component profiles, fastening methods, jointing details, sizes, surface texture, finishes, and accessories; showing compliance with requirements, including:
   1. Physical characteristics of components shown on shop drawings.
   2. Storage and handling requirements and recommendations.
   3. Installation instructions and recommendations.

C. Shop Drawings: Indicate dimensions, layout, joints, construction details, support clips, and methods of anchorage.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Wood Siding:
   1. Centennial Woods LLC: www.centennialwoods.com.
   2. Louisiana Pacific Building Products: www.lpcorp.com.
   3. Substitutions: See Section 01 6000 - Product Requirements.

2.02 SIDING

A. Grade lumber in accordance with the following:
   1. Western Red Cedar: WCLIB (GR).

2.03 ACCESSORIES

A. Preservative Treatment: Dip- or brush-type, non-discoloring.

B. Wood Sealer: Factory-applied, water-based polymer, water repellant sealer that reacts chemically with untreated, natural wood surfaces.

C. Nails: Corrosion resistant type; non-staining, of size and strength to securely and rigidly retain the work.

D. Flashing: Galvanized steel; see Section 07 6200.

PART 3 EXECUTION

3.01 INSTALLATION

A. Fasten siding in place, level and plumb.
   1. Arrange for orderly nailing pattern, blind nail except over trim.
   2. Install siding for natural shed of water.
   3. Position cut ends over bearing surfaces, and sand cut edges smooth and clean.

B. Sand work smooth and set exposed nails and screws.

END OF SECTION

SECTION 07 7123
MANUFACTURED GUTTERS AND DOWNSPOUTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pre-finished aluminum gutters and downspouts.

B. Precast concrete splash pads.

1.2 REFERENCE STANDARDS

A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; American Architectural Manufacturers Association; 1998.

B. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels; 2005.

C. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels; 2005.

D. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2007.

E. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2007.

F. SMACNA (ASMM) - Architectural Sheet Metal Manual; Sheet Metal and Air Conditioning Contractors' National Association; 2003.

1.3 DESIGN REQUIREMENTS

A. Conform to SMACNA Architectural Sheet Metal Manual for sizing components for rainfall intensity determined by a storm occurrence of 1 in 5 years.

B. Maintain one copy of each document on site.

1.4 SUBMITTALS

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

B. Shop Drawings: Indicate locations, configurations, jointing methods, fastening methods, locations, and installation details.

C. Product Data: Provide data on prefabricated components.

1.5 DELIVERY, STORAGE, ANDHANDLING

A. Stack material to prevent twisting, bending, or abrasion, and to provide ventilation. Slope to drain.

B. Prevent contact with materials that could cause discoloration, staining, or damage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Gutters and Downspouts:
   1. Gutter: Berger Building Products
   2. Substitutions: See Section 01 6000 - Product Requirements.

2.2 MATERIALS

A. Pre-Finished Aluminum Sheet: ASTM B209 (ASTM B209M); 0.032 inch (0.8 mm) thick.
   1. Finish: 0.65 to 0.70 Mil Thick Polyester Finish
   2. Color: High Gloss White

2.3 COMPONENTS

A. Gutters: 6" Half Round Single Bead
   1. Aluminum, minimal seams (20 ft. lengths)
   2. Fabricated from .032" aluminum.

B. Downspouts: 4" Plain Round Painted Downspout.

C. Gutter support bracket
   a. #10 Painted Aluminum Combo Circle & Shank w/ Spring Clip

D. Downspout Anchor
   1. Anchoring Devices: Type recommended by fabricator.

2.4 ITEMS & ACCESSORIES

A. End Caps: “C” End Caps

B. Corners: 90 Degree Miter Box – Outside or Inside

C. Downspout Elbows: Plain Round

D. Outlet Tube: B-Style Half Round Wide Flange

E. Round Wire Strainer

F. Splash Pads: Precast concrete type, size 18" x 30"; minimum 3000 psi (21 MPa) at 28 days.

2.5 FABRICATION

A. Form gutters and downspouts of profiles and size indicated.

B. Fabricate with required connection pieces.

C. Form sections square, true, and accurate in size, in maximum possible lengths, free of distortion or defects detrimental to appearance or performance. Allow for expansion at joints.

D. Hem exposed edges of metal.

E. Fabricate gutter and downspout accessories; seal watertight.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that supports and surfaces are ready to receive work.

3.2 PREPARATION

A. Paint concealed metal surfaces and surfaces in contact with dissimilar metals with protective backing paint to a minimum dry film thickness of 15 mil (0.4 mm).

3.3 INSTALLATION

A. Install gutters, downspouts, and accessories in accordance with the drawings.

B. Sheet Metal: Join lengths with formed seams sealed watertight. Flash and seal guttersto downspouts and accessories.

C. Slope gutters to drain.

D. Slope gutters **1/4" per 10'** (0.21%)

END OF SECTION

SECTION 07 7200

ROOF ACCESSORIES

PART 2 PRODUCTS

END OF SECTION

SECTION 08 1433
STILE AND RAIL WOOD DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wood doors, stile and rail design; fire rated and non-fire rated.

1.02 REFERENCE STANDARDS

A. WDMA I.S. 6A - Interior Architectural Wood Stile and Rail Doors; 2013.

1.03 SUBMITTALS

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

B. Shop Drawings: Illustrate door opening criteria, elevations, sizes, types, swings, undercuts required, special beveling, special blocking for hardware, factory machining criteria, factory finishing criteria, cutouts for glazing, cutouts for louvers, cutouts for _____, and _____.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Stile and Rail Wood Doors:
   1. Karona, Inc: www.karonadoor.com.
   2. Masonite Architectural; Aspiro Authentic Stile & Rail Doors: www.architectural.masonite.com.
   3. VT Industries, Inc: www.vtindustries.com.
   4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 DOORS

A. Quality Standard: Custom Grade, Heavy Duty performance, in accordance with WDMA I.S. 6A.

2.03 DOOR AND PANEL FACINGS

A. Adhesive: Type I - Waterproof.

2.04 DOOR CONSTRUCTION

A. Fit door edge trim to edge of stiles after applying veneer facing.

B. Panels: Flat.

2.05 FINISHES

A. Finish work in accordance with WDMA I.S. 6A for Grade specified and as follows:

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 standards.

B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.

C. Machine cut for hardware.

D. Coordinate installation of doors with installation of frames and hardware.

END OF SECTION

SECTION 08 7100
DOOR HARDWARE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Hardware for wood doors.

B. Thresholds.

C. Weatherstripping and gasketing.

1.02 REFERENCE STANDARDS

A. BHMA A156.1 - Butts and Hinges; 2021.

B. BHMA A156.2 - Bored and Preassembled Locks and Latches; 2017.

C. BHMA A156.3 - Exit Devices; 2020.

D. BHMA A156.4 - Door Controls - Closers; 2019.

E. BHMA A156.7 - Template Hinge Dimensions; 2016.

F. BHMA A156.16 - Auxiliary Hardware; 2018.

G. BHMA A156.18 - Materials and Finishes; 2020.

H. BHMA A156.21 - Thresholds; 2019.

I. BHMA A156.22 - Gasketing; 2021.

J. BHMA A156.36 - Auxiliary Locks; 2020.

K. UL (DIR) - Online Certifications Directory; Current Edition.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the manufacture, fabrication, and installation of products that door hardware is installed on.

1.04 SUBMITTALS

A. See Section 01 3000 - 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. Provide complete description for each door listed.

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.

2.02 HINGES

A. Manufacturers:
   1. McKinney; an Assa Abloy Group company: www.assaabloydss.com.
   2. Hager Companies: www.hagerco.com.
   3. Stanley, dormakaba Group: www.stanleyhardwarefordoors.com.
   4. Substitutions: See Section 01 6000 - Product Requirements.

B. Hinges: Comply with BHMA A156.1, Grade 1.
   1. Butt Hinges: Comply with BHMA A156.1 and BHMA A156.7 for templated hinges.
      a. Provide hinge width required to clear surrounding trim.
   2. Provide hinges on every swinging door.
   3. Provide following quantity of butt hinges for each door:
      a. Doors From 60 inches High up to 90 inches High: Three hinges.

2.03 EXIT DEVICES

A. Manufacturers:
   1. Hager Companies: www.hagerco.com.
   2. Stanley, dormakaba Group: www.stanleyhardwarefordoors.com.
   3. Von Duprin, an Allegion brand: www.allegion.com/us.

B. Exit Devices: Comply with BHMA A156.3, Grade 1.
   1. Lever design to match lockset trim.
   2. Provide cylinder with cylinder dogging or locking trim.
   3. Provide exit devices properly sized for door width and height.
   4. Provide strike as recommended by manufacturer for application indicated.
   5. Provide UL (DIR) listed exit device assemblies for fire-rated doors and panic device assemblies for non-fire-rated doors.

2.04 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.

2.05 CYLINDRICAL LOCKS

A. Manufacturers:
   1. Best, dormakaba Group: www.bestaccess.com.
   2. Hager Companies: www.hagerco.com.
   3. Schlage, an Allegion brand: www.allegion.com/us.
   4. Substitutions: See Section 01 6000 - Product Requirements.

B. Cylindrical Locks (Bored): Comply with BHMA A156.2, Grade 1, 4000 Series.
   1. Bored Hole: 2-1/8 inch diameter.
   2. Latchbolt Throw: 1/2 inch, minimum.
   3. Backset: 2-3/4 inch 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.

2.06 AUXILIARY LOCKS (DEADLOCKS)

A. Manufacturers:
   1. Best, dormakaba Group: www.bestaccess.com.
   2. Hager Companies: www.hagerco.com.
   3. Stanley, dormakaba Group: www.stanleyhardwarefordoors.com.
   4. Substitutions: See Section 01 6000 - Product Requirements.

B. Auxiliary Locks (Deadlocks): Comply with BHMA A156.36, Grade 1.
   1. Type: Bored (cylindrical).
   2. Application: Bored.
   3. Backset: 2-3/4 inch, unless otherwise indicated.
   4. Bolt Throw: 1/2 inch, with latch made of hardened steel.
   5. Provide strike that matches frame.

2.07 CLOSERS

A. Manufacturers; Surface Mounted:

1. Corbin Russwin, Norton, Rixson, Sargent, or Yale; an Assa Abloy Group company: www.assaabloydss.com.
2. DORMA USA, Inc; 7400 Series, 8600 Series, 8900 Series, and TS93: www.dorma.com.
3. Hager Companies: www.hagerco.com.
4. Substitutions: See Section 01 6000 - Product Requirements.

B. Closers: Comply with BHMA A156.4, Grade 1.
1. Type: Surface mounted to door.
2. Provide door closer on each exterior door.

2.08 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 dome floor stop.
2. Material: Aluminum housing with rubber insert.

2.09 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.

2.10 THRESHOLDS

A. Thresholds: Comply with BHMA A156.21.
1. Provide threshold at each exterior door, unless otherwise indicated.
2. Type: Flat surface.
3. Material: Aluminum.
4. Threshold Surface: Fluted horizontal grooves across full width.
5. Field cut threshold to profile of frame and width of door sill for tight fit.
6. Provide non-corroding fasteners at exterior locations.

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 SIGNAGE

A. Signage (Room Name Plates and Numbers): Provide on doors for individuals to easily identify room names and/or numbers.
1. Text Required: "RESTROOM" with symbols and braille text.
2. Material: In plastic or metal with paint used to create necessary text, adhered to door.

2.13 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.

2.14 FINISHES

A. Finishes: Provide door hardware of same finish, unless otherwise indicated.
1. Primary Finish: 626; satin chromium plated over nickel, with brass or bronze base material (former US equivalent US26D); BHMA A156.18.

PART 3 EXECUTION

3.01 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.

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.

END OF SECTION

SECTION 09 2116
GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal stud wall framing.

B. Metal channel ceiling framing.

C. Cementitious backing board.

D. Gypsum wallboard.

E. Joint treatment and accessories.

1.02 SUBMITTALS

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

B. Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing system.

PART 2 PRODUCTS

2.01 METAL FRAMING MATERIALS

A. Manufacturers - Metal Framing, Connectors, and Accessories:
   1. ClarkDietrich: www.clarkdietrich.com.
   2. Jaimes Industries: www.jaimesind.com.
   3. Steel Construction Systems: www.steelconsystems.com.
   4. Substitutions: See Section 01 6000 - Product Requirements.

B. Non-structural Framing System Components: ASTM C645; 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.
   1. Studs: C-shaped with knurled or embossed faces.
      a. Products:
         1) MBA Building Supplies; ProSTUD: www.mbastuds.com.
         2) Super Stud Building Products, Inc; The EDGE: www.buysuperstud.com.
         3) Substitutions: See Section 01 6000 - Product Requirements.
   2. Runners: U shaped, sized to match studs.
   3. Ceiling Channels: C-shaped.

C. Non-structural Framing Accessories:
   1. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
   2. Framing Connectors: ASTM A653/A653M G90 galvanized steel clips; secures cold rolled channel to wall studs for lateral bracing.
   3. Flexible Wood Backing: Fire-retardant-treated wood with sheet steel connectors.

D. Grid Suspension Systems: Steel grid system of main tees and support bars connected to structure using hanging wire.

2.02 BOARD MATERIALS

A. Manufacturers - Gypsum-Based Board:
   1. Georgia-Pacific Gypsum: www.gpgypsum.com.
   2. National Gypsum Company: www.nationalgypsum.com.
   3. USG Corporation: www.usg.com.
   4. Substitutions: See Section 01 6000 - Product Requirements.

B. 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. Unfaced fiber-reinforced gypsum panels as defined in ASTM C1278/C1278M, suitable for paint finish, of the same core type and thickness may be substituted for paper-faced board.
3. Thickness:
   a. Vertical Surfaces: 1/2 inch.
   b. Ceilings: 1/2 inch.

C. Backing Board For Wet Areas: One of the following products:
1. Application: Surfaces behind tile in wet areas including tub and shower surrounds and shower ceilings.
2. Application: Horizontal surfaces behind tile in wet areas including countertops.
3. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
4. 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: 1/2 inch.

D. 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: 1/2 inch.
3. Edges: Tapered.
4. Products:
   a. CertainTeed Corporation; Interior Ceiling Drywall: www.certainteed.com/#sle.
   b. Continental Building Products; Sagcheck: www.continental-bp.com/#sle.
   c. Georgia-Pacific Gypsum; ToughRock Span 24 Ceiling Board: www.gpgypsum.com/#sle.

2.03 GYPSUM WALLBOARD 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.

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 C754 and manufacturer's instructions.

B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.

C. Studs: Space studs at 16 inches 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.

D. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.

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.
1. Exception: Tapered edges to receive joint treatment at right angles to framing.

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.

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. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
   1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
   2. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
   3. Level 1: Fire-resistance-rated wall areas above finished ceilings, whether or not accessible in the completed construction.

B. 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.

END OF SECTION

SECTION 09 5100
ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Suspended metal grid ceiling system.

B. Acoustical units.

1.02 SUBMITTALS

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

B. Shop Drawings: Indicate grid layout and related dimensioning.

C. Product Data: Provide data on suspension system components and acoustical units.

1.03 FIELD CONDITIONS

A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Suspension Systems:
   1. Armstrong World Industries, Inc: www.armstrongceilings.com.
   2. CertainTeed Corporation: www.certainteed.com.
   3. Hunter Douglas Architectural: www.hunterdouglasarchitectural.com.
   4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Ceiling systems designed to withstand the effects of earthquake motions determined according to ASCE 7 for Seismic Design Category D, E, or F and complying with the following:
   1. Local authorities having jurisdiction.

2.03 ACOUSTICAL UNITS

A. Acoustical Panels: Painted mineral fiber, with the following characteristics:
   1. Classification: ASTM E1264 Type III.
   2. Size: 24 by 24 inches.
   3. Thickness: 3/4 inch.
   4. Panel Edge: Square.
   5. Suspension System: Exposed grid.

2.04 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, Type ____: Hot-dipped galvanized steel grid with aluminum cap.
   1. Structural Classification: Intermediate-duty, when tested in accordance with ASTM C635/C635M.
   2. Profile: Tee; 15/16 inch face width.
   3. Finish: Baked enamel.
   4. Color: White.

2.05 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 galvanized steel wire.

C. Perimeter Moldings: Same metal and finish as grid.

D. Metal Edge Trim for "Cloud" Suspension Systems: Steel or extruded aluminum; provide attachment clips, splice plates, and preformed corner pieces for complete trim system.
   1. Trim Height: 6 inch.
   2. Finish: Baked enamel.
   3. Color: White.

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. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.

B. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
   1. Use longest practical lengths.

C. 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.

D. Seismic Suspension System, Seismic Design Categories D, E, F: Hang suspension system with grid ends attached to the perimeter molding on two adjacent walls; on opposite walls, maintain a 3/4 inch clearance between grid ends and wall.

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 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.

END OF SECTION

SECTION 09 9110
PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes surface preparation and field painting of exposed exterior and interior items and surfaces.

B. “New Construction” applies to newly installed and repaired items

C. “Existing Construction” applies to items such as fascia that are in good condition and will remain.

1.2 SUBMITTALS

A. Product Data: For each product indicated.

B. Samples: For each type of finish-coat material indicated.

1.3 PROJECT CONDITIONS

A. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F (7 deg C). Maintain storage containers in a clean condition, free of foreign materials and residue.

B. Apply waterborne paints only when temperatures of surfaces to be painted and surrounding air are between 50 and 90 deg F (10 and 32 deg C).

C. Apply solvent-thinned paints only when temperatures of surfaces to be painted and surrounding air are between 45 and 95 deg F (7 and 35 deg C).

D. Do not apply paint in snow, rain, fog, or mist; or when relative humidity exceeds 85 percent; or at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

1.4 EXTRA MATERIALS

A. Furnish extra paint materials from the same production run as the materials applied and in the quantities described below. Package with protective covering for storage and identify with labels describing contents. Deliver extra materials to Owner.

1. Quantity: 5 percent, but not less than 1 gal. (3.8 L) or 1 case, as appropriate, of each material and color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.

B. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

1. Benjamin Moore & Co. (BenjaminMoore).
2. PPG Industries, Inc. (Pittsburgh Paints).
3. Sherwin-Williams Co. (Sherwin-Williams)
4. ICI Dulux.

2.2 PAINT MATERIALS, GENERAL

A. Material Compatibility: Provide primers and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.

C. Chemical Components of Interior Paints and Coatings: Provide products that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24) and the following chemical restrictions:
   1. Flat Paints and Coatings: VOC not more than 0 g/L.
   2. Non-Flat Paints and Coatings: VOC not more than 0 g/L.
   3. Anticorrosive Coatings: VOC not more than 250 g/L.
   4. Varnishes and Sanding Sealers: VOC not more than 350 g/L.
   5. Stains: VOC not more than 0 g/L.
   6. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
   7. Restricted Components: Paints and coatings shall not contain acrolein; acrylonitrile; antimony; benzene; butyl benzyl phthalate; cadmium; di (2-ethylhexyl) phthalate; di-n-butyl phthalate; di-n-octyl phthalate; 1,2-dichlorobenzene; diethyl phthalate; dimethyl phthalate; ethylbenzene; formaldehyde; hexavalent chromium; isophorone; lead; mercury; methyl ethyl ketone; methyl isobutyl ketone; methylene chloride; naphthalene; toluene (methylbenzene); 1,1,1-trichloroethane; or vinyl chloride.

D. Colors: As noted or as selected from manufacturer's full range.

2.3 PREPARATORY COATS

A. Exterior Primer: Exterior alkyd or latex-based primer of finish coat manufacturer and recommended in writing by manufacturer for use with finish coat and on substrate indicated.
   1. Ferrous-Metal and Aluminum Substrates: Rust-inhibitive metal primer.
   2. Zinc-Coated Metal Substrates: Galvanized metal primer.
   3. Where manufacturer does not recommend a separate primer formulation on substrate indicated, use paint specified for finish coat.

B. Interior Primer: Interior latex-based or alkyd primer of finish coat manufacturer and recommended in writing by manufacturer for use with finish coat and on substrate indicated.
   1. Ferrous-Metal Substrates: Quick drying, rust-inhibitive metal primer.
   2. Zinc-Coated Metal Substrates: Galvanized metal primer.
   3. Gypsum Board Primer: Latex-based primer for interior application.
   4. Where manufacturer does not recommend a separate primer formulation on substrate indicated, use paint specified for finish coat.

2.4 EXTERIOR FINISH COATS

A. Exterior: New Construction
   1. Primer: PPG Seal Grip Alkyd Primer
   2. 2 Coats: : PPG Manor Hall Interior/Exterior
   3. Color P1: Color to Match Existing

B. Exterior: Existing Construction
   1. 1 Coat: PPG Manor Hall Interior/Exterior
   2. Color P1: To Match existing

2.5 INTERIOR FINISH

A. NOT USED

PART 3 - EXECUTION

3.1 APPLICATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for paint application.

B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.

C. Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of size or weight of the item, provide surface-applied protection before surface preparation andpainting.

1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.

D. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.
   1. Provide barrier coats over incompatible primers or remove and reprime.
   2. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.
      a. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
      b. Prime, stain, or seal wood to be painted immediately on delivery. Prime edges, ends, faces, undersides, and back sides of wood, including cabinets, counters, cases, and paneling.
      c. If transparent finish is required, back prime with spar varnish.
      d. Back prime paneling on interior partitions where masonry, plaster, or other wet wall construction occurs on back side.
      e. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.
   3. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC's recommendations.
      a. Blast steel surfaces clean as recommended by paint system manufacturer and according to SSPC-SP 6/NACE No. 3.
      b. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
      c. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as the shop coat.
   4. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.

E. Material Preparation:
   1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
   2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.

F. Exposed Surfaces: Include areas visible when permanent or built-in fixtures, grilles, convector covers, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
   1. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coatonly.
   2. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
   3. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
   4. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
   5. Finish interior of wall and base cabinets and similar field-finished casework to match exterior.

G. Sand lightly between each succeeding enamel or varnish coat.

H. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
   1. Omit primer over metal surfaces that have been shop primed and touchup painted.
   2. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance.

I. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.

J. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate. Provide total dry film thickness of the entire system as recommended by manufacturer.

K. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and occupied spaces.

L. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.

M. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.

N. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

O. Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail holes, or other surface imperfections.

3.2 CLEANING AND PROTECTING

A. At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from Project site.

B. Protect work of other trades, whether being painted or not, against damage from painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by COR.

C. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work.
   1. After work of other trades is complete, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

END OF SECTION

SECTION 09 9113
EXTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints.

C. Scope: Finish exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:

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, and operating parts of equipment.
   5. Floors, unless specifically indicated.
   6. Glass.
   7. Concealed pipes, ducts, and conduits.

1.02 SUBMITTALS

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

B. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
   1. Where sheen is specified, submit samples in only that sheen.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide paints and finishes from the same manufacturer to the greatest extent possible.
   1. If a single manufacturer cannot provide specified products, minor exceptions will be permitted provided approval by Architect is obtained using the specified procedures for substitutions.

B. Paints:
   1. Behr Process Corporation: www.behr.com.
   2. PPG Paints: www.ppgpaints.com.
   3. Sherwin-Williams Company: www.sherwin-williams.com.

C. Primer Sealers: Same manufacturer as top coats.

D. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready-mixed, unless required 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 described explicitly in manufacturer's product instructions.

2.03 PRIMERS

A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.

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 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 for finishing.

D. Seal surfaces that might cause bleed through or staining of topcoat.

E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

3.02 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.

D. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

E. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

END OF SECTION

SECTION 09 9123
INTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints.

C. Scope: Paint all interior surfaces exposed to view, walls, doors, trim, and ceilings, 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. Brick, architectural concrete, cast stone, integrally colored plaster, and stucco.
   7. Glass.
   8. Concealed pipes, ducts, and conduits.

1.02 SUBMITTALS

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

B. Product Data: Provide complete list of products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g., "alkyd enamel").
   2. MPI product number (e.g., MPI #47).
   3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.

1.03 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Do not apply materials when relative humidity exceeds 85 percent, at temperatures less than 5 degrees F above the dew point, or to damp or wet surfaces.

D. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide paints and finishes from the same manufacturer to the greatest extent possible.
   1. If a single manufacturer cannot provide specified products; minor exceptions will be permitted provided approval by Architect is obtained using the specified procedures for substitutions.
   2. Substitution of a different paint system using MPI-approved products by the same manufacturer will be considered.

B. Paints:
   1. Behr Process Corporation: www.behr.com.
   2. PPG Paints: www.ppgpaints.com.
   3. Sherwin-Williams Company: www.sherwin-williams.com.

C. Primer Sealers: Same manufacturer as top coats.

D. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready-mixed, unless intended to be a field-catalyzed paint.
   1. 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. Volatile Organic Compound (VOC) Content: Comply with Section 01 6116.

C. Flammability: Comply with applicable code for surface burning characteristics.

D. Colors: To be selected from manufacturer's full range of available colors.
   1. Colors to match existing conditions. Provide limited mock ups for comparison of new paint to existing conditions. Mock Up can be a small sample of a similar material painted as required in this and other sections.

2.03 PAINT SYSTEMS - INTERIOR

A. Interior Surfaces to be Painted, Unless Otherwise Indicated: Including gypsum board, concrete, concrete masonry units, brick, wood, plaster, uncoated steel, shop primed steel, galvanized steel, aluminum, and acoustical ceilings.
   1. Two top coats and one coat primer.

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. Do not begin application of paints and finishes until substrates have been adequately prepared.

B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

D. Test shop-applied primer for compatibility with subsequent cover materials.

E. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces is below the following maximums:
   1. Gypsum Wallboard: 12 percent.
   2. Interior Wood: 15 percent, measured in accordance with ASTM D4442.

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. Masonry:

F. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.

G. Aluminum: Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.

H. Galvanized Surfaces:

I. Ferrous Metal:
   1. Solvent clean according to SSPC-SP 1.
   2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
   3. Remove rust, loose mill scale, and other foreign substances using using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning". Protect from corrosion until coated.

J. Wood Surfaces to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.

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 PROTECTION

A. Protect finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION

SECTION 10 1400
SIGNAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Room and door signs.

1.02 SUBMITTALS

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

B. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.

C. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
   1. When room numbers to appear on signs differ from those on drawings, include the drawing room number on schedule.
   2. When content of signs is indicated to be determined later, request such information from Owner through Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
   3. Submit for approval by Owner through Architect prior to fabrication.

1.03 FIELD CONDITIONS

A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.

B. Maintain this minimum temperature during and after installation of signs.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Flat Signs:
   1. Best Sign Systems, Inc: www.bestsigns.com.
   2. FASTSIGNS: www.fastsigns.com.
   3. Mohawk Sign Systems, Inc: www.mohawksign.com.
   4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 SIGNAGE APPLICATIONS

A. Accessibility Compliance: Signs are required to comply with ADA Standards and ICC A117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.

B. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.
   1. Sign Type: Flat signs with engraved panel media as specified.
   2. Provide "tactile" signage, with letters raised minimum 1/32 inch and Grade II braille.
   3. Character Height: 1 inch.
   4. Sign Height: 2 inches, unless otherwise indicated.
   5. Office Doors: Identify with room numbers to be determined later, not the numbers indicated on drawings; in addition, provide "window" section for replaceable occupant name.
   6. Conference and Meeting Rooms: Identify with room numbers to be determined later, not the numbers indicated on drawings; in addition, provide "window" section with sliding "In Use/Vacant" indicator.
   7. Service Rooms: Identify with room names and numbers to be determined later, not those indicated on drawings.
   8. Rest Rooms: Identify with pictograms, the names "MEN" and "WOMEN", room numbers to be determined later, and braille.

2.03 SIGN TYPES

A. Flat Signs: Signage media without frame.
   1. Edges: Square.
   2. Corners: Square.
   3. Wall Mounting of One-Sided Signs: Tape adhesive.

B. Color and Font: Unless otherwise indicated:
   1. Character Font: Helvetica, Arial, or other sans serif font.
   2. Character Case: Upper case only.
   3. Background Color: Clear.
   4. Character Color: Contrasting color.

2.04 TACTILE SIGNAGE MEDIA

A. Engraved Panels: Laminated colored plastic; engraved through face to expose core as background color:
   1. Total Thickness: 1/16 inch.

END OF SECTION

SECTION 220100

PLUMBING GENERAL

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements specified herein shall apply to all Sections of Division 22.

B. The plans accompanying these specifications are generally diagrammatic and do not show all details required for the complete work. Establish details of the work as necessary to provide for the complete installation of systems and materials.

C. Coordinate the work to avoid conflicts with items such as plumbing and fire protection piping, beams, fire barriers, ceiling types and heights, slab or wall thickness, cabinet heights, or door swings. Do not scale the plans for dimensions. Verify dimensions before starting work and report any discrepancy or interference to the Owner's representative for clarification.

1.2 QUALITY ASSURANCE

A. Where the requirements of the specifications or drawings exceed those of referenced codes, standards and regulations, the drawings or specifications shall govern.

B. Where UL listing is required, equipment and materials shall bear the UL label.

C. The manufacturer's names and catalog numbers are subject to compliance with requirements. Substitutes of equivalent materials and equipment may be submitted for consideration. Any proposed exceptions to requirements shall be clearly and fully stated in one place, including required related changes to building systems, operating procedures, and maintenance functions.

1.3 PERMITS AND FEES

A. Obtain all permits and inspections required for the work involved and pay all charges incident thereto related to:
1. Water.
2. Sewer.

B. Deliver to the Owner all certificates of inspection.

C. Pay charges related to all utility connections and coordinate with utility company.

1.4 SUBMITTALS

A. See Division 1 for additional submittal requirements.

B. Provide submittals to indicate compliance with requirements. Submittals shall include:
1. Specification paragraph.
2. Manufacturer and model number.
3. Schedule information.

4. Electrical characteristics.
5. Accessories and options.
6. Installation instructions.
7. Deviations from requirements.

C. Product information for the following items shall be submitted for review:
1. Equipment scheduled on the drawings.
2. Other items specifically indicated to be submitted for review in other Sections.

D. Record on one set of plans all changes and deviations from the contract plans. Record final location of equipment, piping, controls, ductwork, etc. Make sufficient measurements to locate major duct and piping runs and show same on record plans as as-built conditions. Transfer changes and deviations to project drawings and deliver same to Owner's representative.

E. Submittals not specifically required, or not complying with the format requirements, will be returned unreviewed.

1.5 OPERATION AND MAINTENANCE INSTRUCTIONS

A. See Division 1 for additional requirements for Operation and Maintenance (O&M) instructions.

B. Provide O&M Manuals in PDF document format. The manuals shall consist of printed material that shall, as a minimum, include:
1. Parts lists for individual components of each piece of equipment.
2. Manufacturer's name and address.
3. Location of local parts supplier.
4. Manufacturer's published operation and maintenance instructions.
5. Data sheets highlighting equipment designations and model numbers.
6. Data sheets for fans shall include fan curve or performance data for the full range of static pressure and cfm capabilities, not just the design point.

1.6 INSTRUCTION OF OWNER PERSONNEL

A. Prior to a request for final inspection, at a time designated by the Architect, instruct operating personnel designated by the Owner in operation and maintenance of the systems. The contractor shall give notice to the Architect not less than 30 days prior to the anticipated date of instruction to allow planning by the Owner.

B. The training sessions shall include time in the field. The O&M Manuals shall be used as the basis of instruction. Prepare and insert additional data when need for such data becomes apparent during instruction.

C. The training shall consist of a minimum of on-site training. Training shall be conducted by the manufacturer's service personnel for each piece of equipment. Training shall include a review of the manufacturer's data sheets and O&M manuals. The contractor shall demonstrate, in the field, the sequence of operation of each piece of equipment and each system.

1.7 ELECTRICAL COORDINATION

A. Review Division 26 - Electrical for services supplied to equipment requiring electrical service. Provide equipment that matches services provided.

B. Drawings are based on the equipment of one manufacturer. If equipment actually furnished have requirements other than those indicated on the drawings, services shall be adjusted as required, at no additional cost to the owner. Such adjustments are subject to review by the Architect.

1.8 PRODUCT DELIVERY, STORAGE, HANDLING, AND PROTECTION

A. Provide a dry, weathertight space for storing materials. Store packaged materials in original shipping containers with manufacturer's labels and seals intact. Store equipment and material off the ground or floors exposed to rain.

B. Protect units against damage to coils by installing temporary closure panels over inlet openings. Panels shall be sheet metal, at least 24 gauge. Install closure panels over unit outlets until ductwork is connected.

C. Plug ends of pipes when work is stopped to prevent debris from entering pipes.

D. Equipment and materials shall not be installed until environmental conditions of the job site are suitable. Replace damaged materials.

1.9 CLEANING AND PAINTING

A. Remove oil, dirt, grease and foreign materials from all equipment to provide a clean surface. Touch-up scratched or marred surfaces of equipment enclosures with paint manufactured specifically for that purpose.

1.10 SEQUENCING AND SCHEDULING

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

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

C. Obtain approval from the Owner and Architect at least 7 days prior to any utility interruption or connection.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Equipment and materials shall be new.

B. Once a product line has been established, it shall be consistently maintained throughout the entire installation.

2.2 FIRE STOPS

A. Fire stops shall be asbestos free and shall provide a UL listed fire stopping system. Forming and backing material installed with the sealant shall be bulk ceramic fiber or rigid fiberboard rated for 2300^{0}F.

B. Fire stops shall be compliance with ASTM E84, ASTM E119, ASTM E814, ANSI/UL 263, and ANSI/UL 723.

C. Manufacturers: 3M 303 Fire Barrier, Dow Corning or GE Silicone Foam, Hilti Firestop, Nelson Flameseal, or Thompson & Betts Flame-Safe.

D. Plastic or insulated piping shall be fire stopped using an intumescent fire stopping system designed to expand under heat and seal the penetration. Dow Corning # 2002, 3M # 07270.

2.3 HANGERS AND SUPPORTS FOR PLUMBING SYSTEMS

A. Subject to compliance with requirements, pipe hangers and accessories shall be B-Line, Elcen, Michigan, or Grinnell.

B. Hangers:

1. Pipe hangers for steel and cast iron pipe shall be steel or malleable iron, unless indicated otherwise.
2. Hangers for steel pipes 2-1/2" and smaller shall be split ring type, adjustable swivel ring hangers; Elcen 92, Grinnell 104, or Michigan 111.
3. Hangers for cast iron pipe, 3" and larger shall be adjustable, clevis type, Elcen 12, Grinnell 260, or Michigan 400.
4. Copper piping hangers shall be copper plated. Hangers for copper piping 4" and smaller shall be copper-plated, Elcen 389, Grinnell CT-269, or Michigan 106; over 4" shall be Elcen 12, Grinnell 260, or Michigan 400.
5. Hangers for insulated lines shall be of sufficient size for pipe insulation protective shields to fit outside insulation.

C. Hanger rods:
1. Hangers shall be complete with rods and supports proportioned to the size of pipe to be supported.
2. Hanger rods shall be steel.
3. Hanger rod sizes for single pipes:

Pipe Size	Rod Diameter
2" and smaller	0.375"
2 ½" and 3"	0.5"
4"	0.625"
6"	0.75"
8" and larger	0.875"

4. Sizes for multiple pipe hangers shall be calculated for the total weight of supported piping.

D. Upper attachments:
1. Concrete construction:
   a. Inserts [for piping 2-1/2” and larger] installed in new concrete construction shall be adjustable type.
   b. Inserts installed [in existing concrete construction] [and for pipes 2” and smaller] shall be self-drilling shells by Elcen, Phillips Red Head, or Rawl Saber-Tooth.

2. Steel construction:
   a. For suspending pipes from steel beams provide beam clamps.
   b. For suspending pipes from bottom chord of steel bar joists provide C-clamps with retaining clips.
   c. For suspending pipes from the top chord of steel bar joists provide top-of-beam C-clamps.

E. Factory-fabricated framing channels and fittings:
1. Channel strut systems shall be 14 gauge minimum galvanized steel with factory punched attachment holes.
2. Galvanized pipe clamps, including bolts and nuts, shall be provided with the framing channels and shall be used for securing pipes to channels, except pipe roller type supports shall be provided for pipes 3” and larger for hot water and hot water recirculation.
3. Pipe roller supports shall include rollers, ½” diameter axle, nuts and angle brackets. Pipe clamps on insulated pipes shall fit around pipe, pipe insulation and pipe insulation protective shield. Pipe roller supports on insulated pipes shall be sized to fit around pipe saddles.
4. Framing channels and fittings shall be B-Line Systems B-Line’s Strut System, Michigan O-strut System, or Unistrut Metal Framing System.

F. Pipe supports for floor-supported horizontal piping:
1. Pipe supports for horizontal piping supported on concrete floors and on concrete bases shall be adjustable pipe saddle support with U-bolt and screwed floor flange. Adjustable pipe saddle supports shall be steel; B-Line Systems B3090, Elcen 49, or Michigan 721.
2. Pipe supports for horizontal piping in trench below floor level shall be adjustable pipe roller stands. Adjustable pipe roller stands shall be steel and cast iron; B-Line Systems B3118, Elcen 20, Grinnell 274, or Michigan 619.

G. Pipe supports for vertical piping:
1. Riser clamps shall be steel, B-Line Systems B3373, Elcen 39, Grinnell 261, or Michigan 510.
2. Offset pipe clamps shall be steel, B-Line Systems B3148, Elcen 44, Michigan 700.
3. Clamps for copper tubing shall be copper plated.

H. Insulation protective shields shall be galvanized sheet metal type. Shields shall be 180 degree type at all pipe hangers, except on trapeze hangers, pipe rack and on floor supported horizontal pipes shields shall be 360 degree type.

2.4 IDENTIFICATION OF PIPING, VALVES AND EQUIPMENT

A. Pipe identification shall be preprinted, semirigid snap-on, color-coded pipe markers in accordance with ASME A13.1. Provide pipe markers for the following:
1. Domestic cold water .
2. Domestic hot water [and hot water recirculating lines].

B. Coordinate piping labels with identification indicated on the Drawings.

2.5 PRESSURE RELIEF VALVES

A. Water pressure relief valves shall be ASME rated, bronze body construction with a steel spring. Pressure relief valves shall be: Mason-Neilan, Watts, or Wilkins.

2.6 PRESSURE REDUCING VALVES

A. Pressure reducing valves for water service shall be field adjustable with bronze body construction, stainless steel spring, and replaceable seat.

B. PRVs for plumbing water service shall be rated for [100] psig working pressure, and shall have an adjustable outlet pressure of not less than 35 to 75 psi. PRVs shall be: Watts, A.W. Cash, or Schade-Davis.

2.7 PRESSURE GAUGES AND GAUGE COCKS

A. Gauges shall be Bourdon tube type with 4 ½" dials, plexiglass dial covers, safety disc and ¼" connection. Range for each gauge shall be selected such that the typical operating range falls in the approximate midpoint of the range. Gauge cocks shall be brass with lever handle. Gauges and gauge cocks shall be: Ashcroft, Moeller, Trerice, Weksler or Weiss.

B. Gauges at pumps shall be liquid-filled.

2.8 THERMOMETERS AND TEST WELLS

A. Thermometers shall be red-reading mercury filled adjustable angle, industrial glass type with locking device. Scale length shall be 9" (225 mm). Thermometers shall include brass separable socket. Thermometers shall be: Ashcroft, Moeller, Trerice, Weskler or Weiss.

B. For uninsulated piping, stem shall be 3.5" (90 mm).

C. For insulated piping stem, shall be 6" (150 mm). Sockets shall be extension neck type equal to thickness of insulation.

D. Thermometer scale range shall be as follows:
1. Hot water 30 /240°F [0 /160°C]

E. Test wells shall be brass construction and shall include cap and chain with gasket. Test wells for thermometers on insulated piping shall be provided with extension neck of length equal to insulation thickness.

2.9 EXPANSION SEALS

A. Expansion seal for pipe penetrations of walls below grade shall be mechanical expansion type. Manufacturer shall determine the sizing of links and sleeve for pipe sizes indicated.

B. Expansion seals shall be: Calpico Pipe Linx, or Thunderline Link Seal.

PART 3 - EXECUTION

3.1 Materials shall be installed in accordance with the manufacturer's published recommendations for installation, in accordance with any listing restrictions of a certifying laboratory or agency, and in accordance with the requirements of the authorities having jurisdiction.

3.2 PIPE HANGERS AND SUPPORTS

A. Provide all hangers and rods, turnbuckles, angles, channels and other structural supports to support the piping systems.

B. Pipe hangers, hanger rods, trapeze type hangers, upper attachments and other supports shall be selected based on pipe size plus insulation, and weight of the medium being transported or the medium used for testing, whichever is heavier.

C. Pipe hangers for suspending domestic hot water and heating piping 2-1/2” and smaller shall be sized to fit directly around the pipe. For other insulated piping the hangers shall be sized to bear on the outside of the insulation, insulation protective shields, and saddles.

D. Provide pipe insulation protective shields where hangers or supports are installed on exterior of pipe insulation.

E. Horizontal runs of steel pipe shall be supported as follows:

Pipe Size	Spacing
2” and smaller	8'
2 ½” through 4"	10'
5” and larger	15'

F. Horizontal runs of copper tubing shall be supported with spacing not exceeding 6 feet for pipe size 3/4 inch and less, and 8 feet for pipe sizes 1 inch and larger.

G. Horizontal runs of plastic piping shall be supported in accordance with the following schedule:

Pipe Size	Spacing
1” and smaller	4-1/2'
1 ¼” to 3"	6'
4” and larger	8'

H. Horizontal runs of cast iron soil pipe shall be supported with hanger spacing not exceeding 5 feet with hanger placed behind soil pipe hub or at joint. Pipe hangers or supports shall be spaced not over 5 feet apart at valves.

I. Piping shall be supported not over one foot from each change in direction of piping.

J. Vertical piping shall be guided or supported in the center of each riser but with 10 feet maximum spacing and shall be supported at the base of the riser on a base elbow or tee with pipe stand.

K. Support domestic hot and cold water piping in chases behind plumbing fixtures with plastic brackets and U-bolts secure to cast iron stacks. Size U-bolts to bear on the piping.

L. In filler type concrete construction, inserts and anchors shall be installed in joists or beams only. Install inserts in sides of joists or beams. In framed type concrete construction, inserts and anchors shall be installed no closer than 6 inches to edge of slab. Where the weight to be supported by an insert is 300 pounds or more, install two No. 3 reinforcing bars, each 3 foot long, through the yoke of the insert.

M. Saddles shall be installed at all pipe hangers in horizontal insulated heating hot water, [steam, steam condensate and boiler feedwater] piping 3" in size and larger. Floor

supported piping shall have saddles on the top and bottom of the pipe. Weld saddle lugs to pipe and fill with the same type of insulation as the pipe insulation. Saddles shall be the same thickness as the pipe insulation.

N. Factory fabricated framing channels and fittings shall be used for:
1. Constructing pipe racks for supporting multiple horizontal pipes.
2. Constructing trapeze type hangers for suspending multiple horizontal pipes.
3. Securing vertical exposed water service drops for hose bibbs [and wall hydrants]

O. For floor supported piping, bolt floor flange to floor and bases using all bolt holes.

P. Waterproofing shall not be pierced by support bolts.

Q. The body of all underground piping shall be firmly bedded on solid ground for its entire length.

3.3 IDENTIFICATION OF PIPING, VALVES, AND EQUIPMENT

A. Pipe identification shall be installed in the following locations on all exposed piping and piping above accessible ceilings:
1. Equipment connections.
2. Piping change of directions.
3. Both sides of wall and floor penetrations.
4. Branch takeoffs.
5. At wall and ceiling access panels.
6. On 20 foot centers for exposed straight runs.

3.4 CUTTING AND PATCHING

A. Do not cut any structural member without written permission from the Architect.

3.7 EQUIPMENT START-UP AND CHECK-OUT

B. Verify readiness for start-up of each item of equipment on the basis of inspection, including:
1. Piping and equipment properly connected.
2. Equipment properly set.
3. Wiring properly connected.
4. Controls, safeties, and time switches properly set.
5. Electrical overloaded relays appropriate for load.
6. Electrical accessories properly installed and adjusted.
7. Clean filters in place.

C. Piping Systems:
1. Manually operate relief valves and verify that discharge openings and piping are clear and free-flowing.
2. Open air vents until air is removed from the systems.

D. Start-up equipment and check-out operation in accordance with manufacturer’s published procedures and with the procedures specified herein. Submit report on equipment start-up and check-out with data from recorded findings.

END OF SECTION 22 01 00

SECTION 222500

PLUMBING INSULATION

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

A. Materials shall be the standard products of manufacturers regularly engaged in the production of insulation products.

B. Unless otherwise specified, indoor insulation, adhesives and tapes shall have a flame spread rating no higher than 75 and a smoke developed rating no higher than 150.

C. The outside surface of insulation systems which are located in air plenums, in ceiling spaces, and in attic spaces shall have a flame spread rating no higher than 25 and a smoke developed rating no higher than 50.

D. Flame spread and smoke developed ratings shall be determined by ASTM E 84-1991a. Jackets shall comply with the flame spread and smoke developed ratings required by ASTM C 921. Products shall bear a label indicating flame spread and smoke developed ratings.

E. Materials containing asbestos shall not be used.

1.2 RELATED WORK

A. Where pipes and ducts pass through fire walls, fire partitions, above grade floors, and fire rated chase walls, the penetration shall be sealed with firestopping materials as specified in Section 22 01 00 PLUMBING GENERAL.

1.3 SUBMITTALS

A. Submit product information for insulation materials to the Architect in accordance with Division 1 and Section 22 01 00 PLUMBING GENERAL.

PART 2 - PRODUCTS

2.1 FIBERGLASS PIPE INSULATION

A. Insulation shall be preformed fiberglass, meeting ASTM C 547, maximum K-value of 0.23 Btu/in. per sq. ft.per °F per hour at 75°F (24°C) mean temperature, and white kraft paper jacket with self-sealing longitudinal lap. Insulation for cold pipes shall also include a vapor barrier.

B. Provide fiberglass pipe insulation for the following cold pipes:
1. Domestic cold water.
2. Waste pipe receiving condensate.

C. Provide fiberglass pipe insulation for the following hot pipes:
1. Domestic hot water [and hot water return lines].

D. Fiberglass pipe insulation thickness shall be 1" [except as follows:]

Service	Pipe Size	Thickness
Domestic cold water	All sizes	½"
Domestic hot water, hot water return (up to 140°F)	up to 1-1/2"	1"
Domestic hot water, hot water return (up to 140°F)	over 1-1/2"	1-1/2"
Domestic hot water, hot water return (141° to 200°F)	up to 1-1/2"	1-1/2"
Domestic hot water, hot water return (141° to 200°F)	over 1-1/2"	2"

E. Insulation shall be: CertainTeed, , Johns Manville, Knauf, Schuller, or Owens-Corning.

2.2 FIXTURE PIPING INSULATION

A. Handicapped type fixtures shall have the hot water supply and drain, including the trap, insulated where exposed. The insulation type shall be fiberglass or a pre-manufactured product manufactured specifically for use on handicapped type fixtures.

PART 3 - EXECUTION

3.1 GENERAL

A. Except as otherwise specified, material shall be installed in accordance with the manufacturer's written instructions.

B. Insulation materials shall not be applied until the following have been completed:
1. Rust, scale, dirt and moisture removed from surfaces to be insulated.
2. Required tests
3. Heat tracing.

C. Insulation shall be kept clean and dry. If insulation becomes wet, the insulation shall be removed from the jobsite and replaced with new.

D. Pipe insulation shall be omitted on the following:
1. Pipe used solely for fire protection.
2. Air chambers.
3. Underground domestic cold water piping.
4. Sanitary drain lines.
5. For the following items where the normal pipe operating temperature is above 60°F. (16°C):
   a. Unions.
   b. Strainers.
   c. Check valves.
6. Vents from pressure relief valves.
7. Chromium plated pipe to plumbing fixtures.

E. Seal all vapor barrier joints, breaks, and punctures with tape.

3.2 FIBERGLASS PIPE INSULATION

A. Install insulation after hydrostatic testing and installation of heat tape.

B. Install insulation with jacket drawn tight with side-laps and end joint butt strips secured. End joint butt strips shall be same material as jacket, not less than 3” wide.

C. For cold piping, except domestic cold water, at both butt ends of insulation sections, and at fittings, valves, riser clamps and inserts apply a wet coat of white vapor barrier coating and seal joints with 3" wide vapor barrier tape or band.

3.3 PIPES PASSING THROUGH SLEEVES AND PREPARED OPENINGS

A. Pipe insulation shall be continuous through pipe sleeves.

B. Where walls are indicated to be sealed, pipe penetrations shall be sealed. Provide aluminum jacket with factory applied moisture barrier shall be provided over the insulation. The aluminum jacket shall extend 2 inches (50 mm) beyond both sides of the wall and shall be secured on each end with a band.

3.4 PIPES PASSING THOUGH HANGERS

A. Insulation shall be continuous through hangers, except for domestic hot water and heating hot water piping 2-1/2” and smaller.

B. Insulated pipes shall be supported on hangers with the addition of a protection shield to protect insulation. The shield length shall be 6 inches.

C. A cellular glass or calcium silicate insulation insert shall be installed under each shield at pipes 2 inches (50 mm) and larger. The insert shall cover not less than the bottom 180 degree arc of the pipe. Inserts shall be the same thickness as the insulation, and shall extend 2 inches (50 mm) on each end beyond the protection shield.

D. Vertical pipes shall be supported with riser clamps with the addition of two protection shields covering the 360 degree arc of the insulation. An insulation insert of cellular glass or calcium silicate shall be installed between each shield and the pipe. The insert shall cover the 360 degree arc of the pipe. Inserts shall be the same thickness as the insulation, and shall extend 2 inches (50 mm) on each end beyond the protection shield. If the insulation thickness is less than 1 inch (50 mm) wooden or cork dowels or blocks may be installed between the pipe and the shield to prevent the hanger from crushing the insulation as an option instead of installing insulation inserts.

E. The vertical weight of pipe risers shall be supported with hangers located in a horizontal section of the pipe.

F. Vertical pipe risers longer than 30 feet (9 m), shall be additionally supported with hangers in the vertical run of the pipe which are directly clamped to the pipe, penetrating the pipe insulation. Hangers shall be insulated and the insulation jacket sealed as indicated herein for anchors in a similar service.

G. Inserts shall be covered with a jacket material of the same appearance and quality as the adjoining pipe insulation jacket, shall overlap the adjoining pipe jacket and shall be sealed as required for the pipe jacket. The jacket material used to cover inserts in flexible cellular insulation shall conform to ASTM C 921, Type 1, and is allowed to be of a different material than the adjoining insulation material.

END OF SECTION 22 25 00

SECTION 224100

PLUMBING PIPING, VALVES AND SPECIALTIES

PART 1 - GENERAL

1.1 RELATED WORK

A. See Section 22 01 00 PLUMBING GENERAL for piping hangers and supports, piping identification, pressure relief valves, pressure reducing valves, pressure gauges and gauge cocks, thermometers and test wells, pressure/temperature test plugs.

1.2 SYSTEM PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing piping systems with the following minimum working pressure ratings, except where indicated otherwise:
1. Water Distribution Systems, Below Ground: 150 psig.
2. Water Distribution Systems, Above Ground: 125 psig.
3. Soil, Waste, and Vent Systems: 10-foot head of water.

B. Quality Assurance
1. Comply with the provisions of ASME B31.9 "Building Services Piping" for materials, products, and installation.
2. Provide listing/approval stamp, label, or other marking on piping made to specified standards.

1.3 SUBMITTALS

A. Submit product information for piping and valves to the Architect in accordance with Division 1 and Section 22 01 00 PLUMBING GENERAL.

PART 2 - PRODUCT

2.1 PIPE AND FITTINGS

A. Water Distribution Piping Below Ground:
1. Piping: Soft copper tube, ASTM B 88, Type K.
2. Fittings: Cast copper alloy, solder joint pressure fittings with Alloy Sn95 solder, ASME B16.18.

B. Water Distribution Piping Above Ground:
1. Piping: Hard copper tube, ASTM B 88, Type L.
2. Fittings: Wrought-copper or cast copper alloy pressure fittings; and solder joints with Alloy Sn95 solder, ASME B16.22.
3. Copper Unions: ASME B16.18, cast-copper-alloy body, hexagonal stock, with ball-and-socket joint, metal-to-metal seating surfaces, and solder-joint, threaded, or solder-joint and threaded ends.
4. Threaded Ends: Threads conforming to ASME B1.20.1.
5. Bronze flanges: ASME B16.24, Classes 150 and 300;

C. Soil, Waste, and Vent Piping Below Ground:
   1. Piping: Hub-and-spigot cast-iron soil pipe, ASTM A 74.
   2. Fittings: Hub-and-spigot cast-iron soil pipe fittings, ASTM C 564 neoprene rubber gaskets, lubricant, and compression joints, ASTM A 74, Service Class.

D. Soil, Waste, and Vent Piping Above Ground:
   1. Piping: Hubless cast-iron soil pipe, CISPI 301.
   2. Fittings: Hubless cast-iron soil pipe fittings; stainless-steel, or cast-iron couplings for hubless cast-iron soil pipe and fittings; and hubless joints, with ASTM C 564 neoprene sealing sleeve, with stainless-steel corrugated shield-and-clamp assembly, CISPI 301.
   3. Sealing gasket: ASTM C 564 neoprene sealing gasket, with cast-iron housing and stainless steel bolts.

E. Wrought-Copper and Bronze, Grooved-End Fittings: ASTM B 75 (ASTM B 75M) Tube and ASTM B 584 Bronze Castings.

F. Wrought-Copper, Solder-Joint, DWV Drainage Fittings: ASME B16.29.

G. Cast-Copper-Alloy, Solder-Joint, DWV Drainage Fittings: ASME B16.23.

H. Malleable-Iron Unions: ASME B16.39, Classes 150 and 300, hexagonal stock, with ball-and-socket joint, metal-to-metal bronze seating surfaces, and female threaded ends having threads conforming to ASME B1.20.1.

I. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern, with threads conforming to ASME B1.20.1.

J. Galvanized, Cast-Iron Threaded Fittings: ASME B16.4, Classes 125 and 250, standard pattern, with threads conforming to ASME B1.20.1.

K. Galvanized, Cast-Iron Threaded Drainage Fittings: ASME B16.12, recessed drainage pattern, with threads conforming to ASME B1.20.1.

2.2 VALVES

A. Unless indicated otherwise, provide valves as follows:
   1. Shutoff Duty: Gate, ball, plug or butterfly valves.

B. Provide rising stem or rising outside screw and yoke stems. Nonrising stem valves may be used where headroom prevents full extension of rising stems.

C. Unless otherwise indicated, valves size shall be same size as upstream pipe.

D. Operators: Provide the following special operator features:
   1. Handwheels, fastened to valve stem, for valves other than quarter turn.
   2. Lever handles, on quarter-turn valves 6“ and smaller, except for plug valves. Provide plug valves with square heads; provide one wrench for every 10 plug valves.

E. Extended Stems: Where insulation is indicated or specified, provide extended stems arranged to receive insulation.

F. Comply with MSS SP-45 for bypass and drain connections.

G. Provide valves with the following connections types:
1. Solder-Joint for copper tube, 2" and smaller. Comply with ANSI B16.18. Use solder having a melting point below 840 F (449 C) for gate, globe, and check valves; below 421 F (216 C) for ball valves.
2. Threaded for steel pipe, 2" and smaller. Comply with ANSI B1.20.1.
3. Flanged for steel pipe, 2-1/2" and larger. Comply with ANSI B16.1 for cast iron, ANSI B16.5 for steel, and ANSI B16.24 for bronze valves.

H. Gate Valves
1. Gate Valves, 2" and Smaller: MSS SP-80; Class 125, body and bonnet of ASTM B 62 cast bronze; with threaded or solder ends, solid disc, copper-silicon alloy stem, brass packing gland, "Teflon" impregnated packing, and malleable iron handwheel. Provide Class 150 valves meeting the above where system pressure requires.
2. Gate Valves, 2" and Smaller: MSS SP-80; Class 150, body and union bonnet of ASTM B 62 cast bronze; with threaded or solder ends, solid disc, copper-silicon alloy stem, brass packing gland, "Teflon" impregnated packing, and malleable iron handwheel. Do not use solder end valves for hot water heating or steam piping applications.
3. Gate Valves, 2-1/2" and Larger: MSS SP-70; Class 125 iron body, bronze mounted, with body and bonnet conforming to ASTM A 126 Class B; with flanged ends, "Teflon" impregnated packing, and two-piece backing gland assembly.
4. Gate valves shall be: Crane, Grinnell, Hammond, Nibco, or Stockham,

I. Ball Valves
1. Ball Valves, 1 Inch and Smaller: Rated for 150 psi saturated steam pressure, 400 psi WOG pressure; two-piece construction; with bronze body conforming to ASTM B 62, standard (or regular) port, chrome-plated brass ball, replaceable "Teflon" or "TFE" seats and seals, blowout-proof stem, and vinyl-covered steel handle. Provide solder ends for condenser water, chilled water, and domestic hot and cold water service; threaded ends for heating hot water and low-pressure steam.
2. Ball Valves, 1-1/4" to 2": Rated for 150 psi saturated steam pressure, 400 psi WOG pressure; 3-piece construction; with bronze body conforming to ASTM B 62, conventional port, chrome-plated brass ball, replaceable "Teflon" or "TFE" seats and seals, blowout proof stem, and vinyl-covered steel handle. Provide solder ends for condenser water, chilled water, and domestic hot and cold water service; threaded ends for heating hot water and low-pressure steam.
3. Ball valves shall be: Conbraco, Crane, Grinnell, Jamesbury, Jenkins, Lunkenheimer, Nibco, Powell, Stockham, or Watts

J. Plug Valves
1. Plug Valves, 2" and Smaller: Rated at 150 psi WOG; bronze body, with straightaway pattern, square head, and threaded ends.
2. Plug Valves, 2-1/2" and Larger: MSS SP-78; rated at 175 psi WOG; lubricated plug type, with semisteel body, single gland, wrench operated, and flanged ends.
3. Plug valves shall be: Lunkenheimer or Powell

K. Globe Valves

1. Globe Valves, 2" and Smaller: MSS SP-80; Class 125; body and screwed bonnet of ASTM B 62 cast bronze; with threaded or solder ends, brass or replaceable composition disc, copper-silicon alloy stem, brass packing gland, "Teflon" impregnated packing, and malleable iron handwheel. Provide Class 150 valves meeting the above where system pressure requires.
2. Globe Valves, 2-1/2" and Larger: MSS SP-85; Class 125 iron body and bolted bonnet conforming to ASTM A 126, Class B; with outside screw and yoke, bronze mounted, flanged ends, and "Teflon" impregnated packing, and two-piece backing gland assembly.
3. Globe valves shall be: Crane, Grinnell, Hammond, Jenkins, Lunkenheimer, Milwaukee, Nibco, Powell, or Stockham.

L. Check Valves
1. Swing Check Valves:
   a. 2" and smaller: MSS SP-80; Class 125, cast-bronze body and cap conforming to ASTM B 62; with horizontal swing, Y-pattern, and bronze disc; and having threaded or solder ends. Provide valves capable of being reground while the valve remains in the line. Provide Class 150 valves meeting the above specifications, with threaded end connections, where system pressure requires or where Class 125 valves are not available.
   b. 2-1/2" and larger: MSS SP-71; Class 125, cast iron body and bolted cap conforming to ASTM A 126, Class B; horizontal swing, and bronze disc or cast-iron disc with bronze disc ring; and flanged ends. Provide valves capable of being refitted while the valve remains in the line.
   c. Swing check valves shall be: Crane, Grinnell, Hammond, Jenkins, Lunkenheimer, Milwaukee, Nibco, Powell, or Stockham.
2. Wafer Check Valves: Class 250, cast-iron body; with replaceable bronze seat, and non-slam design lapped and balanced twin bronze flappers and stainless steel trim and torsion spring. Provide valves designed to open and close at approximately one foot differential pressure. Wafer check valves shall be: Bell & Gossett, Center Line, Metraflex, Mission, or Stockham.
3. Lift Check Valves, 2" and Smaller: Class 125; cast-bronze body and cap conforming to ASTM B 62; horizontal or angle pattern, lift-type valve, with stainless steel spring, bronze disc holder with renewable "Teflon" disc, and threaded ends. Provide valves capable of being refitted and ground while the valve remains in the line. Lift check valves shall be: Hammond, Jenkins, Lunkenheimer.

2.3 PIPING SPECIALTIES

A. Backflow Preventers:
1. General: ASSE Standard, backflow preventers, of size indicated for maximum flow rate indicated and maximum pressure loss indicated.
   a. Working Pressure: 150 psig minimum except where indicated otherwise.
   b. 2 Inches and Smaller: Bronze body with threaded ends.
   c. 2-1/2 Inches and Larger: Bronze, cast-iron, steel, or stainless-steel body with flanged ends.
   d. Interior Lining: FDA-approved epoxy coating, for backflow preventers having cast-iron or steel body.
   e. Interior Components: Corrosion-resistant materials.

f. Exterior Finish: Polished chrome plate when used in chrome- plated piping system.
g. Strainer on inlet, where strainer is indicated.

2. Pipe-Applied, Atmospheric-Type Vacuum Breakers: ASSE 1001, with floating disc and atmospheric vent.
3. Hose Connection Vacuum Breakers: ASSE 1011, nickel plated, with nonremovable and manual drain features, and ASME B1.20.7 garden-hose threads on outlet. Units attached to rough-bronze-finish hose connections may be rough bronze.
4. Reduced Pressure Zone Backflow Preventer: ASSE 1013, NPT body connections, bronze ball valve shut-offs and bronze strainer.
5. Double Check Valve Assemblies: ASSE 1015, cast iron with bronze seats and gate valves on inlet and outlet.
6. Backflow preventers shall be: Ames, A.W. Cash, Cla-Val, Conbraco, Febco, Hersey, Grinnell, Sparco, Watts, Wilkins, or Zurn.

B. Water Pressure Regulators:
1. General: ASSE 1003, water pressure regulators, rated for initial working pressure of 150 psig minimum, of size, flow rate, and inlet and outlet pressures indicated. Include integral factory-installed or separate field-installed Y type strainer.
a. 2 Inches and Smaller: Bronze body with threaded ends.
b. 2-1/2 Inches and Larger: Bronze or cast-iron body with flanged ends.
c. Interior Lining: FDA-approved epoxy coating, for regulators with a cast-iron body.
d. Interior Components: Corrosion-resistant materials.
e. Exterior Finish: Polished chrome plate when used in chrome plated piping system.
2. Single-seated, direct-operated type.
3. Single-seated, direct-operated, integral-bypass type.
4. Pilot-operated type, single- or double-seated, cast-iron body main valve, with bronze-body pilot valve.
5. Water pressure regulators shall be Bermad, A.W. Cash, Cla-Val, Conbraco, G A Industries, Honeywell, Braukmann, Keckley, Spence, Watts, Wilkins, or Zurn.

C. Thermostatic Water-mixing Valves:
1. General: ASSE 1017, manually adjustable, thermostatic water-mixing valve with bronze body. Include checkstop and union on hot-water and cold-water supply inlets, adjustable temperature setting, and capacity at pressure loss as indicated.
2. Operation and Pressure Rating: Bimetal thermostat, 125 psig minimum.
3. Thermostatic Water-Mixing Valves: Unit, with options as indicated.
a. Piping, of sizes and in arrangement, with valves and unions indicated.
b. Piping Component Finish: Polished chrome plate.
c. Piping Component Finish: Satin spray.
d. Piping Component Finish: Rough brass.
e. Cabinet: Steel box with steel hinged door and white enameled finish.
f. Cabinet: Stainless-steel box with stainless-steel, hinged door.
g. Cabinet Mounting: Recessed.
h. Cabinet Mounting: Surface.
i. Thermometer.
4. Thermostatic water mixing valves shall be: Lawler, Leonard, Powers, Symmons, or T & S.

D. Strainers: Y pattern, except where otherwise indicated, full size of connecting piping. Include Type 304 stainless-steel screens with 3/64-inch perforations except where other screens are indicated.
   1. Pressure Rating: 125 psig minimum steam working pressure except where otherwise indicated.
   2. Sizes 2 Inches and Smaller: Bronze body, with female threaded ends.
   3. Sizes 2-1/2 Inches and Larger: Cast-iron body, with interior FDA-approved epoxy coating and flanged ends.
   4. Y-Type Strainers: Screwed screen retainer with centered blowdown.
      a. Drain: Pipe plug.
      b. Drain: Factory- or field-installed, hose-end drain valve.

E. Hose Bibbs: Bronze body, with renewable composition disc, 1/2 or 3/4 inch (DN 15 or DN 20) threaded or solder-joint inlet. Provide ASME B1.20.7 garden-hose threads on outlet and integral or field-installed, nonremovable, drainable, hose-connection vacuum breaker.
   1. Finish: Rough brass.
   2. Finish: Chrome or nickel plated.
   3. Operation: Wheel handle.
   4. Operation: Operating key (handle). Provide 1 operating key.

F. Wall Hydrants: ASME A112.21.3M or ASSE 1019, nonfreeze, automatic draining, antibackflow type, key operation, with 3/4 or 1 inch (DN 20 or DN 25) threaded or solder-joint inlet, and ASME B1.20.7 garden-hose threads on outlet. Provide 1 operating key.
   1. Type: Projecting.
   2. Type: Recessed.
   3. Finish: Rough bronze.
   4. Finish: Polished bronze.
   5. Finish: Nickel bronze.
   6. Wall Hydrants shall be: Ancon, Jones, Josam, Smith, Wade, Watts, Woodford, or Zurn.

G. Hose-End, Drain Valves: 3/4 inch ball valve, rated for 400 psig WOG. Include 2-piece bronze body conforming to ASTM B 62, standard port, chrome-plated brass ball, replaceable "TFE" seats and seals, blowout-proof stem, and vinyl-covered steel handle.
   1. Inlet: Solder-joint or threaded.
   2. Outlet: Short-threaded nipple with ASME B1.20.7 garden-hose thread and cap.
   3. Hose-End, Drain Valve Option: MSS SP-80, gate valve, Class 125, ASTM B 62 body, with 3/4 inch solder-joint or threaded inlet and ASME B1.20.7 garden-hose thread outlet and cap. Hose bibbs are prohibited for this application.

H. Water Hammer Arresters: ASME A112.26.1M, ASSE 1010, or PDI WH-201, bellows or piston type with pressurized cushioning chamber. Sizes are based on water-supply fixture units, ASME A112.26.1M sizes "A" through "F" and PDI WH-201 sizes "A" through "F." Water Hammer Arresters shall be: Amtrol, Ancon, Jones, Josam, Precision, Smith, Sioux, Wade, Watts or Zurn.

I. Trap Seal Primer Valves: ASSE 1018, water-supply-fed type, with the following characteristics:
   1. 125 psig minimum working pressure.
   2. Bronze body with atmospheric-vented drain chamber.

3. Inlet and Outlet Connections: 1/2 inch threaded, union, or solder joint.
4. Gravity Drain Outlet Connection: 1/2 inch threaded or solder joint.
5. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.
6. Trap seal primer valves shall be: Ancon, Jones, Josam, Wade, Watts, or Zurn.

J. Stack Flashing Fittings: Counterflashing-type, cast-iron fitting, with bottom recess for termination of roofing membrane, and with threaded or hub top for extension of vent pipe.

K. Vent Caps: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and set-screws to secure to vent pipe.

L. Vent Terminals: Commercially manufactured, shop-fabricated or field-fabricated, frost-proof assembly constructed of galvanized steel, copper, or lead-coated copper. Size to provide 1 inch enclosed air space between outside of pipe and inside of flashing collar extension, with counterflashing, as indicated.

M. Roof Flashing Assemblies: Manufactured assembly consisting of 4 psf lead flashing collar with boot and skirt extending at least 8 inches from pipe, with galvanized steel boot reinforcement and counterflashing fitting.

N. Cleanouts: Size cleanouts as indicated on drawings, or where not indicated, same size as connected drainage piping. Cleanouts larger than 4 inches are not required except where indicated. Provide ASME A112.36.2M, cast-iron body with straight threads and gasket seal or taper threads for plug, flashing flange and clamping ring, and a brass closure plug. Cleanouts for installation in floors not having membrane waterproofing may be furnished without clamping ring.

O. Floor Drains: Size outlets as indicated on the drawings. Provide ASME A112.21.1M, cast-iron body, with seepage flange and clamping device. Floor drains for installation in floors not having membrane waterproofing may have seepage flange without clamping device. Floor drains for use as area drains in exterior slab on grade may be furnished with anchor flange instead of seepage flange and clamping device. Provide trap primer connection on all open drains subject to evaporation.

PART 3 - EXECUTION

3.1 BURIED PIPING

A. Grade trench bottom to provide smooth, firm, stable, and rock-free foundation throughout length of piping.

B. Remove unstable, soft, and unsuitable materials at surface on which piping is to be laid and backfill with clean sand or pea gravel to indicated level.

C. Shape bottom of trench to fit bottom of piping. Fill unevenness with tamped-sand backfill. Dig bell holes at each pipe joint to relieve bells of loads and to ensure continuous bearing of pipe barrel on foundation.

D. Install detection tape over full length of buried piping.

3.2 SERVICE ENTRANCE PIPING

A. Extend water distribution piping and connect to water service piping of size and in location indicated for service entrance to building. Water service piping is specified in Division 2.

B. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside building at water service entrance.

C. Extend building sanitary drain piping and connect to sanitary sewer piping of size and in location indicated for service entrance to building. Install cleanout and extension to grade at connection of building sanitary drain and building sanitary sewer. Sanitary sewerage piping is specified in separate Section of Division 2.

D. Install sleeve and mechanical sleeve seal at service penetrations through foundation wall for watertight installation.

E. Prime and paint exterior gas pipe and fittings from meter to building interior to prevent corrosion.

3.3 WATER DISTRIBUTION PIPING

A. Install piping level without pitch.

3.4 DRAINAGE AND VENT PIPING INSTALLATION

A. Install cast-iron soil pipe and cast-iron soil pipe fittings according to CISPI 1990 revised and edited edition of "Cast Iron Soil Pipe and Fittings Handbook, Volume I," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

B. Make changes in direction for drainage and vent piping using appropriate Y branches, Y branches with 1/8 bends, and long-sweep 1/4, 1/5, 1/6, 1/8, and 1/16 bends. Sanitary tees and short-sweep quarter bends may be used on vertical stacks of drainage lines where change in direction of flow is from horizontal to vertical. Use long-turn double-Y-branch and 1/8-bend fittings where 2 fixtures are installed back to back or side by side and have a common drain. Straight tees, elbows, and crosses may be used on vent lines. Make no change in direction of flow greater than 90 degrees. Where different sizes of drainage pipes and fittings are connected, use proper size standard increasers and reducers. Reduction of the size of drainage piping in the direction of flow is prohibited.

C. Lay buried building drains beginning at low point of each system, true to grades and alignment indicated, with unbroken continuity of invert. Place hub or bell ends of piping facing upstream. Install required gaskets according to manufacturer's recommendations for use of lubricants, cements, and other special installation requirements. Maintain swab or drag in piping and pull past each joint as completed.

D. Install drainage and vent piping at the following minimum slopes, except where another slope is indicated:
   1. Sanitary Building Drain: 1/4 inch per foot for piping 3" and smaller; 1/8 inch per foot for piping 4" and larger.
   2. Horizontal Sanitary Drainage Piping: 1/4 inch per foot.

3. Vent Piping: 1/8 inch per foot.

3.5 CONNECTIONS

A. Supply Runouts to Fixtures: Install hot- and cold-water supply piping runouts of sizes indicated, but not smaller than required by plumbing code to fixtures.

B. Drainage Runouts to Fixtures: Provide drainage and vent piping runouts, with approved trap, of sizes indicated, but not smaller than required by plumbing code, to plumbing fixtures and drains.

C. Locate drainage piping runouts as close as possible to bottom of floor slab supporting fixtures or drains.

3.6 VALVES

A. Locate valves for easy access and provide separate support where necessary.

B. Install valves and unions for each fixture and item of equipment arranged to allow equipment removal without system shutdown. Unions are not required on flanged devices.

C. Install valves in horizontal piping with stem at or above the center of the pipe.

D. Install valves in a position to allow full stem movement.

E. Shutoff Valves: Install shutoff valves on inlet to each plumbing equipment item, on each supply to each plumbing fixture not having stops on supplies, and elsewhere as indicated. For shutoff valves 2" and smaller, use gate or ball valves; for shutoff valves 2-1/2" and larger, use gate or butterfly valves.

F. Drain Valves: Install drain valves specified in Division 22 Section "Plumbing Specialties" on each plumbing equipment item located to drain equipment for service and repair. Install drain valve at base of each riser, at low points of horizontal runs, and where required to drain water distribution piping system.
   1. Install hose-end drain valves at low points in water mains, risers, and branches.

G. Check Valves: Install swing check valve on discharge side of each pump and elsewhere as indicated. Use MSS SP-80, Class 125, cast-bronze body for 2" and smaller piping and MSS SP-71, Class 125, cast-iron body for 2-1/2" and larger piping. Install for proper direction of flow as follows:
   1. Swing Check Valves: Horizontal position with hinge pin level.
   2. Wafer Check Valves: Horizontal or vertical position, between flanges.
   3. Lift Check Valve: With stem upright and plumb.

H. Balance Valves: Install valve in each hot-water circulating loop, discharge side of each pump, and elsewhere as indicated. Use ball valve for 2" and smaller piping and butterfly valve for 2-1/2" and larger piping.

3.7 PIPING SPECIALTY INSTALLATION

A. Install backflow preventers of type, size, and capacity indicated, at each water supply connection to mechanical equipment and systems, and to other equipment and systems as indicated. Locate backflow preventer in same room as equipment being connected. Install air-gap fitting on units having atmospheric vent connection and pipe relief outlet drain to nearest floor drain. Do not install bypass around backflow preventer.

B. Install pressure-regulating valves with inlet and outlet shutoff valves and balance cock bypass. Install pressure gage on valve outlet and install valved bypass where indicated.

C. Install strainers on supply side of each control valve, pressure-regulating valve, and solenoid valve, and where indicated.

D. Install hose bibbs with integral or field-installed vacuum breaker.

E. Install wall hydrants with integral or field-installed vacuum breaker.

F. At all open trap drains subject to evaporation install trap seal primer valves with valve outlet piping pitched down toward drain trap a minimum of 1/8 inch per foot (1:100) (1 percent) and connect to floor drain body, trap, or inlet fitting. Adjust valve for proper flow.

G. Install cleanouts in above-ground piping and building drain piping as indicated, and where not indicated, according to the following:
   1. Size same as drainage piping up to 4 inches size. Use 4 inches size for larger drainage piping except where larger size cleanout is indicated.
   2. Locate at each change in direction of piping greater than 45 degrees.
   3. Locate at minimum intervals of 50 feet for piping 4 inches and smaller and 100 feet for larger piping.
   4. Locate at base of each vertical soil or waste stack.

H. Install cleanout deck plates (covers), of types indicated, with top flush with finished floor, for floor cleanouts for piping below floors.

I. Install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall, for cleanouts located in concealed piping.

J. Install flashing flange and clamping device with each stack and cleanout passing through floors having waterproof membrane.

K. Install vent flashing sleeves on stacks passing through roof. Secure over stack flashing according to the manufacturer's written instructions.

L. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1 inch clearance between vent pipe and roof substrate.

3.8 FLOOR AND ROOF DRAIN INSTALLATION

A. Install drains according to manufacturer's written instructions, in locations indicated.

B. Install drains at low points of surface areas to be drained, or as indicated. Set tops of drains flush with finished floor or roof.

C. Install drain flashing collar or flange so that no leakage occurs between drain and adjoining surface. Maintain integrity of waterproof membranes, where penetrated.

D. Position drains for easy accessibility and maintenance and protect from evaporation with trap seal primer valves or trap guards.

3.9 FIELD QUALITY CONTROL

A. Inspect water distribution piping as follows:
1. Do not enclose, cover, or put into operation water distribution piping system until it has been inspected and approved by the authority having jurisdiction.
2. During progress of the installation, notify the plumbing official having jurisdiction at least 24 hours prior to time inspection must be made. Perform tests specified below in presence of the plumbing official.
a. Roughing-In Inspection: Arrange for inspection of piping system before concealed or closed-in after system roughing-in and prior to setting fixtures.
b. Final Inspection: Arrange for final inspection by plumbing official to observe tests specified below and to ensure compliance with requirements of plumbing code.
3. Reinspections: When a plumbing official finds that piping system will not pass test or inspection, make required corrections and arrange for reinspection by the plumbing official.
4. Reports: Prepare inspection reports signed by plumbing official.

B. Test water distribution piping as follows:
1. Test for leaks and defects in new water distribution piping systems and parts of existing systems that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of system tested.
2. Leave uncovered and unconcealed in new, altered, extended, or replaced water distribution piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved for testing.
3. Cap and subject the piping system to a static water pressure of 50 psig (345 kPa) above the operating pressure without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for 4 hours. Leaks and loss in test pressure constitute defects that must be repaired.
4. Repair leaks and defects with new materials and retest system or portion thereof until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.
6. Inspect drainage piping as follows:
a. Do not enclose, cover, or put into operation drainage and vent piping system until it has been inspected and approved by the authority having jurisdiction.
b. During progress of installation, notify the plumbing official having jurisdiction at least 24 hours prior to time such inspection must be made. Perform tests specified below in presence of the plumbing official.
c. Roughing-In Inspection: Arrange for inspection of piping system after system roughing-in, before concealing, and prior to setting fixtures.
d. Final Inspection: Arrange for final inspection by plumbing official to observe tests specified below and to ensure compliance with requirements of plumbing code.

7. Reinspections: Make required corrections and arrange for reinspection by plumbing official when piping system fails to pass test or inspection.
8. Reports: Prepare inspection reports signed by the plumbing official.

C. Drainage and Vent Piping System Tests: Test drainage and vent systems according to procedures of authority having jurisdiction or, in absence of published procedure, as follows:
1. Test for leaks and defects in new drainage and vent piping systems and parts of existing systems that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with a diagram of the portion of the system tested.
2. Leave uncovered and unconcealed in new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose for testing work that has been covered or concealed before it has been tested and approved.
3. Rough Plumbing Test Procedure: Except for outside leaders and perforated or open-jointed drain tile, test piping of plumbing drainage and venting systems on completion of roughing-in piping installation. Tightly close all openings in piping system and fill with water to point of overflow, but not less than 10 feet head of water (30 kPa). Water level shall not drop during the period from 15 minutes before inspection starts through completion of inspection. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and their traps filled with water, test connections and prove gastight and watertight. Plug stack openings on roof and building drain where it leaves the building and introduce air into the system equal to pressure of 1 inch water column (250 Pa). Use a U tube or manometer inserted in the trap of a water closet to measure this pressure. Air pressure shall remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects using new materials and retest system or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.10 CLEANING

A. Clean and disinfect water distribution piping as follows:
1. Purge new potable water distribution piping systems and parts of existing potable water systems that have been altered, extended, or repaired prior to use.
2. Use purging and disinfecting procedure prescribed by authority having jurisdiction or, if a method is not prescribed by that authority, the procedure described in either AWWA C651 or AWWA C652 or as described below:
   a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
   b. Fill system or part thereof with water/chlorine solution containing at least 50 parts per million of chlorine. Isolate (valve off) and allow to stand for 24 hours.
   c. Drain system or part thereof of previous solution and refill with water/chlorine solution containing at least 200 parts per million of chlorine. Isolate and allow to stand for 3 hours.
   d. Flush system with clean, potable water until chlorine does not remain in water coming from system following allowed standing time.

e. Submit water samples in sterile bottles to authority having jurisdiction. Repeat procedure if biological examination made by the authority shows evidence of contamination.

B. Prepare and submit reports for purging and disinfecting activities.

C. Clean interior of piping system. Remove dirt and debris as work progresses.

3.11 COMMISSIONING

A. Fill water systems.

B. Before operating systems, perform these steps:
1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to full open position.
3. Open throttling valves to proper setting.
4. Remove plugs used during testing of piping systems and plugs used for temporary sealing of piping during installation.
5. Remove and clean strainer screens. Close drain valves and replace drain plugs.

C. Check plumbing equipment and verify proper settings, adjustments, and operation. Do not operate water heaters before filling with water.

D. Check plumbing specialties and verify proper settings, adjustments, and operation.

E. Energize pumps and verify proper operation.

END OF SECTION 22 41 00

SECTION 224400

PLUMBING FIXTURES

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with requirements of ANSI Standard A117.1, "Buildings and Facilities -- Providing Accessibility and Useability for Physically Handicapped People," and Public Law 90-480, "Architectural Barriers Act, 1968," with respect to plumbing fixtures for the physically handicapped.

B. Listing and Labeling: Provide electrically operated fixtures specified in this Section that are listed and labeled.
1. The terms "listed" and "labeled" shall be as defined in the National Electrical Code, Article 100.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

1.2 DELIVERY, STORAGE, AND HANDLING

A. Deliver plumbing fixtures in manufacturer's protective packing, crating, and covering.

B. Store plumbing fixtures on elevated platforms in a dry location.

1.3 SUBMITTALS

A. Submit product information for plumbing fixtures to the Architect in accordance with Division 1 and Section 22 01 00 PLUMBING GENERAL.

PART 2 - PRODUCTS

2.1 GENERAL

A. Furnish, set and connect all plumbing fixtures and trim, fittings, other components, and supports as specified hereinafter.

B. Manufacturers: All fixtures shall be the product of the same manufacturer, except for special types indicated.

C. Provide chrome plated finish on all exposed supply and waste services.

2.2 FIXTURES

A. Water Closets:
1. Manufacturers: Provide a product of one of the following:
a. American Standard, Inc.
b. Crane Plumbing/Fiat Products.
c. Eljer; A Household International Co.

d. Kohler Co.
e. Mansfield Plumbing Products, Inc.
f. Universal-Rundle Corp.

2. Water Closet: As scheduled with elongated bowl, bolt caps, fitted with a seat, chair carrier.

B. Urinals:

1. Manufacturers: Provide a product of one of the following:
   a. American Standard, Inc.
   b. Crane Plumbing/Fiat Products.
   c. Eljer; A Household International Co.
   d. Kohler Co.
   e. Mansfield Plumbing Products, Inc.
   f. Universal-Rundle Corp.
2. Urinal: As scheduled with: elongated rim, 2" outlet and wall hanger fitted with a flush valve and chair carrier.

C. Lavatories:

1. Manufacturers: Provide a product of one of the following:
   a. American Standard, Inc.
   b. Crane Plumbing/Fiat Products.
   c. Eljer; A Household International Co.
   d. Kohler Co.
   e. Mansfield Plumbing Products, Inc.
   f. Universal-Rundle Corp.
2. Lavatories: As scheduled with: perforated grid drain, insulated P-trap and insulated supplies with stops.

D. Mop Basins:

1. Manufacturers: Provide a product of one of the following:
   a. Aqua Glass Corp.
   b. Crane Plumbing/Fiat Products.
   c. Florestone Products Co., Inc.
   d. Stern-Williams Co., Inc.
   e. Swan Corp.
2. Mop Basins: Floor mounted receptor with cast brass drain, stainless steel strainer and stainless steel cap on all 4 sides. Provide with faucet specified hereinafter.

E. Sinks:

1. Manufacturers: Provide a product of one of the following:
   a. American Standard, Inc.
   b. Briggs Div.; Briggs Industries, Inc.
   c. Crane Plumbing/Fiat Products.
   d. Eljer; A Household International Co.
   e. Elkay Manufacturing Co.
   f. Just Manufacturing Co.
   g. Kohler Co.
   h. Moen Group; Stanadyne Corp.
   i. Universal-Rundle Corp.
2. Sinks: As scheduled with: sound deadened bowl fitted with scheduled faucet, perforated grid drain, 1-1/2" P-trap and wheel handle angle supplies.

F. Water Coolers and Drinking Fountains:
1. Manufacturers: Provide a product of one of the following:
a. EBCO Manufacturing Co.
b. Elkay Manufacturing Co.
c. Filtrine Manufacturing Co.
d. Halsey Taylor; A Household International Co.
e. Haws Drinking Faucet Co.
f. Sunroc Corp.
g. Western Drinking Fountains; Sunroc Corp.
2. Water Coolers: As scheduled with: removable chrome plated brass drain stainers, 1-1/2" cast brass P-trap, bubbler with built-in pressure regulator, touch pad activator that delivers water as long as pad is depressed, lead-free water distribution system and non-CFC refrigeration system. .

2.3 FIXTURE TRIM

A. Toilet Seats:
1. Manufacturers: Provide a product of one of the following:
a. Bemis Mfg. Co.
b. Beneke Div.; Sanderson Plumbing Products, Inc.
c. Church Seat Co.
d. Kohler Co.
e. Olsonite Corp.
f. Sperzel Industries, Inc.
2. General: Provide toilet seats compatible with water closets, and of type, color, and features indicated.
3. Toilet Seats: Extra heavy-duty, commercial/industrial type, elongated, open front, solid plastic, with check hinge.

B. Flush Valves:
1. Manufacturers: Provide a product of one of the following:
a. Coyne & Delany Co.
b. Sloan Valve Co.
c. Zurn Industries, Inc.; Flush Valve Operations.
2. Provide flushometers compatible with fixtures, with features and of consumption indicated.
3. Construction: Cast-brass body, brass or copper pipe or tubing inlet with wall flange and tailpiece with spud, screwdriver check stop, vacuum breaker, and brass lever handle actuation . Type shall be diaphragm operation.
4. Finish: Exposed metal parts shall be polished chrome-plated, except components installed in a concealed location may be rough brass or unfinished.

C. Plumbing Fixture Supports
1. Manufacturers: Provide a product of one of the following:
a. Ancon, Inc.
b. Josam Co.
c. Smith (Jay R.) Mfg. Co.
d. Wade Div.; Tyler Pipe.
e. Zurn Industries, Inc.; Hydromechanics Div.
2. General: ASME A112.6.1M, categories and types as required for wall-hanging fixtures specified, and wall reinforcement. Provide supports as follows:

a. Carriers: Supports for wall-hanging water closets and fixtures supported from wall construction. Water closet carriers shall have an additional faceplate and coupling when used for wide pipe spaces. Provide tiling frame or setting gage with carriers for wall-hanging water closets.
b. Chair Carriers: Supports with steel pipe uprights for wall-hanging fixtures. Urinal chair carriers shall have bearing plates.

D. Faucets
1. Manufacturers: Provide a product of one of the following:
a. American Standard, Inc.
b. Chicago Faucet Co.
c. Cambridge Brass Company
d. Central Brass
e. Delta; Commercial Faucet Division
f. Eljer; A Household International Co.
g. Kohler Co.
h. Royal Brass Mfg. Co.
i. T & S Brass and Bronze Works, Inc.
2. General: Unless otherwise specified, provide faucets that are cast brass with polished chrome-plated finish.

E. Fittings
1. Manufacturers: Provide a product of one of the following:
a. Brass Craft
b. McGuire Mfg. Co.
c. Kohler Co.
2. General: Unless otherwise specified, provide fittings fabricated of brass, with a polished chrome plated finish.
3. Escutcheons: Polished chrome-plated, sheet steel wall flange with friction clips.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for potable cold water and hot water supplies and soil, waste, and vent piping systems to verify actual locations of piping connections prior to installing fixtures.

B. Examine walls, floors, and cabinets for suitable conditions where fixtures are to be installed.

C. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF PLUMBING FIXTURES

A. Install supports for plumbing fixtures in accordance with categories indicated, and of type required:
1. Carriers for following fixtures:
a. Wall-hanging water closets.
2. Chair carriers for the following fixtures:
a. Wall-hanging urinals.

b. Wall-hanging lavatories and sinks.
c. Wall-hanging electric water coolers.

B. Install plumbing fixtures level and plumb, in accordance with fixture manufacturers' written installation instructions, roughing-in drawings, and referenced standards.

C. Install floor-mounted, floor-outlet water closets with closet flanges and gasket seals.

D. Install wall-hanging, back-outlet water closets with support manufacturer's tiling frame or setting gage.

E. Install wall-hanging, back-outlet urinals with gasket seals.

F. Fasten wall-hanging plumbing fixtures securely to supports attached to building substrate when supports are specified, and to building wall construction where no support is indicated.

G. Fasten counter-mounting-type plumbing fixtures to casework.

H. Secure supplies behind wall or within wall pipe space, providing rigid installation.

I. Set mop basins in leveling bed of cement grout.

J. Install stop valve in an accessible location in each water supply to each fixture.

K. Install trap on fixture outlet except for fixtures having integral trap.

L. Install escutcheons at each wall, floor, and ceiling penetration in exposed finished locations and within cabinets and millwork. Use deep pattern escutcheons where required to conceal protruding pipe fittings.

M. Seal fixtures to walls, floors, and counters using a sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color.

3.3 ADJUSTING AND CLEANING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Adjust water pressure at electric water coolers, and faucets, shower valves, and flushometers having controls, to provide proper flow and stream.

C. Replace washers of leaking and dripping faucets and stops.

D. Clean fixtures, fittings, and spout and drain strainers with manufacturers' recommended cleaning methods and materials.

3.4 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

END OF SECTION 22 44 00

SECTION 224600

DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

A. Provide water heaters and accessories complying with the following:
1. UL 174, "Household Electric Storage Tank Water Heaters."
2. UL 1453, "Electric Booster and Commercial Storage Tank Water Heaters."
3. NFPA 70 "National Electrical Code."

B. Provide water heaters and safety relief valves that comply with ASME Boiler and Pressure Vessel Code and that bear the appropriate code symbols.

1.2 WARRANTY

A. Special Project Warranty: Submit a written warranty, executed by manufacturer, agreeing to repair or replace water heater units that fail in materials or workmanship within the specified warranty period. Failures include, but are not limited to, tanks, coils, heat exchangers, and burners. This warranty shall be in addition to, and not a limitation of, other rights the Owner may have against the Contractor under the Contract Documents.

B. Warranty period is 3 years after date of Substantial Completion.

1.3 SUBMITTALS

A. Submit product information for domestic water heaters to the Architect in accordance with Division 1 and Section 22 0100 PLUMBING GENERAL.

PART 2 - PRODUCTS

2.1 STORAGE ELECTRIC WATER HEATERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Bradford-White Corp.
2. Lochinvar Water Heater Corp.
3. Rheem Mfg.
4. Ruud Mfg. Div.; Rheem Mfg.
5. A.O. Smith Water Products Co. Div.; A.O. Smith Corp.
6. State Industries, Inc.

B. Description: Automatic, electric, storage type; with 150 psig rated storage tank, integral controls, and relief valve.
1. Insulation: Fiberglass or polyurethane foam, surrounding tank.
2. Jacket: Steel, with baked-on enamel finish.
3. Tank: 150 psig rated, glass-lined steel, with anode rod.

4. Heating Element: Single, screw-in, immersion type.
5. Controls: Adjustable thermostat temperature control.
6. Safety Controls: Automatic, high-temperature-limit cutoff.
7. Temperature and Pressure Relief Valve: ASME rated and labeled, 3/4 inch size.
8. Vacuum Relief Valve: ANSI Z21.22, 3/4 inch size.
9. Storage Capacity: As Scheduled.
10. Electric Input: As Scheduled.
11. Minimum Recovery Rate: As Scheduled.
12. Electrical Characteristics: See electrical drawings.

PART 3 - EXECUTION

3.1 WATER HEATERS

A. Install thermometers on water heater inlet and outlet piping. Provide thermometers as indicated in Section 22 0100 PLUMBING GENERAL.

3.2 CONNECTIONS

A. Install piping adjacent to equipment arranged to allow servicing and maintenance.

B. Connect hot and cold water piping to units with shutoff valves and unions. Connect hot water circulating piping to unit with shutoff valve, check valve, and union. Extend relief valve discharge to closest floor drain.

C. Where water heater piping connections are dissimilar metals, make connections with dielectric fittings or dielectric unions.

D. Install vacuum relief valve in cold water inlet piping.

3.3 DRAIN

A. Install drain as indirect waste to spill into open drain or over floor drain.

B. Install drain valve at low point in water piping, for water heaters not having tank drain.

3.4 ELECTRICAL CONNECTIONS

A. Power wiring and disconnect switches are specified in Division 26.

B. Grounding: Connect unit components to ground in accordance with the National Electrical Code.

3.5 COMMISSIONING

A. Perform the following before start-up final checks:
1. Fill water heaters with water.
2. Piping systems test complete.
3. Check for piping connections leaks.
4. Check for clear vent.
5. Test operation of safety controls and devices.

B. Perform the following start-up procedures:
1. Energize circuits.
2. Adjust operating controls.

3. Adjust hot water outlet temperature setting.

END OF SECTION 22 4600

SECTION 230100

MECHANICAL GENERAL

PART 1 - GENERAL

1.1 ENERAL REQUIREMENTS

A. The requirements specified herein shall apply to all Sections of Division 23.

B. The plans accompanying these specifications are generally diagrammatic and do not show all details required for the complete work. Establish details of the work as necessary to provide for the complete installation of systems and materials.

C. Coordinate the work to avoid conflicts with items such as plumbing and fire protection piping, beams, fire barriers, ceiling types and heights, slab or wall thickness, cabinet heights, or door swings. Do not scale the plans for dimensions. Verify dimensions before starting work and report any discrepancy or interference to the Owner's representative for clarification.

1.2 QUALITY ASSURANCE

A. All mechanical work shall be in accordance with the following codes and agencies:
1. Georgia Building Code (International Building Code, 2018 Edition, with latest Georgia Amendments)
2. Georgia Mechanical Code (International Mechanical Code, 2018 Edition, with latest Georgia Amendments)
3. Georgia Energy Code (The International Energy Conservation Code, 2015 Edition with latest Georgia Amendments).
4. State and local ordinances governing mechanical work.
5. SMACNA HVAC Duct Construction Standards.

B. Where the requirements of the specifications or drawings exceed those of referenced codes, standards and regulations, the drawings or specifications shall govern.

C. Where UL listing is required, equipment and materials shall bear the UL label.

D. The manufacturer's names and catalog numbers are subject to compliance with requirements. Substitutes of equivalent materials and equipment may be submitted for consideration. Any proposed exceptions to requirements shall be clearly and fully stated in one place, including required related changes to building systems, operating procedures, and maintenance functions.

1.3 PERMITS AND FEES

A. Deliver to the Owner all certificates of inspection.

B. Pay charges related to all utility connections and coordinate with utility company.

1.4 SUBMITTALS

A. See Division 1 for additional submittal requirements.

B. Provide submittals to indicate compliance with requirements. Submittals shall include:
   1. Specification paragraph.
   2. Manufacturer and model number.
   3. Schedule information.
   4. Electrical characteristics.
   5. Accessories and options.
   6. Installation instructions.
   7. Deviations from requirements.

C. Product information for the following items shall be submitted for review:
   1. Equipment scheduled on the drawings.
   2. Other items specifically indicated to be submitted for review in other Sections.

D. Dimensioned drawings for the following shall be submitted. Reproducible copies of contract drawings shall not be used for creation of shop drawings. Indicate coordination with plumbing, fire protection, electrical, structural, and architectural design.
   1. 1/8” = 1’-0” scale floor plan drawings showing HVAC ductwork including mounting heights above finished floor.
   2. 1/8” = 1’-0” scale floor plan drawings showing HVAC piping including mounting heights above finished floor.
   3. Refrigerant piping layouts approved by the air conditioning unit manufacturer, including pipe sizing, valves, and accessories.

E. Record on one set of plans all changes and deviations from the contract plans. Record final location of equipment, piping, controls, ductwork, etc. Make sufficient measurements to locate major duct and piping runs and show same on record plans as as-built conditions. Transfer changes and deviations to project drawings and deliver same to Owner's representative.

F. Submittals not specifically required, or not complying with the format requirements, will be returned unreviewed.

1.5 OPERATION AND MAINTENANCE INSTRUCTIONS

A. See Division 1 for additional requirements for Operation and Maintenance (O&M) instructions.

B. Provide ane electronic PDF document form for O&M Manuals. The manuals shall consist of printed material that shall, as a minimum, include:
   1. Parts lists for individual components of each piece of equipment.
   2. Manufacturer's name and address.
   3. Location of local parts supplier.
   4. Manufacturer's published operation and maintenance instructions.
   5. Data sheets highlighting equipment designations and model numbers.
   6. Data sheets for fans shall include fan curve or performance data for the full range of static pressure and cfm capabilities, not just the design point.
   7. HVAC Controls.
   8. Final test and balance report.

1.6 INSTRUCTION OF OWNER PERSONNEL

A. Prior to a request for final inspection, at a time designated by the Architect, instruct operating personnel designated by the Owner in operation and maintenance of the systems. The contractor shall give notice to the Architect not less than 30 days prior to the anticipated date of instruction to allow planning by the Owner.

B. The O&M Manuals shall be used as the basis of instruction. Prepare and insert additional data when need for such data becomes apparent during instruction.

C. The training shall consist of on-site training. Training shall be conducted by the manufacturer's service personnel for each piece of equipment. Training shall include a review of the manufacturer's data sheets and O&M manuals. The contractor shall demonstrate, in the field, the sequence of operation of each piece of equipment and each system.

1.7 COMPLETION OF WORK

A. At a minimum of two weeks prior to a request for final inspection, the contractor shall have completed and submitted the complete test and balance report.

B. Incomplete Work: Prior to starting the inspection process at the semifinal or other inspections where work is inspected as being completed, the contractor shall give the Architect a list of work not completed, reason for incompletion, and date when said work will be completed.

C. Inspection: At final inspection the entire system shall be shown to be in specified working condition. The following shall be available during the inspection:
1. Contractor Representative.
2. Mechanic with hand tools.
3. Specified test data.
4. Certificates.
5. Controls Manufacturer's Representative.
6. Complete Specifications and Drawings with all addenda and revisions.
7. Operating and Maintenance Manuals.
8. Final submitted and approved test and balance report.
9. Contractor's Pre-Final Punch list indicating disposition of all items with initials of person confirming completion.

D. Uncovering of Concealed Work: Floor cleanouts shall be opened for inspection and then re-closed. Other concealed areas shall be opened upon request, where access is provided.

1.8 ELECTRICAL COORDINATION

A. Review Division 26 - Electrical for services supplied to equipment requiring electrical service. Provide equipment that matches services provided.

B. Drawings are based on the equipment of one manufacturer. If equipment actually furnished have requirements other than those indicated on the drawings, services shall be adjusted as required, at no additional cost to the owner. Such adjustments are subject to review by the Architect.

C. Motor quantities and sizes indicated are the minimum requirements. Larger motor sizes and equipment wattage ratings may be provided if necessary to meet the performance requirements specified herein or indicated on the Drawings. Where the provided motor quantity or sizes differ from indicated motor quantity or size, coordinate the electrical revisions and provide at no additional cost to the Owner.

1.9 PRODUCT DELIVERY, STORAGE, HANDLING, AND PROTECTION

A. Provide a dry, weathertight space for storing materials. Store packaged materials in original shipping containers with manufacturer's labels and seals intact. Store equipment and material off the ground or floors exposed to rain.

B. Protect units against damage to coils by installing temporary closure panels over inlet openings. Panels shall be sheet metal, at least 24 gauge. Install closure panels over unit outlets until ductwork is connected.

C. Plug ends of pipes when work is stopped to prevent debris from entering pipes.

D. Close open ends of ductwork with temporary closures of sheet plastic taped in place on horizontal ducts and sheet metal caps with drip overhangs from ducts opening upward.

E. Equipment and materials shall not be installed until environmental conditions of the job site are suitable. Replace damaged materials.

1.10 CLEANING AND PAINTING

A. Remove oil, dirt, grease and foreign materials from all equipment to provide a clean surface. Touch-up scratched or marred surfaces of equipment enclosures with paint manufactured specifically for that purpose.

1.11 SEQUENCING AND SCHEDULING

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

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

C. Obtain approval from the Owner and Architect at least 7 days prior to any utility interruption or connection.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Equipment and materials shall be new.

B. Once a product line has been established, it shall be consistently maintained throughout the entire installation.

2.2 FIRE STOPS

A. Fire stops shall be asbestos free and shall provide a UL listed fire stopping system. Forming and backing material installed with the sealant shall be bulk ceramic fiber or rigid fiberboard rated for 2300^0F.

B. Fire stops shall be compliance with ASTM E84, ASTM E119, ASTM E814, ANSI/UL 263, and ANSI/UL 723.

C. Manufacturers: 3M 303 Fire Barrier, Dow Corning or GE Silicone Foam, Hilti Firestop, Nelson Flameseal, or Thompson & Betts Flame-Safe.

2.3 HANGERS AND SUPPORTS FOR HVAC SYSTEMS

A. Subject to compliance with requirements, pipe hangers and accessories shall be B-Line, Elcen, Michigan, or Grinnell.

B. Hangers:
1. Hangers for steel pipes 2-1/2" and smaller shall be split ring type, adjustable swivel ring hangers; Elcen 92, Grinnell 104, or Michigan 111.
2. Copper piping hangers shall be copper plated. Hangers for copper piping 4" and smaller shall be copper-plated, Elcen 389, Grinnell CT-269, or Michigan 106; over 4" shall be Elcen 12, Grinnell 260, or Michigan 400.
3. Hangers for insulated lines shall be of sufficient size for pipe insulation protective shields to fit outside insulation.

C. Hanger rods:
1. Hangers shall be complete with rods and supports proportioned to the size of pipe to be supported.
2. Hanger rods shall be steel.
3. Hanger rod sizes for single pipes:

Pipe Size	Rod Diameter
2" and smaller	0.375"
2 ½" and 3"	0.5"

4. Sizes for multiple pipe hangers shall be calculated for the total weight of supported piping.
5. Hanger rod sizes for sprinkler piping shall be in accordance with NFPA 13.

D. Upper attachments:
1. Concrete construction:
   a. Inserts [for piping 2-1/2” and larger] installed in new concrete construction shall be adjustable type.
   b. Inserts installed [in existing concrete construction] [and for pipes 2” and smaller] shall be self-drilling shells by Elcen, Phillips Red Head, or Rawl Saber-Tooth.
2. Steel construction:
   a. For suspending pipes from steel beams provide beam clamps.
   b. For suspending pipes from bottom chord of steel bar joists provide C-clamps with retaining clips.

c. For suspending pipes from the top chord of steel bar joists provide top-of-beam C-clamps.

E. Factory-fabricated framing channels and fittings:
1. Channel strut systems shall be 14 gauge minimum galvanized steel with factory punched attachment holes.
2. Galvanized pipe clamps, including bolts and nuts, shall be provided with the framing channels and shall be used for securing pipes to channels, except pipe roller type supports shall be provided for pipes 3” and larger for heating hot water[, steam, steam condensate, boiler feedwater].
3. Pipe roller supports shall include rollers, ½” diameter axle, nuts and angle brackets. Pipe clamps on insulated pipes shall fit around pipe, pipe insulation and pipe insulation protective shield. Pipe roller supports on insulated pipes shall be sized to fit around pipe saddles.
4. Framing channels and fittings shall be B-Line Systems B-Line’s Strut System, Michigan O-strut System, or Unistrut Metal Framing System.

F. Pipe supports for floor-supported horizontal piping:
1. Pipe supports for horizontal piping supported on concrete floors and on concrete bases shall be adjustable pipe saddle support with U-bolt and screwed floor flange. Adjustable pipe saddle supports shall be steel; B-Line Systems B3090, Elcen 49, or Michigan 721.
2. Pipe supports for horizontal piping in trench below floor level shall be adjustable pipe roller stands. Adjustable pipe roller stands shall be steel and cast iron; B-Line Systems B3118, Elcen 20, Grinnell 274, or Michigan 619.

G. Pipe supports for vertical piping:
1. Riser clamps shall be steel, B-Line Systems B3373, Elcen 39, Grinnell 261, or Michigan 510.
2. Offset pipe clamps shall be steel, B-Line Systems B3148, Elcen 44, Michigan 700.
3. Clamps for copper tubing shall be copper plated.

H. Insulation protective shields shall be galvanized sheet metal type. Shields shall be 180 degree type at all pipe hangers, except on trapeze hangers, pipe rack and on floor supported horizontal pipes shields shall be 360 degree type.

PART 3 - EXECUTION

3.1 Materials shall be installed in accordance with the manufacturer's published recommendations for installation, in accordance with any listing restrictions of a certifying laboratory or agency, and in accordance with the requirements of the authorities having jurisdiction.

3.2 PIPE HANGERS AND SUPPORTS

A. Provide all hangers and rods, turnbuckles, angles, channels and other structural supports to support the piping systems.

B. Pipe hangers, hanger rods, trapeze type hangers, upper attachments and other supports shall be selected based on pipe size plus insulation, and weight of the medium being

transported or the medium used for testing, whichever is heavier.

C. Pipe hangers for suspending domestic hot water and heating piping 2-1/2” and smaller shall be sized to fit directly around the pipe. For other insulated piping the hangers shall be sized to bear on the outside of the insulation, insulation protective shields, and saddles.

D. Provide pipe insulation protective shields where hangers or supports are installed on exterior of pipe insulation.

E. Horizontal runs of steel pipe shall be supported as follows:

Pipe Size	Spacing
2” and smaller	8'
2 ½” through 4"	10'
5” and larger	15'

F. Horizontal runs of copper tubing shall be supported with spacing not exceeding 6 feet for pipe size 3/4 inch and less, and 8 feet for pipe sizes 1 inch and larger.

G. Horizontal runs of plastic piping shall be supported in accordance with the following schedule:

Pipe Size	Spacing
1” and smaller	4-1/2'
1 ¼” to 3"	6'
4” and larger	8'

H. Horizontal runs of cast iron soil pipe shall be supported with hanger spacing not exceeding 5 feet with hanger placed behind soil pipe hub or at joint. Pipe hangers or supports shall be spaced not over 5 feet apart at valves.

I. Piping shall be supported not over one foot from each change in direction of piping.

J. Vertical piping shall be guided or supported in the center of each riser but with 10 feet maximum spacing and shall be supported at the base of the riser on a base elbow or tee with pipe stand.

K. In filler type concrete construction, inserts and anchors shall be installed in joists or beams only. Install inserts in sides of joists or beams. In framed type concrete construction, inserts and anchors shall be installed no closer than 6 inches to edge of slab. Where the weight to be supported by an insert is 300 pounds or more, install two No. 3 reinforcing bars, each 3 foot long, through the yoke of the insert.

L. Saddles shall be installed at all pipe hangers in horizontal insulated heating hot water, [steam, steam condensate and boiler feedwater] piping 3" in size and larger. Floor supported piping shall have saddles on the top and bottom of the pipe. Weld saddle lugs to pipe and fill with the same type of insulation as the pipe insulation. Saddles shall be the same thickness as the pipe insulation.

M. Factory fabricated framing channels and fittings shall be used for:
   1. Constructing pipe racks for supporting multiple horizontal pipes.
   2. Constructing trapeze type hangers for suspending multiple horizontal pipes.

N. For floor supported piping, bolt floor flange to floor and bases using all bolt holes.

O. Waterproofing shall not be pierced by support bolts.

P. The body of all underground piping shall be firmly bedded on solid ground for its entire length.

3.7 EQUIPMENT START-UP AND CHECK-OUT

Q. Verify readiness for start-up of each item of equipment on the basis of inspection, including:
   1. Adjustment of vibration isolators.
   2. Alignment of shafts and couplings.
   3. Direction of rotation by jogging motor.
   4. Completion of lubrication procedures.
   5. Piping and equipment properly connected.
   6. Equipment properly set.
   7. Wiring properly connected.
   8. Controls, safeties, and time switches properly set.
   9. Electrical overloaded relays appropriate for load.
   10. Electrical accessories properly installed and adjusted.
   11. Clean filters in place.

R. Prepare first-run checklist for equipment, perform first-run observations and record findings.
   1. Verify direction of motor rotation after final electrical connections.
   2. Measure ampere draw of electric motors and compare with nameplate rating and with overload heater ratings.
   3. Monitor temperature build-up in motors and bearings.

S. Start-up equipment and check-out operation in accordance with manufacturer's published procedures and with the procedures specified herein. Submit report on equipment start-up and check-out with data from recorded findings.

T. In addition to other requirements specified herein, manufacturer shall provide services to start-up, check-out, and test the following equipment and systems:
   1. Rooftop air conditioning units (DOAS Units).

U. Air measuring and control system:
   1. Manufacturer shall provide start-up services, and demonstration testing for the Owner to verify the accuracy of each system, and shall submit a certificate indicating same.

V. DDC System Acceptance Conditions:
   1. Calibration and testing: calibrate equipment and verify operation before the system is placed on-line. Check each control point within the system by making

a comparison between the control command at the operator console and field-controlled device. DDC control loops, interlocks, sequences, energy management programs and alarms shall be tested and stable operation verified. Control loop parameters and tuning constants shall be adjusted to produce accurate, stable control system operation. Before obtaining permission to schedule the acceptance test, provide written certification that the installed complete system has been calibrated, tested and is ready to begin acceptance testing.

2. Acceptance test: conduct the final acceptance test, with the Owner on site, on the complete and total installed and operational automation system to demonstrate that it is functioning in accordance with requirements specified herein. Demonstrate the correct operation of monitored and controlled points as well as the operation and capabilities of sequences, reports, specialized control algorithms, diagnostics and software.
   a. Final system acceptance will be based upon the completion of the following items:
      1. Completion of the installation of hardware and software items. Demonstrate complete operation of the system, including hardware and software, with no failure during a [ ] consecutive day period. Obtain receipt from the Owner acknowledging no failures within the test period. Submit a daily log documenting failures.
      2. Satisfactory completion of the record drawings, and operating and maintenance manuals.
      3. Satisfactory completion of training programs.
   b. Upon final acceptance, the warranty period shall begin.

3.8 TESTING, ADJUSTING AND BALANCING

A. The Contractor shall obtain the services of an independent test and balancing agency who shall perform testing and balancing of:
   1. Air distribution systems including each register and diffuser.
   2. HVAC piping systems.
   3. Scheduled equipment.

B. The testing and balancing agency shall be [a certified member of AABC or NEBB. The balancing personnel shall be familiar with and perform the balancing in accordance with AABC or NEBB procedures using forms of the appropriate organization.

C. Instruments used for testing and balancing of air and hydronic systems shall have been calibrated within (6) months prior to balancing.

D. Final readings shall be set within -5% and +10% of design conditions.

E. Report format:
   1. Report forms shall be the standard forms of the AABC or NEBB.
   2. The report shall by typed and bound in a hardback 3-ring binder.
   3. Include a title page with name and address of project; name and address of Contractor; dates of all tests; name and telephone number of balancing agency.

4. Flow data for each register, grille and diffuser.
5. Flow data for each piece of equipment.
6. Report any defects, deficiencies, or abnormal conditions in the mechanical systems which prevent system balance. Make recommendations for correcting unsatisfactory items which cannot be successfully balanced.
7. Report shall be signed by balancer and shall have been completed and submitted prior to final inspection.

F. Do not proceed with adjusting and balancing work until work is complete and operable, and piping and ductwork testing, cleaning and flushing, specified equipment start-up and check-out is complete.

G. Air system procedure:
1. Adjust air handling and distribution systems to provide required or design supply, return, relief, and exhaust air quantities.
2. Make air quantity measurements in ducts by traverse of entire cross sectional area of duct.
3. Measure air quantities at air inlets and outlets.
4. Use volume control devices to regulate air quantities only to the extent that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers.
5. Vary total system air quantities by adjustment of fan speeds. Replace equipment belts and/or sheaves as necessary for the correct performance of the system test and balance. Vary branch air quantities by damper regulation.
6. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Allow for 50 percent loading of filters.
7. Adjust automatic outside air, return, relief and exhaust air dampers for design conditions. For variable volume systems, balance for minimum outside air, when each air handling unit is operating at its maximum air quantity. Return air dampers shall be adjusted to a less than fully open position only if required to achieve the minimum outside air quantity indicated on the drawings. Return and minimum outside air damper linkages shall be adjusted to position their respective dampers at full stroke.
8. Measure temperature conditions across closed outside air, return air, relief air and exhaust air dampers to check leakage.
9. Where modulating dampers are provided, take measurements and balance at extreme conditions.
10. Adjust pattern adjustment devices in diffusers for horizontal discharge, unless otherwise indicated on the drawings.
11. Balance and adjust systems to prevent food odor from migrating from kitchen and dining areas.

H. The Test and Balance Agency shall:
1. Retest, adjust, and balance systems subsequent to significant system modifications; re-record test results.
2. Report excessive noise levels and vibration that cannot be corrected by balancing procedures.
3. Record all data representing actually measured or observed condition.

4. Patch holes in insulation, vapor barriers, ductwork, and housings, which have been cut or drilled for test purposes.
5. Mark equipment settings, including damper control positions, valve indicators, fan speed control devices, and controls and devices, to show final settings at completion of testing, adjusting, and balancing work. Provide markings either paint or permanent identification materials.

END OF SECTION 23 01 00

SECTION 23 65 10

SPLIT SYSTEM AIR-CONDITIONING EQUIPMENT

PART 1 - GENERAL

1.1 RELATED WORK

A. Motors shall be as indicated in Section 23 01 00, MECHANICAL GENERAL.

1.2 WARRANTY

A. Equipment provided under this Section shall be provided with a parts and labor warranty, including refrigerants and lubricants, for 1 year after date of substantial completion.

B. Compressors shall be furnished with the manufacturer's 5-year warranty, i.e., a 4-year extended warranty in addition to the standard 1-year warranty.

1.3 SUBMITTALS

A. Submit product information for air-conditioning equipment to the Architect in accordance with Division 1 and Section 23 01 00, MECHANICAL GENERAL.

PART 2 - PRODUCTS

2.1 GENERAL

A. Units shall be UL listed.

B. All moving parts shall be protected with factory installed metal guards. Rotating parts shall be statically and dynamically balanced at the factory.

C. Portions of equipment exposed to the weather shall be constructed of heavy gauge galvanized steel with a factory weatherproof finish.

D. Coils shall be constructed of copper tubes and aluminum fins mechanically bonded to the tubes.

E. Units shall be provided with oil filter and oil level sight glass, suction line accumulator, and relief valve or fusible plug.

F. Units shall be furnished with factory refrigerant precharge.

2.2 COMPRESSORS

A. Compressors shall be scroll.

B. Compressors shall be provided with:
1. Crankcase oil heaters.
2. Rapid cycling protection by an adjustable time delay switch.
3. Positive pressure lubrication system with reversible oil pump.
4. Vibration isolators.
5. Suction and discharge service valves.
6. Oil-level bull's eye.
7. Thermal protectors embedded in motor windings
8. 60 second oil pressure safety.
9. Manual restart after thermal overload or low oil pressure shut-down.

C. Controls shall include:
1. Suction and discharge pressure gauges with valves.
2. Automatic head pressure control for operation down to 50 °F.
3. Factory wired 24V control transformer.
4. Weatherproof electrical enclosure.

2.3 HEAT PUMPS

A. Condensing unit shall be designed, fitted, tested, and rated in accordance with ARI 210/240. Unit shall include compressors, motors, condensers, controls, mounting frame, and enclosure.

B. Provide coil guard to protect condenser fins from damage.

C. Heat pump units shall be provided with reversing valve and defrost control system.

D. Provide a low refrigerant pressure safety switch.

E. Unit shall be manufactured by: Carrier, Trane, or York.

2.4 INDOOR SECTION FOR SPLIT SYSTEMS UNITS

A. The indoor unit shall be manufactured by the same manufacturer as the matching outdoor section. The enclosure shall be insulated and designed for vertical airflow, bottom. Fans shall be 3-speed centrifugal type. Unit shall include coil, expansion valve, check valve, condensate drain pan, filters and [1"] thick throwaway filters installed in a filter rack.

B. Electric heat shall be exposed element type, Nickel chrome coiled wire, with minimum 1 wire diameter open space between adjacent coils. Maximum wire density shall be 37 watts per square inch. Maximum wire surface temperature shall be 1400 F. Coils rated more than 48 amperes shall have heating elements subdivided. Each subdivided load shall not exceed 48 amperes and shall be fuse protected. Integral terminal boxes shall include:
1. Load carrying type thermal cutouts for secondary over-temperature protection with manual reset.
2. Thermal cutouts for primary over-temperature protection with automatically reset.
3. Line feeder and control connection terminal blocks.
4. Incoming line fuses for ungrounded conductors.
5. Controls transformer with fused primary and 120V or 24V secondary for 3-phase heaters.

2.5 MISCELLANEOUS PIPING

A. Furnace intake and exhaust piping shall be Schedule 40 pipe and fittings meeting requirements of ASTM D 1785 "Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120."

B. Refrigerant Piping:
1. Refrigerant suction and liquid lines shall be Type L copper tubing, sized as recommended by the condensing unit/evaporator coil manufacturer. Precharged line sets may be provided at the Contractor's option, and as recommended by the manufacturer.
2. Solder shall be 95/5 tin antimony or tin/silver alloy type; flux shall be nonacid type, approved by solder manufacturer.]

PART 3 - EXECUTION

3.1 Units shall be installed as indicated and as recommended by the manufacturer.

3.2 Condensate drain shall be piped full size to nearest floor drain. Provide condensate drain traps and slope drain from trap to floor drain at 1/4" per foot (minimum).

3.3 Controls:

A. Install thermostats where indicated.

B. Control Wiring: Install in compliance with NEC. Install cables and conductors simultaneously where more than one can be installed with the same routing. Bundle cables neatly together. Conceal all cable in finished spaces. Install exposed cable parallel and perpendicular to surfaces or exposed structural members, and follow surface contours, where possible. Make splices and connections only within junction boxes and equipment enclosures. Use connectors that are compatible with conductor material. Make terminations so there is no bare conductor at terminals. Provide substantial support for wiring and run clear or equipment access paths. Wiring located exterior to the building shall be installed in liquid-tight flexible conduit in accordance with Division 26.

C. Provide all control relays and contactors required for automatic control of equipment. [Coordinate requirements with Section 23 95 00 HVAC CONTROLS.]

3.4 Grade level condensing units shall be provided with and secured to a 6" high concrete pad.

3.5 PIPING

A. Refrigerant piping:
1. Clean inside of refrigerant lines with methyl alcohol before assembly and take care thereafter to prevent flux and foreign matter from being sealed in. Cut pipe ends square deburr. Clean pipe and fittings with #00 steel wool.
2. Make joints with a gas brazing process. During brazing, purge the interior of the pipe continuously with nitrogen. Use flux for brazing dissimilar metals.

3. Provide refrigerant piping between indoor evaporator coils and outdoor condensing units in accordance with equipment manufacturer's recommendations.

B. Condensate drain piping:
1. Do not combine furnace drain piping with cooling coil drain piping.
2. Slope combustion chamber drain downward to floor drain. Anchor to wall with wall clamps, allowing free movement through clamp for expansion.
3. Connect coil condensate piping to drain pans and construct piping with trap as indicated in the detail. Terminate at floor drain to suit local code requirements.

END OF SECTION 23 65 10

SECTION 26 05 00

BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 DESCRIPTION AND DEFINITIONS

A. This division of the Specifications covers the complete electrical systems as indicated on the drawings or as specified herein. Provide all equipment, materials, labor, and supervision to install electrical systems. The requirements of this Section apply to all electrical work hereinafter described. The General and Special Conditions are considered a part of this Division of the Specifications and all provisions contained therein which affect this work are as binding as though incorporated herein.

B. The following words and phrases shall be interpreted as indicated:
1. "approved": approved or accepted by Governing Officials or Authorities Having jurisdiction
2. "materials": equipment and/or materials
3. "or equal/or equivalent": an equivalent with respect to appearance or function as determined by the Architect/Engineer; submittal approval may be required - refer to individual specification sections
4. "provide": furnish, install, connect, and test the operation thereof
5. "work": materials provided - see above definitions
6. "wiring": conductors/cabling and raceway system, including fittings, boxes, connectors, supports, hardware, labeling, and related accessories

1.2 QUALITY ASSURANCE

A. All electrical work shall be in accordance with the latest locally adopted edition of the following codes and agency standards:
1. National Electrical Code, 2017 Edition, with Georgia Amendments.
2. The National Electrical Safety Code (ANSI C-2).
3. The Life Safety Code (NFPA 101).
4. Occupation Safety and Health Administration (OSHA).
5. Regulations of the local serving utility company regarding metering and service entrance.
6. Accessibility Codes: Americans with Disabilities Act Guidelines (ADA), and ANSI A117.1, and Georgia Accessibility Code.
7. International Building Code, with Georgia Amendments.
8. International Energy Conservation Code (IECC 2009) with latest Georgia amendments.
9. Municipal or other locally enforced ordinances governing electrical work.

B. Material Standards: All material shall conform to the standards where such standards have been established for the particular material indicated. Publications and standards of the organizations listed below are applicable to materials specified herein.
1. American National Standards Institute (ANSI)
2. Insulated Cable Engineers Association (ICEA)
3. Institute of Electrical and Electronic Engineers (IEEE)
4. National Electrical Manufacturers Association (NEMA)
5. National Fire Protection Association (NFPA)
6. Underwriters' Laboratories, Inc. (UL)

C. Listing and Labeling: Provide equipment assemblies that are listed and labeled.
   1. The terms "listed" and "labeled": As defined in the National Electrical Code, Article 100.
   2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

1.3 PERMITS

A. Obtain all permits and inspections for the installation of this work and pay all charges incident thereto. Deliver to the Owner all certificates of said inspection issued by authorities having jurisdiction.

1.4 WARRANTY

A. The Contractor warrants to the Owner and Architect that materials and equipment furnished under this Contract will be of good quality and new unless otherwise required or permitted by the Contract Documents, that the Work will be free from defects not inherent in the quality required or permitted, and that the Work will conform with the requirements of the Contract Documents. Work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective. The Contractor's warranty excludes remedy for damage or defect caused by modifications not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear under normal usage. If required by the Architect, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment. Refer to Division 1 for other warranty requirements.

1.5 PROJECT DOCUMENTS

A. Keep on hand at the project site a complete set of all project drawings and specifications, including, but not limited to, all architectural and engineering drawings. Refer to these documents as necessary; coordinate and install all work accordingly so that all electrical equipment will be properly located and accessible.

B. The drawings are diagrammatic and are intended to indicate the arrangements of electrical equipment. Do not scale drawings. Obtain dimensions for layout of equipment from drawings of other trades unless indicated on Electrical plans. Review drawings of other trades for door swings, cabinets, counters, and built-in equipment; conditions indicated on Architectural plans shall govern. Coordinate installation of electrical equipment with structural system and mechanical equipment and access thereto. Coordinate installation of electrical equipment with ductwork and piping, and wall thickness. Verify construction dimensions at the site and make changes necessary to conform to the building as constructed. Work improperly installed due to lack of construction verification shall be corrected at no additional cost to the Owner.

C. Equipment layout is based on one manufacturer's product. Where equipment selected by the Contractor for use on the project differs from layout indicated, the Contractor shall be responsible for coordinating space requirements and connection arrangements.

D. Bring all discrepancies shown on different drawings, between drawings and specifications or between documents and field conditions to the immediate attention of the Architect.

1.6 SUBMITTALS

A. Shop Drawings and Product Data:
   1. Submit for review by the Architect data for materials and equipment to be used on the project. Submittals shall be supported by descriptive material, catalog cuts, diagrams,

and performance charts published by the manufacturer to show conformance to specification and drawing requirements. Model numbers alone will not be acceptable. Provide documentation of complete electrical characteristics for all equipment.

2. Provide equipment layout plans, drawn to ¼”=1’-0”, showing the space arrangement of electrical spaces such as main service equipment area, electrical closets, and each area where electrical distribution equipment is to be installed. Base layout on dimensions of the equipment actually submitted for use on the project. Submit plans for review with shop drawings.
3. Refer to the individual sections for indication of equipment for which submittals are required.
4. Refer to Division 1 for additional information on submittal requirements.

B. Record Documents: Refer to Division 1 for requirements for record documents, as-built drawings, and related submittals.

1.7 EQUIPMENT REQUIRING ELECTRICAL SERVICE

A. Review all specification sections and drawings for equipment requiring electrical service. Provide service to and make connections to all equipment requiring electrical service.

B. Drawings indicate equipment with loads, horsepowers, voltages, and corresponding control equipment, feeders, and overcurrent devices which were used as a basis for design. If equipment actually furnished have loads other than those indicated on the drawings or specified herein, control equipment, feeders, and overcurrent devices shall be adjusted in size accordingly at no additional cost to the Owner. Such adjustment shall be subject to the review of the Architect.

C. Incidental items not indicated on the drawings or mentioned in the specifications but that can legitimately and reasonably be inferred to belong to the work or be necessary in good practice to provide a complete system, shall be furnished and installed as though itemized here in detail.

1.8 MECHANICAL SYSTEMS INTERFACE

A. All control wiring and associated raceway systems for mechanical systems shall be provided under Divisions 21, 22, 24, and 25, unless otherwise shown on the Electrical drawings. Review Division 21, 22, 24, and 25 specifications, project drawings, and shop drawings for control systems to assure compatibility between equipment furnished under Division 26 and wiring furnished under Division 21, 22, 24, and 25.

B. Motor controllers (starters) shall be provided under Division 26, unless otherwise indicated to be provided under Division 21, 22, 24, and 25 as an integral component of Division 21, 22, 24, and 25 equipment.

C. Power wiring to all motors and controllers and between motors and controllers shall be provided under Division 26.

D. All electric heating equipment shall be provided and installed under Division 23. Power wiring to all electric heating equipment shall be provided under Division 26.

1.9 SITE INVESTIGATION

A. Prior to submitting bids for the project, visit the site of the work to become aware of existing conditions which may affect the cost of the project.

1.10 SCHEDULING OF OUTAGES OF EXISTING SERVICES

A. Electrical work requiring interruption of electrical circuits which would adversely affect the normal operation of the other portions of the Owner's property, shall be done at a time acceptable to the Owner. Schedule all work requiring interruption of electrical circuits at least two weeks prior to actual shutdown. Submit schedule in writing indicating extent of system to be de-energized, date and time when power is intended to be interrupted, and date and time power will be restored. Schedule shall be subject to the review of the Architect and the Representative of the Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Furnish all materials specified herein or indicated on the drawings. All materials shall be new, unless otherwise indicated.

B. Where Underwriters' Laboratories (UL) testing standards and listings exist for an item of material or equipment, the listed material shall bear the UL label.

PART 3 - EXECUTION

3.1 PRODUCT DELIVERY, STORAGE, HANDLING, AND PROTECTION

A. Inspect materials upon arrival at site and verify conformance with project requirements. Prevent unloading of unsatisfactory material. Handle materials in accordance with applicable standards and recommendations, and in a manner to prevent damage to materials. Store packaged materials in original undamaged condition with manufacturer's labels and seals intact. Containers which are broken, opened, damaged, or watermarked are unacceptable and shall be removed from the premises and replaced.

B. All material, except items specifically designed to be installed outdoors, shall be stored in an enclosed, dry building or trailer. Areas for general storage shall be provided. Provide temperature and/or humidity control where necessary. All material for interior installation, including conductors, shall be stored in an enclosed weathertight structure and shall be protected from water, direct sunlight, cold or heat. Equipment stored other than as specified above shall be removed from the premises and replaced.

C. Equipment and materials shall not be installed until such time as the environmental conditions of the job site are suitable to protect the equipment or materials. Conditions shall be those for which the equipment or materials are designed to be installed.

3.2 CLEANING, PAINTING, AND IDENTIFICATION

A. Remove oil, dirt, grease and foreign materials from all raceways, boxes, panelboard trims and cabinets to provide a clean surface for painting. Touch-up scratched or marred surfaces of lighting fixtures, panelboard and cabinet trims, or other equipment enclosures with paint furnished by the equipment manufacturer specifically for that purpose.

B. Where painting of trim covers for flush mounted panelboards, communication equipment cabinets, pull boxes, junction boxes, and control cabinets is required under this or any other Division of these specifications, remove trim covers before painting. Do not paint locks, latches, hinges, or exposed trim clamps.

C. Where plywood backboards are used to mount equipment provided under Divisions 26, 27, or 28, paint backboards with two coats of light gray paint. Provide fire-retardent plywood, 3/4" thick minimum.

D. Identify electrical components where required in the individual specification sections.
   1. Equipment connected to utility power shall have black faced nameplates. Equipment connected to emergency power shall have red faced nameplates
   2. Nameplates shall be constructed from laminated phenolic engraved plastic three-ply with a white interior core at least 1/16 inch thick.
   3. Plastic strips shall be stamped, pressure-sensitive adhesive type labels, with white letters.
   4. Stencils shall be machine cut with 1/4-inch high minimum size letters. Paint shall be enamel or lacquer type. Unless otherwise indicated, labeling shall use condensed gothic letters and arabic numerals properly spaced for easy and legible reading.
   5. Nameplates for surface mounted equipment shall be installed on the exterior, and for flush or recessed mounted equipment shall be installed on the inside of the door or cover with epoxy cement adhesive, unless otherwise indicated.

3.3 EXCAVATION, TRENCHING AND BACKFILLING

A. Perform all excavation to install underground circuiting and raceway systems indicated on the drawings or specified herein. During excavation, pile material for backfilling back from the banks of the trench to avoid overloading and to prevent cave-ins. Provide shoring as required by OSHA Standards. Remove and dispose of all excavated materials not to be used for backfill. Grade to prevent surface water from flowing into trenches and excavation. Remove any water accumulating therein by pumping.

B. Grade the bottom of trenches to provide uniform bearing and support for underground circuiting and raceway systems on undisturbed soil at every point along entire length. Tamp overdepths with loose, granular, moist earth. Remove unstable soil that is not capable of supporting equipment or installation and replace with specified material for a minimum of 12" below invert of equipment or installation.

C. Backfill the trenches with excavated materials approved for backfilling, consisting of earth, loam, sandy clay, or sand and gravel, free from large clods of earth and stones, deposited in 6" layers and tamped until the installation has a cover of not less than the adjacent ground but not greater than 2" above existing ground. Backfill simultaneously on both sides of the trench. Compaction of the filled trench shall be at least equal to that of the surrounding undisturbed material. Do not settle backfill with water. Reopen any trenches not meeting compaction requirements or where settlement occurs, refill, compact, and restore surface, mounded over and smoothed off.

D. Refer to Division 31 for additional requirements.

3.4 COORDINATION AND COOPERATION

A. Schedule the work, coordinate, and cooperate with all trades to avoid interferences, delays, and unnecessary work. If any conflicts occur which, in the installer's opinion, necessitate departures from the drawings and specifications, details of departures and reasons therefore shall be submitted in writing for the Architect's consideration.

B. Notify other trades of dedicated electrical space to ensure those spaces stay clear of pipes, duct work and other foreign systems.

3.5 OPERATION AND MAINTENANCE MANUALS AND INSTRUCTIONS

A. Provide printed material for binding in operation and maintenance manuals. Include electrical equipment shop drawings as a minimum, and other information as necessary. Refer to Division 1 for additional information on submittal requirements.

B. Instructions of Owner Personnel:

1. Before final project review, as designated by the Architect, provide a competent representative to instruct Owner's designated personnel in systems indicated.
2. Use Operation and Maintenance Manuals as basis of instruction. Review contents with personnel in detail to explain all aspects of operation and maintenance.
3. Prepare and insert additional data in Operation and Maintenance Manuals when the need for such data becomes apparent during instruction.

3.6 ELECTRICAL ACCEPTANCE TESTS AND MANUFACTURERS CERTIFICATION

A. Refer to the individual specification sections and the Electrical Acceptance Testing section for equipment or system test requirements. Testing documentation shall be provided for reference at the time of final project review.

B. Where specified under the individual system specification sections, the systems shall be reviewed for compliance with these specifications, installation in accordance with the manufacturer's recommendations, and system operation by a representative of the manufacturer. The manufacturer shall submit certification that the system has been reviewed by the manufacturer, is installed in accordance with the manufacturer's recommendations, and is operating in accordance with the specifications.

3.7 CONSTRUCTION OBSERVATION ASSISTANCE

A. Provide personnel to assist the Architect or his representative during all construction observation visits. Provide tools and equipment as required to demonstrate the system operation and provide access to equipment, including screwdrivers, wrenches, ladders, flashlights, circuit testing devices, meters, keys, etc.

B. Remove panelboard trims, motor controls covers, device plates, junction box covers, etc. as directed for inspection of internal wiring. Turn over to the Owner one set of keys for all lockable electrical equipment on the project. Accessible ceilings shall be removed as directed for inspection of equipment installed above ceilings.

C. Energize and de-energize circuits and equipment as directed. Demonstrate operation of equipment and systems as directed.

D. Provide authorized representatives of the manufacturers to demonstrate to the Architect compliance with the Contract Documents at a time designated by the Architect.

END OF SECTION 26 05 00

SECTION 26 05 19

WIRES AND CABLES

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work required under this section of the specifications consists of the furnishing, installation and connection of the building wiring system. Exterior branch circuit wiring and feeder conductors extended beyond the building are included. Wiring systems for communication and other signaling systems are not included in this section unless specified to be included, by reference, in the respective specification sections for these systems.

1.2 QUALITY ASSURANCE

A. Industry Referenced Standards. The following specifications and standards are incorporated into and become a part of this Specification by reference.

1. Underwriters' Laboratories, Inc. (UL) Publications:
   a. No. 44 Rubber - Insulated Wire and Cables
   b. No. 83 Thermoplastic - Insulated Wires
   c. No. 493 Thermoplastic - Insulated Underground Feeder and Branch Circuit Cables
   d. No. 486 Wire Connectors and Soldering Lugs
   e. No. 486A Wire Connectors and Soldering Lugs for Use with Copper Conductors.
   f. No. 486C Splicing Wire Connectors.
   g. No. 486D Insulated Wire Connectors for Use With Underground Conductors.
2. Insulated Cable Engineers Association (ICEA) Standards:
   a. S-61-402 Thermoplastic Insulated Wire and Cable
3. National Electrical Manufacturers' Association (NEMA) Standards:
   a. WC-5 Thermoplastic Insulated Wire and Cable
4. National Fire Protection Association (NFPA) Publications:
   a. No. 70 National Electrical Code (NEC)
5. Institute of Electrical and Electronics Engineers (IEEE) Standards:
   a. No. 241 IEEE Recommended Practice for Electric Power Systems in Commercial Buildings.
   b. No. 404 Standard for Power Cable Joints.
6. American Society for Testing and Materials (ASTM):
   a. No. B3 Soft or Annealed Copper Wire.
   b. No. B8 Concentric Lay Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
   c. No. B33 Tinned Soft or Annealed Copper Wire for Electrical Purposes
   d. No. B172 Rope Lay Stranded Copper Conductors, Having Bunch Stranded Members for electrical Conductors.
   e. No. B539 Standard Methods for Measuring Contact Resistance of Electrical Connections (Static Contacts).
7. American National Standards Institute (ANSI) Standards:
   a. CC3 Connectors for use between aluminum or aluminum-copper overhead conductors.
   b. RS-364-21A Insulation Resistance Test.

c. SG-14 Unplated split-bolt and Vice-Type Electrical Connectors for Copper Conductors.

8. National Electrical Contractors' Association (NECA):
   a. Standards of Installation

B. Acceptable Manufacturers. Products by the following manufacturers which conform to this specification are acceptable.

1. Insulated cable - copper:
   a. Cablec
   b. Carol
   c. Okonite
   d. Southwire
   e. American Insulated Wire
   f. Rome
2. Mechanically applied (crimp) conductor terminations:
   a. Scotch (3M)
   b. Ideal
   c. Thomas and Betts (T&B)
   d. Burndy
3. Vinyl electrical insulating tape:
   a. Scotch (3M)
   b. Tomic
   c. Permacel
4. Twist-On Wire Connectors:
   a. Scotch (3M)
   b. Ideal
   c. Buchanan
5. Encapsulated insulating kits:
   a. Scotch (3M)
   b. Raychem
   c. Essex Group, Inc.
6. Portable cable fittings:
   a. Crouse Hinds
   b. Appleton
   c. Thomas and Betts (T&B)
7. Hydraulically applied conductor terminations:
   a. Square D
   b. Burndy
   c. Ilsco
   d. Scotch (3M)
   e. Thomas and Betts (T&B)
8. Metal-clad (MC) cable:
   a. Cablec
   b. Carol
   c. Okonite
   d. Southwire
   e. American Insulated Wire
   f. Rome
   g. AFC

PART 2 - PRODUCTS

2.1 GENERAL MATERIALS REQUIREMENTS

A. Provide all materials under this section of the specifications.

B. All wire and cable shall be UL listed and shall bear a UL label along the conductor length at intervals not exceeding 24 inches.

C. All conductors shall have size, grade of insulation, voltage and manufacturer's name permanently marked on the outer cover at intervals not exceeding 24 inches.

D. Conductor size shall be a minimum of No. 12 AWG, but shall not be less than indicated on the drawings.

E. Insulation voltage level rating shall be 600 volts.

2.2 MATERIALS DESCRIPTION

A. Conductors No. 10 AWG and smaller shall be solid copper, 90 degrees centigrade type THHN/THWN or XHHW, unless otherwise indicated on the drawings, required by the National Electrical Code or specified elsewhere in Division 26.

B. Conductors larger than No. 10 AWG shall be stranded copper, 90 degrees centigrade, type THHN/THWN, XHHW, unless otherwise indicated on the drawings, required by the National Electrical Code, or specified herein.

C. Lighting fixture wire shall be No. 16 AWG silicone rubber insulated, stranded fixture wire, type SFF-2 (150 degrees centigrade), or No. 16 AWG thermoplastic, nylon jacketed stranded fixture wire, type TFFN (90 degrees centigrade).

D. Portable power cables and outlets shall be provided where indicated on the drawings. Cables shall be sized as indicated on the drawings with equal size green equipment ground. #14/2 with ground may be used for connection to lighting fixtures. Cables shall be jacketed 600 volt SO type. Cable connectors shall be steel case liquid tight sized for cable diameter and shall use strain relief gland fitting to prevent tension on conductor terminations. Use wire mesh strain relief cable grips at both ends of cable. Use cast type outlet device box for device cable drops.

E. Splices and taps.
   1. No. 10 AWG and smaller: Dry type connectors shall have live spring allowing reentry twist-off operation without damaging conductors. Connectors for solid conductors shall be solderless, screw-on, spring pressure cable type, 600 volt, 105 degree centigrade with integral insulation, UL approved for aluminum and copper conductors. Connectors for stranded conductors shall be crimp-on type with integral insulation cover.
   2. No. 8 and larger: Hydraulically applied crimping sleeve or tap connector sized for the conductor or indent, split-bolt or bolt clamp-type connectors. Insulate the hydraulically applied connector with 90 degree centigrade, 600 volt insulating cover. Insulate the mechanically applied connectors with heat shrink insulator sleeve or plastic electrical insulating type. Insulator materials and installation shall be approved for the specific application, location, voltage and temperature.

F. General requirements for connections: For each electrical connection indicated, provide complete assembly of materials, including but not necessarily limited to, pressure connectors, terminals

(lugs), electrical insulating tape, heat-shrinkable insulating tubing, cable ties, solderless wire-nuts, and other items and accessories as needed to complete splices and terminations of types indicated.

G. Connectors and Terminals: Provide electrical connectors and terminals which mate and match, including sizes and ratings, with equipment terminals which are recommended by equipment manufacturer for intended applications.

H. Electrical Connection Accessories: Provide electrical insulating tape, heat-shrinkable insulating tubing and boots, wirenuts and cable ties as recommended for use by accessories manufacturers for type services indicated.

I. Electrical insulating tape shall be 600 volt, flame retardent, cold and weather resistant, .85 mil thick minimum plastic vinyl.

2.3 MC CABLE OPTION

A. At the Contractor's option, metal-clad cable may be used for branch circuiting in areas with accessible ceilings and metal stud drywall partition construction or other areas as indicated on the plans, for 20A, 120V branch circuits except homeruns, where permitted by the National Electrical Code. Outer jacket shall be impervious metal sheath without an overall nonmetallic covering listed for use in environmental air plenums. Conductors shall be copper, minimum size No. 12, with THHN/THWN or XHHN insulation. Each cable shall contain an internal grounding conductor; the outer jacket shall not be used for the ground. Type AC cable, or BX, shall not be used. For circuits serving receptacles, the metal clad cable shall contain a neutral conductor sized 173% (minimum) of the phase conductor ampacity; or individual, dedicated, separate neutrals shall be provided for each branch circuit (i.e., no sharing of neutrals).

PART 3 - EXECUTION

3.1 EXECUTION

A. Install all wiring in raceway system, except where conductors are indicated or specified not to be installed in raceway. No conductors shall be installed into conduit until the conduit system is complete. Ideal #77, Carlon-Slikum, Burndy "Slikon", or other approved pulling compound shall be used when pulling conductors into conduit.

B. Do not install more conductors in a raceway than indicated on the drawings. A maximum of three branch circuits are to be installed in any one conduit, on a 3 phase 4 wire system, unless specifically indicated otherwise on the drawings. No two branch circuits of the same phase are to be installed in the same conduit, unless specifically indicated on the drawings.

C. Conductors shall be electrically continuous and free from short circuits or grounds. All open, shorted or grounded conductors and any with damaged insulation shall be removed and replaced with new material free from defects.

D. Color code all service, feeder, and branch circuit conductors. Control and signal system conductors need not be color coded. Phase conductors No. 10 and smaller shall have solid color compound insulation or color coating. Phase conductors No. 8 and larger shall have solid color compound, color coating or colored phase tape. Colored tape shall be installed on conductors in every box, at each terminal point, cabinet, pullbox or other enclosure. Grounded conductor (i.e., neutrals and equipment grounds) color coding shall comply with the National Electrical Code requirements. Coding shall be as follows:

1. 208Y/120 volt three phase four wire system - Phase A: Black, Phase B: Red, Phase C: Blue, Neutral: White
2. 480Y/277 volt three phase four wire system - Phase A: Brown, Phase B: Orange, Phase C: Yellow, Neutral: Gray
3. 240/120 volt single phase three wire system - Phase A: Black, Phase B: Red, Neutral: White
4. Grounding conductors shall be green. Grounding conductors for isolated ground circuits shall be green with a yellow trace.

E. Maintain phase rotation established at service equipment throughout entire project.

F. Group and lace with nylon tie straps all conductors within enclosures, i.e. panels, motor controllers, and cabinets.

G. Support conductors installed in vertical raceways at intervals not exceeding those distances indicated in the National Electrical Code. Support conductors in pull boxes with bakelite wedge type supports provided for the size and number of conductors in the raceway.

H. Secure portable cables in accordance with the NEC. Install strain relief devices to prevent tension on terminations if cable is pulled. Install cable grips on drops and connect to outlet box or structure. Leave slack cable loop at drop point.

I. Connect all conductors. Install electrical connections as indicated, in accordance with equipment manufacturer's written instructions and with recognized industry practices, and complying with applicable requirements of Industry Referenced Standards.

J. Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams. Mate and match conductors of electrical connections for proper interface between electrical power supplies and installed equipment.

K. Cover splices with electrical insulating material of equivalent, or of greater insulation resistivity rating, than electrical insulation rating of those conductors being spliced.

L. Prepare cables and wires by cutting and stripping covering armor, jacket, and insulation properly to ensure uniform and neat appearance where cables and wires are terminated. Exercise care to avoid cutting through tapes which will remain on conductors. Also avoid "ringing" copper conductors while skinning wire.

M. Trim cables and wires as short as practicable and arrange routing to facilitate inspection, testing and maintenance.

N. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturers' published torque tightening values for equipment connectors. Tighten by utilizing proper torquing tools, including torque screwdriver, beam-type torque wrench, and ratchet wrench with adjustable torque settings. Where manufacturer's torquing requirements are not available, tighten connectors and terminals to comply with torquing values contained in UL Standards listed.

O. Terminate conductors No. 10 AWG and smaller specified to be stranded, with crimp type lug or stud. Direct termination of stranded conductors without crimp terminator to terminal screws, lugs, or other points is not permitted even if terminal is rated for stranded conductors. Crimp terminal shall be the configuration type suitable for terminal point.

P. Make connections between lighting fixture junction box and fixture with fixture wire.

Q. Make splices in conductors only within junction boxes, wiring troughs and other enclosures as permitted by the National Electrical Code. Do not splice conductors in pull boxes, panelboards, disconnect switches, motor control enclosures.

R. Splices in conductors installed below grade are not permitted, unless indicated on the drawings. For taps and splices indicated on the drawings, connections shall be made in flush mounted watertight junction box with crimp connectors and watertight resin encapsulation kit.

3.2 FIELD QUALITY CONTROL

A. Upon completion of installation of electrical connections, and after circuitry has been energized with power source, test connections to demonstrate capability and compliance with requirements. Ensure that direction of rotation of each motor fulfills requirement. Correct malfunctioning units at site, then retest to demonstrate compliance.

3.3 MC CABLE

A. Where permitted elsewhere in these specifications, MC cable shall be supported as required by NEC Article 334, at intervals not exceeding six feet. Draping cable over ducts, pipes, etc., unsecured is not acceptable.

END OF SECTION 26 05 19

SECTION 26 05 26

GROUNDING

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work required under this section of the specifications consists of the furnishing, installation, and connections of the project grounding systems. The project electrical system is a 3 phase, 4 wire grounded wye system supplemented with an equipment grounding system. Equipment grounding system shall be established with equipment grounding conductors; the use of metallic raceways for equipment grounding is not acceptable.

1.2 QUALITY ASSURANCE

A. Industry Referenced Standards. The following specifications and standards are incorporated into and become a part of this Specification by reference.
   1. Underwriters' Laboratories, Inc. (UL) Publications:
      a. Rubber-Insulated Wire and Cables
      b. Thermoplastic - Insulated Wires
      c. Electrical Grounding and Bonding Equipment
      d. Thermoplastic - Insulated Underground Feeder and Branch Circuit Cables
      e. Wire Connectors and Soldering Lugs
   2. National Electrical Manufacturers' Association (NEMA) Standards:
      a. WC-5 Thermoplastic Insulated Wire and Cable
      b. WC-7 Cross-Linked-Thermosetting
   3. National Fire Protection Association (NFPA) Publications:
      a. National Electrical Code (NEC)
   4. National Electrical Contractors' Association (NECA):
      a. Standards of Installation
   5. Bellcore (Telecordia) Standards:
      a. TR-NWT-000295 Isolated Ground Planes: Definition and Application to Telephone Central Offices

B. Acceptable Manufacturers. Products by the following manufacturers which conform to this specification are acceptable.
   1. Hydraulically applied conductor terminations:
      a. Burndy
      b. Ilsco
      c. Scotch/3M
      d. Thomas and Betts (T & B)
      e. Anderson
   2. Mechanically applied (crimp) conductor terminations:
      a. Scotch/3M
      b. Ideal
      c. Thomas and Betts (T & B)
      d. Burndy
   3. Exothermic connections:
      a. Erico/Cadweld
      b. Harger
      c. Thompson

PART 2 - PRODUCTS

2.1 GENERAL MATERIALS REQUIREMENTS

A. Provide all materials under this section of the specifications.

2.2 MATERIALS DESCRIPTION

A. Grounding Conductors
1. Equipment grounding conductors shall be green insulated type THW, THWN, or XHHW conductors sized as indicated on the drawings. Where size is not indicated on the drawings, conductor size shall be determined from the National Electrical Code table on sizes of equipment grounding conductors.
2. Grounding electrode conductors shall be bare or green insulated copper conductor sized as indicated on the drawings. Where size is not indicated on the drawings, conductor size shall be determined from the National Electrical Code table on sizes of grounding electrode conductors. Bonding jumpers shall be flexible copper bonding jumpers sized in accordance with the National Electrical Code tables for grounding electrode conductors.

B. Disconnect Switches, Transformers, and Motor Controllers: Provide a conductor termination grounding lug bonded to the enclosure of each equipment item.

C. Devices: Each receptacle and switch device shall be furnished with a grounding screw connected to the metallic device frame.

D. Ground Rods shall be 3/4" x 10'-0" copper clad steel.

E. Other Materials: Reference Ground Bus (RGB). Bus shall be solid copper ¼”x4”x24”, mounted 48” AFF on C-channel. Terminations onto the bus shall be two hole lug type. Bus shall be pre-drilled for conductor termination lug connections and pre-drilled for five future connections.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Ground all non-current carrying parts of the electrical system, i.e., wireways, equipment enclosures and frames, junction and outlet boxes, machine frames and other conductive items in close proximity with electrical circuits, to provide a low impedance path for potential grounded faults. Metal raceways shall be electrically continuous throughout the entire system. Metal raceways into electrical equipment components and cabinets such as disconnect switches, panelboards, etc. shall be connected to the equipment grounding buses by means of grounding bushings. Connections of raceways that employ locknuts shall use two locknuts to insure grounding continuity. Heavy duty thermowelds shall be employed if connections are buried under floor slab or grade. Buried connections shall be painted with a corrosion-inhibiting material.

B. Equipment Grounding Conductors
1. Grounding conductors for branch circuits are not shown on the drawings; however, grounding conductors shall be provided in all branch circuit raceways. Grounding conductors shall be the same AWG size as branch circuit conductors, unless otherwise indicated. Grounding conductors for feeders are typically indicated on the drawings and the

raceway is sized to accommodate grounding conductor shown. Where grounding conductor size is not indicated on the drawings, conductor shall be in accordance with the equipment grounding conductor table of the National Electrical Code.

2. A grounding conductor shall be installed in all flexible conduit installations. For branch circuits, grounding conductor shall be sized to match branch circuit conductors.
3. The equipment grounding conductor shall be attached to equipment with bolt or sheet metal screw used for no other purpose. Where grounding conductor is stranded, attachment shall be made with lug attached to grounding conductor with crimping tool.
4. Equipment grounding conductors shall be attached to outlet boxes with bolt or sheet metal screw used for no other purpose. Where grounding conductor is stranded, attachment shall be made with lug attached to grounding conductor with crimping tool. Connect equipment grounding conductor from wiring device outlet box to wiring device.
5. Ground all motors by drilling and tapping the bottom of the motor junction box and attaching the equipment grounding conductor to the box with a round head bolt used for no other purpose. Conductor attachment shall be through the use of a lug attached to conductor with crimping tool.
6. Equipment grounding conductors shall terminate on distribution equipment grounding bus only. Do not terminate on neutral bus. Provide a single terminal lug for each conductor. Conductor shall terminate in the same section as the phase conductors originate. Do not terminate neutral conductors on the ground bus.

C. Service entrance and separately derived electrical systems, grounding electrode system.

1. The neutral conductor of the electrical service serving the premises wiring system shall be grounded to the ground bus bar in the service equipment. The ground bus bar in the service equipment shall be grounded to the cold water system, the ground rod system, and other grounding electrodes specified herein or indicated on the drawings. Grounding electrode conductors shall be installed in rigid, non-metallic conduit to point of ground connection, unless subject to physical damage in which case they shall be installed in galvanized rigid steel. Where metallic conduit is permitted, bond conduit at both ends to grounding electrode conductor with a UL bonding bushing.
2. Make connection to main metallic water pipe entering the building. Make connections ahead of any valve or fittings whose removal may interrupt ground continuity. Install a bonding jumper of the same size as the grounding conductor around the water meter.
3. Bond together the following systems to form the grounding electrode system. All system connections shall be made as close as possible to the service entrance equipment and each connected at the service entrance equipment ground bus. Do not connect electrode systems together except at ground bus.
   a. Cold water piping system
   b. Ground rod system
   c. Structural steel metal building frame or main rebar in a foundation footing, for a concrete structure
   d. Lightning protection system
4. Grounding electrode connections to structural steel, reinforcing bars, ground rods, or where indicated on the drawings shall be with chemical exothermic weld connection devices recommended for the particular connection type. Connections to piping shall be with UL listed mechanical ground clamps.
5. Bonding shall be in accordance with the National Electrical Code.
6. Install ground rods where indicated on the drawings or as required, with the top of the ground rods 12" below finished grade.
7. Ground the neutral of all dry type transformers to building steel which shall serve as the grounding electrode for the separately derived system. In reinforced concrete structures building steel shall be considered to be reinforcing steel of vertical columns or the reinforcing steel of the ground floor slab. Make connection to building steel with an

exothermic weld in a location in unfinished space where the connection will not be subject to physical abuse.

8. Ground the neutral and frame of the emergency generator to building steel and the ground rod system, which shall serve as the grounding electrode for the separately derived system. In reinforced concrete structures building steel shall be considered to be reinforcing steel of vertical columns. Make connection to building steel with an exothermic weld in a location in unfinished space where the connection will not be subject to physical abuse.
9. Where more than one service serves a building, connect each service equipment ground bus together with a #4/0 copper conductor in PVC conduit.

D. Other Grounding Requirements

1. Lighting fixtures shall be grounded with a green insulated ground wire secured to the fixture with a UL listed bond lug, screw, or clip specifically made for such use.
2. Outlet boxes shall have grounding jumper connecting device and outlet box. Refer to the CONDUITS AND BOXES specification section.
3. Mount Reference Ground Bus 48” above finished floor on C-channel. Homerun #4/0 cable from communication backboards and separately derived systems to the RGB. This is in addition to other grounding requirements of this section. Bus shall be mounted in the adjacent to the service entrance or where shown on plans.
4. At each building expansion joint flexible copper bonding jumpers shall be attached to building structure by exothermic weld process. Install bonding jumpers in concealed locations that will not subject connections or jumpers to physical abuse. Install 100' on centers across expansion joints.

3.2 FIELD QUALITY CONTROL

A. Upon completion of installation, test the installation in accordance with the ELECTRICAL ACCEPTANCE TESTING section of this specification. Grounding resistance reading shall be taken before connection is made to the building cold water piping system. Ground resistance readings shall not be taken within forty-eight hours of rainfall. Results of ground resistance readings shall be forwarded, in writing, immediately to the Architect. Remedy any deficient components of the grounding system, then retest to demonstrate compliance.

END OF SECTION 26 05 26

SECTION 26 05 33

CONDUITS AND BOXES

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section covers the complete conduit raceway system, including outlet boxes, junction boxes, and pullboxes.

B. Definitions: The term conduit, as used in this Specification, shall mean any or all of the raceway types specified. The following abbreviations are referenced in this section:
1. RGS Rigid Galvanized Steel
2. IMC Intermediate Metallic Conduit
3. EMT Electrical Metallic Tubing
4. "Box" includes all outlet, device, junction, and pull boxes

1.2 QUALITY ASSURANCE

A. Referenced Industry Standards: The following specifications and standards are incorporated into and become a part of this Specification by reference.
1. Underwriters' Laboratories, Inc. (UL) Publications:
   a. No. 1 Flexible Metal Electrical Conduit
   b. No. 6 Rigid Galvanized Conduit
   c. No. 467 Electrical Grounding and Bonding
   d. No. 651 Rigid Nonmetallic Electrical Conduit
   e. No. 797 Electrical Metallic Tubing
   f. No. 1242 Intermediate Metal Conduit
   g. Electric Cabinets and Boxes
   h. Electrical Grounding and Bonding Equipment
   i. Electrical Outlet Boxes and Fitting
2. American National Standards Institute (ANSI):
   a. C-80.1 Rigid Galvanized Conduit.
   b. C-80.3 Electrical Metallic Tubing.
3. National Fire Protection Association (NFPA):
   a. No. 70 National Electrical Code (NEC).
4. American Society for Testing and Materials (ASTM):
   a. A123 Zinc (Hot Galvanized) Coating on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strips.
   b. A153 Zinc (Hot Dipped) Coating on Iron and Steel Hardware.

B. Acceptable Manufacturers: Products of the following manufacturers, which comply with these specifications, are acceptable.
1. Metallic Conduit and Fittings:
   a. Appleton
   b. Crouse Hinds
   c. Killark
   d. O-Z/Gedney
   e. RACO
   f. Wheatland
   g. Allied

h. Steel City, compression fittings

2. Support Channel:
   a. Kindorf
   b. Unistrut
   c. B-line
3. Non-Metallic Conduit and Fittings:
   a. Carlon
   b. Queen City
   c. Thomas & Betts
4. Galvanizing Compound:
   a. ZRC Products Company
5. Fire-rated foam sealant:
   a. Dow-Corning
6. Electrical tape:
   a. Scotch
   b. Tomic
   c. Permacel
7. Floor Boxes:
   a. FSR, Inc.
   b. Hubbell
   c. Steel City
   d. Walker/Wiremold.

1.3 STORAGE, HANDLING, AND COORDINATION

A. Refer to the BASIC ELECTRICAL REQUIREMENTS section of the specification for storage and handling requirements.

B. Non-metallic conduits stored on site prior to installation shall be stored on a surface off of the ground and shall be protected from direct sunlight and from construction debris.

C. Damaged, oxidized, warped, improperly stored material or material with excessive amounts of foreign debris shall be removed and replaced with new materials.

D. Coordination: Review architectural drawings for areas where outlets occur within specific architectural or structural features and install outlets as shown; or if not shown, accurately center and align boxes within the architectural features or detail.

PART 2 - PRODUCTS

2.1 GENERAL MATERIALS REQUIREMENTS

A. All conduit, fittings, and boxes shall be listed and bear a label by Underwriters' Laboratories (UL) for use as raceway system for electrical conductors.

B. Raceway is required for all wiring, unless specifically indicated or specified otherwise.

C. Size: The minimum size of conduit shall be 1/2". The size of all conduits shall be in accordance with the NEC, but not less than indicated on the drawings.

2.2 CONDUIT AND FITTINGS

A. Electrical Metallic Tubing: EMT couplings and connectors shall be steel water-tight and concrete-tight. Malleable iron, die cast or pressure cast fittings are not permitted. Fittings 2.0" and smaller shall be compression type or steel set screw type. Connectors for conduits 2.5" and larger shall be set screw type with four screws each. All connectors shall be insulated throat type.

B. Rigid Galvanized Steel and Intermediate Metallic Conduit: Fittings for RGS and IMC shall be standard threaded couplings, locknuts, bushings and elbows. All materials shall be steel or malleable iron only. Bushings shall be metallic insulating type consisting of insulating insert molded or locked into the metallic body of the fittings.

C. Non-Metallic Conduit: Non-metallic conduit shall be heavy wall, Schedule 40 PVC, unless otherwise indicated on the drawings. Non-metallic conduit fittings shall be of the same material as the conduit furnished and be the product for the same manufacturer.

D. Flexible Conduit
1. Flexible conduit shall be steel metallic type. Where specified herein, indicated on the drawings, or when used in damp or wet locations, as classified by the National Electrical Code, flexible conduit shall be liquid tight.
2. All flexible conduit shall be classified as suitable for system grounding.
3. Connectors for flexible conduit shall be steel insulated throat type rated suitable for system ground continuity. Connectors for liquid tight flexible conduit shall be screw-in ground cone type.
4. Flexible conduit use for other than connections to lighting fixtures shall not be less than 1/2" trade size and in no case shall flexible conduit size be less than permitted by the National Electrical Code for the number and size of conductors to be installed herein. 3/8" flexible conduit may be used for connection to lighting fixtures providing conduit fill requirements of the National Electrical Code are not exceeded.

E. Rigid Aluminum Conduit: Rigid aluminum conduit fittings shall be standard threaded couplings, locknuts, bushings, and elbows. Material shall be compatible with aluminum conduit of malleable iron, steel or aluminum alloy. Iron or steel fittings shall be zinc or cadmium plated. Aluminum fittings shall not contain more than 0.4 percent copper. Locknuts and bushings shall be as specified for RGS and IMC conduit.

2.3 MISCELLANEOUS CONDUIT FITTINGS AND ACCESSORIES

A. Electrical tape for corrosion protection shall be vinyl all-weather type.

B. Expansion and deflection couplings shall accommodate 3/4" deflection, expansion, or contraction in any direction and shall allow 30 degree angular deflections. Couplings shall contain an internal flexible metal braid to maintain raceway system ground continuity.

C. Fire and smoke stop materials shall be rock wool fiber, silicone foam, or silicone sealant, UL rated to maintain the fire floor or fire wall partition rating.

D. Corrosion-inhibiting coatings shall be cold-galvanizing compound type.

E. Conduit Supports
1. All parts and hardware shall be zinc-coated or have equivalent corrosion protection.
2. Conduit straps shall be single hole cast metal type or two hole galvanized metal type. Conduit clamps shall be spring steel type for use with exposed structural steel.
3. Conduit support channels shall be 1.5" x 1.5" x 14 gauge galvanized steel channel. Channel suspension shall be by threaded steel rods. Use swivel type connector to attach

suspension rods to structure. Spring steel clips are not acceptable. Conduit straps shall be spring steel straps compatible with channel. Wire or chain is not acceptable for conduit hangers.

4. Individual conduit hangers shall be galvanized spring steel specifically designed for the purpose, sized appropriately for the conduit type and diameter, and have pre-assembled closure bolt and nut and provisions for receiving threaded hanger rod. Support with 1/4" threaded steel rod for individual conduits 1.5" and smaller and 3/8" rod for individual conduits 2.0" and larger.
5. Individual conduit straps on metal studs shall be spring steel and shall wrap around entire face of stud securely biting into both edges and have provisions for screwing into stud. Size for conduit to be supported. Tie wraps are not acceptable.
6. Support multiple conduits from metal studs using pre-assembled bar hanger assembly consisting of hanger bar, retaining clips and conduit straps.
7. Supports for 3/8” flexible conduit to lighting fixtures shall be secured to ceiling grid wire hangers with a metal clip specifically designed for this purpose. Caddy #PCS2. No other conduit shall be supported from the ceiling system.

2.4 SURFACE METALLIC RACEWAY AND WIREWAY

A. Surface Metal Raceway shall be a two-piece raceway of galvanized steel, consisting of a cover and a base. The surface metal raceway shall accommodate single or two gang receptacles rated up to 100 amps at 208 or 600 volts as indicated on the plans. The system shall be a complete system with necessary fittings and outlets. The system shall be listed by Underwriters' Laboratories, Inc. for service as equipment grounding conductors. Surface Metal Raceway shall be as manufactured by WireMold Co. and of the type indicated on the plans.

B. Wireway shall be a steel enclosed wiring trough with removable cover. Wireway systems shall be furnished complete with necessary fittings. Wireway shall be as manufactured by Square-D and of the type as indicated on the plans.

2.5 BOXES

A. Boxes shall be as follows, unless otherwise specified, indicated on the drawings, or required by the NEC:
1. Sheet metal boxes of 50 cubic inches internal capacity and smaller shall be sheet steel, galvanized, with suitable covers and screws.
2. Sheet metal boxes larger than 50 cubic inches internal capacity shall be constructed of code gauge welded sheet steel, reinforced if required, and finished with standard gray enamel or galvanized and shall have removable screw mounted covers with brass machine screws.
3. Cast metal "FS" or "FD" type boxes shall have threaded hubs. In special cases where standard types are not available, blank boxes may have threaded hubs brazed on, or if necessary suitably thick boxes may be drilled and tapped.

B. Outlet boxes for surface mounted and pendant mounted lighting fixtures shall be 4" octagon boxes, 1-1/2" deep.

C. Outlet boxes for flush mounted lighting fixtures shall be 4" square boxes 1-1/2" deep, with blank cover, installed adjacent to fixture. Connection to fixture shall be with flexible conduit.

D. Outlet boxes for switches, receptacles and wall mounted junction boxes shall be 4" square boxes, 1-1/2" deep with square edge tile type cover. Where only one conduit enters box, 3-1/2" deep single gang switch box may be used.

E. Outlet boxes for switches and receptacles in exposed wiring system shall be cast FS boxes with matching device plate. Surface outlet boxes for dry locations shall be the cast type for locations requiring rigid or IMC raceway types. Switch and receptacle boxes for exposed wiring in equipment rooms may be surface mounted "handy" type boxes. Wall boxes for outdoor or wet locations use shall be the cast type furnished complete with weatherproof covers and rubber or neoprene gaskets. Device plates for exterior installations shall be weatherproof, spring loaded hinged covers. Use FD box for GFI receptacle.

F. Outlet boxes for individual switches, and receptacles flush mounted in exposed concrete block shall be single gang masonry boxes 3-1/2" deep.

G. Outlet boxes for devices mounted in metal door jambs shall be sheet metal partition boxes 1-6/16" wide and 1-5/8" deep.

H. Outlet boxes for support of surface or pendant mounted lighting fixtures shall be provided with fixture stud.

I. Outlet boxes shall be provided with green sheet metal screw for attachment of equipment grounding conductor.

J. Where actual device provided requires larger outlet box than specified herein, provide outlet box suitable for specific device. These outlet boxes shall be of the same type as specified herein for the installation required.

K. Outlet boxes installed in poured concrete or cast in place shall be concrete-tight type. The box depth shall allow 2" minimum of concrete cover.

L. Dimensions of pull boxes and junction boxes shall not be less than those dimensions required by the National Electrical Code for the number, size and position of conductors entering the box. Only a single extension ring shall be permitted on a box to increase the volume.

M. Horizontal pull boxes containing more than one feeder shall be provided with reinforced flange and removable 12 gauge 1-1/2" x 1-1/2" galvanized channel for support of conductors. Wood supports within pull boxes are not acceptable.

N. Provide box covers for all junction and pull boxes.

O. Exterior junction or pull boxes shall be cast aluminum or PVC raintight and watertight boxes with screw cover lids. Box dimensions shall be sized in accordance with the National Electrical Code minimum requirements, unless otherwise indicated on the drawings. Covers shall be galvanized steel, checkered pattern, suitable for pedstrian traffic secured to box with stainless steel screws. Box shall be furnished with continuous neoprene gasket to seal cover. Conduit entry shall be by factory drilled and tapped openings. Provide PVC adapter fitting for PVC conduits. Metallic boxes shall be provided with grounding lug secured by bolt to the enclosure.

P. Where installation of floor mounted device requires penetration of a fire rated floor slab, the installation shall be made with a fire rated "poke-through" fitting, UL listed for use with concrete floors with fire rating to match that of floor penetrated. Fitting shall be selected for depth of floor slab. Fire barrier shall also be rated to prevent passage of smoke when heat is not present.

Q. Provide floor outlet boxes compatible with devices indicated on drawings.

R. Floor boxes for installation in concrete floors on grade shall be the nominal 4-inch diameter, round, cast type with flush cover plates. Flush covers and visible box rings shall be brass or bronze with matching finished screws. Covers shall be: Two separately hinged lids for duplex receptacles. One hinged lid for single receptacle, inset within 2-inch plug. One combination plug, 2 x 1/2 inch type and one split bell nozzle (aluminum), 2 x 1/2 inch type for telephone or data terminal

PART 3 - EXECUTION

3.1 INSTALLATION

A. General

1. Conceal all conduits, except in unfinished spaces such as equipment rooms or where indicated on the drawings.
2. Leave all empty conduits with a 200 pound test nylon pull cord.
3. Install as complete raceway runs prior to installation of cables or wires.
4. Flattened, dented, or deformed conduits are not acceptable and shall be removed and replaced.
5. Secure RGS and IMC to sheet metal enclosures with two locknuts and insulated bushing. Secure EMT to sheet metal enclosures with insulated throat connectors.
6. Fasten conduit support device to structure with wood screws on wood, toggle bolts on hollow masonry, anchors as specified on solid masonry or concrete, and machine bolts, clamps, or spring steel clips, on steel. Nails are not acceptable.
7. Protect conduits against dirt, plaster, and foreign debris with conduit plugs. Plugs shall remain in place until all masonry is complete. Protect conduit stub-ups during construction from damage: any damaged conduits shall not be used.
8. Provide seal-off fittings and sealants for all conduits originating from outside building, from below grade, all conduits entering refrigerated spaces, i.e., freezers and coolers, and all conduits entering exterior mounted electrical equipment with insulating putty to prevent entrance of moisture.
9. Install conduit with wiring, including home runs, as indicated on the drawings. Deviations shall be made only where necessary to avoid interferences and when approved by Architect by written authorization.
10. Conduits which penetrate roof membranes shall be installed in accordance with roofing system manufacturer's recommendations and architectural specifications with a sheet metal pitch pocket filled with asphaltic compound, unless otherwise indicated.
11. Use flexible conduit for connection to vibrating equipment and rotating machinery and for connection from junction box to flush mounted lighting fixtures.
12. Separate raceway systems are to be installed for power systems and for control, signal and communications systems. Do not install control, signal or communications cables in the same raceways as branch circuit or feeder cables, unless indicated otherwise.
13. Provide expansion fitting in all conduits where length of run exceeds 200 feet or where conduits pass building expansion joints.
14. Holes and sleeves shall be provided through floors, walls and roofs as necessary for conduit installation, including flashing and waterproofing as required at exterior walls and roofs. Install sleeves or forms for openings in new work. Provide inserts and holes as required, sleeved, bonded, curbed, flashed, and finished, whether in concrete, steel grating, metal panels, roofs, or other building features.
15. Provide nonshrink grout or foam sealant at all sleeves or holes after the installation of conduit and at all unused sleeves. Install fire- and smoke-rated seals at all conduit penetrations or sleeves of fire-rated floors, ceilings, walls, or partitions.

16. Coat all field-cut threads in galvanized conduit with aluminum paint, zinc treatment cold galvanizing compound, or other approved treatment material.

3.2 APPLICATIONS FOR CONDUIT PERMITTED

A. Interior Installations, Concealed in Walls or Above Ceilings, or Exposed
1. Unless excluded below, not permitted in accordance with the National Electrical Code, or otherwise indicated, all conduit shall be Electrical Metallic Tubing.
2. Conduit shall be run parallel or at right angles to existing walls, ceilings, and structural members.
3. Support branch circuit conduits at intervals not exceeding 10 ft. and within three feet of each outlet, junction box, cabinet or fitting. Attach individual branch circuit conduits to structural steel members with spring steel type or beam conduit clamps and to non-metallic structural members with one hole conduit straps. For exposed conduits and where conduits must be suspended below structure, single conduit runs shall be supported from structure by hangar rod and conduit clamp assembly. Multiple conduits shall be supported by trapeze type support suspended from structure. Do not attach conduits to ceiling suspension system channels or suspension wires.
4. Attach feeder conduits larger than 1" trade diameter to or from structure on intervals not exceeding 12 ft. with conduit beam clamps, one hole conduit straps or trapeze type support in accordance with support systems described for branch circuit conduits.
5. Exposed conduits shall be painted as specified under the PAINTING section of the specifications, or as otherwise indicated in the Architectural documents.
6. Do not install conduits through structural members.
7. Install conduit sleeves in slabs where conduits 2.0" and larger pass through. Sleeves shall extend 1" minimum above finished slab.
8. Install all conduits or sleeves penetrating rated fire walls or fire floors to maintain fire rating of wall or floor.
9. Conduits attached to building construction on opposite sides of a building expansion joint shall be provided with an expansion and deflection coupling. In lieu of an expansion coupling, conduits 2-1/2" and smaller may be provided with junction boxes on both sides of the expansion joint connected by 15" of slack flexible conduit with bonding jumper.
10. No conduit installation requiring cutting of cross-webs of concrete masonry units is permitted. Conduit shall be threaded through cells or concrete masonry units lowered around conduit. Neither horizontal joint reinforcement nor bond beam reinforcement shall be cut for conduit installation.
11. Conduit types shall not be mixed indiscriminately with other types in the same run, unless specified herein or required by the NEC.
12. Conduits which penetrate the building exterior walls or roof shall be RGS or IMC.

B. Underground Raceway Installations
1. Direct Burial Conduit
   a. Install top of conduits 18" minimum below finished grade. Maximum depth shall be 36".
   b. Install top of conduits 6" minimum below bottom of building slabs.
   c. Where transition is made from below grade PVC installation to above grade or slab, make transition with rigid galvanized elbow and extend through slab or above grade with galvanized rigid steel conduit. For corrosion protection, where the elbow penetrates surface, wrap with vinyl all-weather electrical tape or coat with bituminous asphaltic compound, for 6" above and below concrete surface.
   d. For other excavation and backfilling requirements, refer to EARTHWORK specification section.
   e. Conduit shall be run following the most direct route between points.

C. Installations Within or Below Concrete Floor Slabs

1. Conduits installed within concrete floor slabs which are in direct contact with grade shall be RGS or IMC. Conduits installed within concrete floor slabs which are above grade shall be RGS, IMC, or schedule 40 Heavy Wall PVC. Where transition is made from raceway in slab to any type of raceway out of slab, make transition with RGS elbow. For corrosion protection, where elbow penetrates surface, wrap with vinyl all-weather electrical tape or coat with bituminous asphaltic compound, for 6" above and below concrete surface.
2. Service entrance conduits shall be either RGS or, where installed underground, schedule 40 heavy wall PVC encased in a concrete ductbank. Service entrance conduits shall be installed "outside the building" as defined by the National Electrical Code. Other conduit in direct contact with earth shall be either schedule 40 heavy wall PVC or RGS.
3. Conduit shall be run following the most direct route between points.
4. Raceways routed in concrete floor slabs shall be located with minimum separation and cover for raceways and fittings as follows:
   a. Minimum top cover of 1-inch for conduits 1-1/4-inch and smaller.
   b. Minimum top cover of 1-1/2 inches for conduits 1-1/2-inch and larger.
   c. Conduits routed parallel in finish floor slab concrete shall be spaced a minimum distance of three times their trade diameters apart, with a maximum of three conduits in any two foot wide section.
   d. Conduits located on top of structural floor slabs shall be spaced such that a minimum bottom cover of one inch shall be maintained for conduits and fittings.
5. Conduit shall not be installed in concrete which is less than 3" thick or where the outside diameter is larger than 1/3 of the slab thickness.
6. Conduits installed in concrete slabs shall be buried in the concrete slab. Wire low conduits to upper side of the bottom reinforcing steel, and upper conduits to the lower side of the top reinforcing steel. Separate parallel runs of conduits within slab by at least 1".
7. Conduits shall not be installed within shear walls unless specifically indicated on the drawings. Conduits shall not be run directly below and parallel with load bearing walls.
8. Protect each metallic conduit installed in concrete slab or conduits 1.5" and smaller passing through a concrete slab against corrosion where conduit enters and leaves concrete by wrapping conduit with vinyl all-weather electrical tape.
9. Protect all conduits entering and leaving concrete floor slabs from physical damage during construction.
10. Install all conduits penetrating rated fire floors to maintain the fire rating of the floor penetrated.
11. The maximum projection of conduit stub-up and bushing above slab shall be 3". Install flush with finished slab where indicated.

D. Miscellaneous Applications

1. Use flexible conduit for connections to flush- or chain-mounted lighting fixtures, motors, dry type transformers, plumbing or HVAC equipment, and kitchen/laundry equipment.
   a. Flexible conduit used for connection of motors, dry type transformers, plumbing and HVAC equipment, kitchen equipment, and laundry equipment shall not exceed 18" in length for trade diameter sizes 3" or less, 21" in length for 3 1/2" trade diameter size, and 24" in length for 4" trade diameter size.
   b. Flexible conduit from outlet box to lighting fixtures shall not exceed 6 feet in length.
   c. Maintain ground continuity through flexible conduit with green equipment grounding conductor; do not use flexible conduit for ground continuity.
   d. Liquid tight conduit shall be used to connect equipment in mechanical equipment rooms, exterior installations, kitchen areas, and where equipment is subject to dripping oil, moisture, or corrosive atmospheres.

2. Rigid aluminum conduit may be used where indicated on the drawings, or for all trade sizes 3.0" and larger for conduits not installed in concrete slabs, not installed in direct contact with earth, not installed in hazardous locations as defined by Article 500 of the National Electrical Code, and not installed in areas exposed to excessive moisture.
3. Where hazardous locations, as classified by the National Electrical Code, exist, all conduits, seal-off fittings, and other accessories and the installation of these materials shall comply with Article 500 of the National Electrical Code.
4. All raceways in direct contact with water in pools or fountains shall be non-corrosive metal as required by Article 680 of the NEC.
5. All conduits for interior wiring systems whose voltage is above 600 volts shall be RGS or IMC.
6. All conduits entering refrigerated spaces shall be RGS.

3.3 BOX INSTALLATION

A. All boxes shall be completely accessible as required by the NEC. Provide access panels in any non-accessible spaces if required.

B. Provide an outlet box for each lighting fixture and for each device. Boxes shall not be smaller than indicated in this section of the specifications and shall be larger if required by Article 370 of the National Electrical Code for the number and size of conductors installed. Where lighting fixtures are installed in continuous rows, only one outlet box is required.

C. Outlet boxes for flush mounted lighting fixtures shall be accessible. Where fixture installation is in an inaccessible ceiling, outlet box shall be accessible when fixture is removed.

D. Set outlet boxes for flush mounted devices to within 1/8" of finished wall. Spacers or shims between box and device are not acceptable.

E. Where low voltage device is to be installed in common outlet boxes with line voltage device, provide metal barrier within outlet box to establish two separate compartments.

F. Where ganged installations of switches controlling lighting circuits of opposite phase are indicated, separate switches with permanently installed nonmetallic barrier. Where space available for horizontal ganged installation is not adequate, install switches vertically to maintain required clearances between energized terminals.

G. Where an emergency powered device is to be installed in common outlet boxes with an utility powered device, provide metal barrier within outlet box to establish two separate compartments.

H. Support every box from structure:
1. Secure to wood with wood screws.
2. Secure to hollow masonry with toggle bolts.
3. Secure to metal with sheet metal screws, machine bolts, or clamps.
4. Anchors for solid masonry and concrete shall be self drilling expansion shields, insert expansion shields, or lead shields with machine bolts. Power actuated pin studs may be used in concrete.
5. Secure outlet boxes to metal studs with spring steel clamp which wraps around entire face of stud and digs into both sides of stud. Clamp shall be screwed into stud.
6. Where box is suspended below structure, support from structure with threaded steel rod. Secure rod directly to outlet boxes with double nuts. For pull boxes larger than 18" x 18" x 6", construct 1-1/2" x 1-1/2" x 14 gauge metal channel frame. Connect frame to box by bolting and secure frame to threaded rod at each corner.

7. Hub type cast boxes need not be directly attached to structure if rigid conduit is used and supported in conformance with the National Electrical Code.

I. Support outlet boxes for support of surface mounted lighting fixtures by light weight channel spanning between and attached to main ceiling support member. Attach channel to ceiling support members.

J. Do not use outlet boxes for support of fixtures not recommended by fixture manufacturer to be supported by outlet box; boxes shall be used only as junction boxes.

K. Remove only knockouts required and plug all unused openings. Use threaded plugs for cast boxes and snap-in metal plugs for sheet metal boxes.

L. Outlet boxes in the same wall shall not be mounted back-to-back. Offset 6" minimum. Offset 24” minimum at fire rated partitions.

M. Install pull boxes only in unfinished spaces or concealed above ceilings, except when indicated on the drawings.

N. Install pull boxes for any of the following conditions:
1. Where indicated on the drawings.
2. Where conduit run exceeds 200 ft. from box to box or box to terminal.
3. Where conduit contains more than 4-90 degree bends or the equivalent offsets.
4. To facilitate conductor installation or to insure that the manufacturer's maximum pulling tension is not exceeded.

O. Do not splice conductors in pull boxes. Splices are not permitted in pull boxes except where shown on the drawings. Where splices are permitted, make splices with splicing sleeves attached to conductors with hydraulic crimping tool. Split bolt connectors are not acceptable for splices within pull boxes.

P. Where a pull box for multiple circuits is required, separate circuits as follows:
1. Circuit conductors and feeders shall be individually laced with nylon tie straps. Boxes installed in masonry walls shall have covers of required depth to avoid cutting of masonry. Boxes for exterior work shall be FS or FD Series, with cadmium plated covers. the type with enlarged tab to permit identification of each circuit and feeder within pull box. Identify each with respect to load served.
2. Circuits shall be separated by full height and length sheet metal or polyester resin barrier secured to box by angle brackets.

Q. Box covers shall be in place and secured to box.

R. Box identification: Using an indelible wide tip black marker, indicate on the cover of each junction and pull box the designation of the circuits contained therein, e.g., HDA-1,3,5. Where painting of boxes is specified under this Division or elsewhere in these specifications, marking shall be done after final finish coat is applied.

S. Exterior pull or junction boxes
1. Exterior pull or junction boxes shall be mounted flush with finished grade, unless specified elsewhere or indicated to be above ground on the drawings.
2. Flush mounted boxes shall be surrounded on all sides and bottom with 6" minimum of concrete. Top of concrete shall be flush with grade.

3. Seal conduit entries into box with duct seal to prevent entrance of moisture, after conductors are installed.
4. Taps and splices, where permitted by these specifications within exterior junction boxes, shall be performed with an encapsulating watertight splice or tap kit which insulates and moisture seals the connection.

T. After completion, clean all box interiors and exteriors of dirt and construction debris.

U. Where exposed wiring in rigid steel conduit is indicated, provide cast outlet box with threaded hubs.

V. Where conduits enter sheet-steel outlet boxes, cabinets or pull boxes, fasten with two locknuts and insulating bushings or single locknut and combination locknut/bushing.

W. Unless otherwise indicated, boxes not containing wiring devices or lighting fixtures shall be provided with suitable blank cover plates. Blank cover plates shall match any nearby switch or receptacle plates, or other type necessary to achieve matching appearance

3.4 ADJUSTMENT, CLEANING AND PROTECTION

A. Upon completion, clean all installed materials of excess paint, dirt, and construction debris. All conduit systems shall be cleaned of water and debris prior to the installation of any conductors.

END OF SECTION 26 05 33

SECTION 260800

ELECTRICAL ACCEPTANCE TESTING

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work required under this section of the specifications consist of the start-up testing and inspection of the electrical equipment designated within. All labor and testing equipment which is required shall be provided under this section of the specifications.

1.2 RELATED DOCUMENTS

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

1.3 GENERAL

A. The Contractor shall perform the tests as outlined below to insure system acceptance.

B. When the tests and inspections have been completed, a label shall be attached to all devices tested. The label shall provide the name of the testing company, the date the tests were completed, and the initials of the engineer who performed the tests.

C. The tests shall insure that the equipment is operational and functioning within industry standards and manufacturer's tolerances. Forward all test reports to the Architect at least two weeks prior to the project final inspection for review. Reports shall be bound as required by Division 1 of this specification.

1.4 QUALITY ASSURANCE

A. Industry Referenced Standards. The testing and inspection shall comply with all applicable sections of the following codes and standards:
1. American National Standards Institute - ANSI
2. American Society for Testing and Materials - ASTM
3. Association of Edison Illuminating Companies - AEIC
4. Institute of Electrical and Electronics Engineers - IEEE
5. Insulated Power Cable Engineers Association - IPCEA
6. International Electrical Testing Association - NETA Acceptance Testing Specifications
7. National Electrical Code - NEC
8. National Electrical Manufacturers Association - NEMA
9. National Fire Protection Association - NFPA
10. State and Local Codes and Ordinances
11. National Electrical Contractors' Association (NECA):
    a. Standards of Installation

B. The inspection and testing shall comply with the project plans and specifications as well as with the manufacturer's drawings, instruction manuals, and other applicable data for the apparatus tested.

1.5 SUBMITTALS

A. Refer to BASIC ELECTRICAL REQUIREMENTS for submittal requirements.

1.6 DIVISION OF RESPONSIBILITY

A. The Contractor shall:
1. Perform routine insulation-resistance, continuity, and rotation tests for all distribution and utilization equipment prior to and in addition to tests performed by the testing firm specified herein.
2. Supply a suitable and stable source of electrical power to each test site.

1.7 SAFETY AND PRECAUTIONS

A. Safety practices shall comply with applicable state and local safety orders as well as with the Occupational Safety and Health Act of 1970 (OSHA). Compliance with the National Fire Protection Association standard NFPA 70E and the Accident Prevention Manual for Industrial Operations of the National Safety Council shall be observed.

B. Tests shall only be performed on apparatus which is de-energized. The testing company's lead test engineer for the project shall be a designated safety representative and shall supervise testing observations and safety requirements. Work shall not proceed until he has determined that it is safe to do so.

C. Power circuits shall have conductors shorted to ground by a hotline grounded device approved for the purpose. Warning signs and protective barriers shall be provided as necessary to conduct the tests safely.

1.8 REPORTS

A. The test report(s) shall include the following sections:
1. Scope of testing
2. Electrical equipment tested
3. Description of test procedures
4. Test results
5. Conclusions and recommendations
6. Appendix, including test forms

B. Each piece of equipment shall be recorded on a data sheet listing the condition of the equipment as found and as left. Included shall be recommendations for any necessary repair and/or replacement parts. The data sheets shall indicate the name of the engineer who tested the equipment and the date of the test completion.

C. Record copies of the completed test report shall be submitted no more than 14 days after completion of the testing and inspection.

1.9 TEST EQUIPMENT

A. All test equipment shall be in good mechanical and electrical condition. All field instruments shall have been calibrated within six months of the testing date, and dated calibration labels shall be visible on the testing equipment. Submit calibration certification in the final report.

PART 2 - PRODUCTS

2.1 GENERAL MATERIALS REQUIREMENTS

A. All materials are specified under other sections of this specification. All testing equipment required shall be provided under this section of the specifications.

PART 3 - EXECUTION

3.1 EQUIPMENT TO BE TESTED

A. Equipment shall be tested in accordance with the following scopes of work.
1. Low Voltage Switchgear and Switchboards
2. Lighting Control System
3. Grounding System
4. Cables, 600 Volts

3.2 LOW VOLTAGE SWITCHGEAR AND SWITCHBOARDS

A. Visual and Mechanical Inspection
1. Verify that the contractor has cleaned enclosure interiors of accumulated dust, dirt, oil films, and other foreign materials.
2. Inspect all electrical and mechanical components for condition and any evidence of defects or failure.
3. Check for proper travel and alignment of any drawout or plug-in circuit breakers.
4. Check breaker connections to bus.
5. Inspect bolted connections. The electrical contractor shall torque wrench tighten or remake any questionable connections. Refer to manufacturer's instructions for proper torque values.
6. Inspect for missing or loose hardware or accessories.
7. Inspect ground bus connections.
8. Operate key and door interlock devices to assure proper operation.
9. Inspect for labels, and nameplate compliance with up-to-date circuit connections.
10. Verify that potential transformers, including their overcurrent protection and current transformers, meet specified requirements.
11. Check switchboard anchorage, area clearances, and alignment and fit of components.

B. Electrical Tests
1. Insulation Resistance Test: Megger main secondary bus and feeder circuits phase-to-phase and phase-to-ground.
2. Energize any space heater circuits to insure proper operations.
3. Insulation resistance test of buses and portions of control wiring that disconnect from solid state devices through normal disconnecting features. Insulation resistance less than 100 megohms is not acceptable.

C. Check phase rotation with a Biddle phase rotation meter. Check phasing of alternate supply sources to the same bus.

D. Instruments and Meter Tests
1. Inspect panel mounted instruments and meters. Clean and check for calibration accuracy. Make minor adjustments as necessary.
2. Ratio and polarity tests on current and voltage transformers.
3. Calibrate ammeters and voltmeters at midscale. Use check instruments with documented up-to-date calibration traceable to NIST standards.

4. Verify appropriate capacity, overcurrent protection, and operating voltage of control power elements including control power transformer and control power wiring.
5. Calibrate watthour and demand meters to 0.5 percent, and verify meter multipliers. Use check instruments with documented up-to-date calibration traceable to NIST standards.

E. Infrared Scanning:
1. Use an infrared scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
2. After Substantial Completion, but not more than 2 months after Final Acceptance, perform an infrared scan of switchboard bus joints and connections. Open or remove metal doors, covers, inspection plates, and barriers to make joints and connections accessible to a portable scanner.
3. Follow-up Infrared Scanning: Perform 2 additional follow-up infrared scans of the same joints and connections, one 4 months after Substantial Completion and one 11 months after Substantial Completion.
4. Record of Infrared Scanning: Report shall identify all connections checked and describe results of scanning. Include graphic indication of scanning results, notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.3 LIGHTING CONTROL SYSTEM

A. Visual and Mechanical Inspection
1. Inspect each device for physical damage.
2. Check for proper labeling of conductors
3. Inspect all system lamps and LED's for proper operation. Replace all non-operational equipment.
4. Check all cabinet doors, latches, and hinges for proper operation. Adjust, lubricate, and/or repair as required.

B. Electrical Tests
1. Verify the absence of unwanted voltages between circuit conductors and ground that would constitute a hazard or prevent proper system operation.
2. Meggar test all conductors (other than those intentionally grounded) for isolation from ground.
3. Test all conductors (other than those intentionally connected together) for conductor-to-conductor isolation using as insulation testing device.
4. The control unit shall be tested to verify it is in the proper operating condition as detailed in the manufacturer's manual.
5. Each control circuit shall be tested to confirm proper operation of the circuit.

3.4 GROUNDING SYSTEM

A. Visual and Mechanical Inspection
1. Inspect wiring system outlet and junction boxes for proper grounding. Green grounding conductor shall be connected to outlet and junction boxes. Inspect a minimum of 5% of project boxes.
2. Verify connections of grounds for the secondary of separately derived grounding systems, i.e. at dry type transformers. Note type of connection, i.e. mechanical or exothermic.
3. Verify proper connection to all components of building service entrance grounding system. Note all system components which are interconnected and

type of connection either mechanical or exothermic. Note depth of driven ground rods.

B. Electrical Tests
1. Perform ground-impedance measurements utilizing the fall-of-potential method per ANSI/IEEE Standard 81 "IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System". Instrumentation utilized shall be specifically designed for ground impedance testing. Provide sufficient spacing so that plotted curves flatten in the 62% area of the distance between the item under test and the current electrode.
2. When sufficient spacing of electrodes described above is impractical, perform ground-impedance measurements utilizing either the intersecting curves method or the slope method. (Ref. Nos. 40 and 41 in IEEE Std. 81.)

C. Equipment Grounds
1. Utilize two-point method of IEEE Std. 81. Measure between equipment ground being tested and known low-impedance grounding electrode or system.

D. Test Values
1. The main ground electrode system impedance-to-ground should be no greater than five (5) ohms for commercial or industrial systems and one (1) ohm of less for generating stations, transmission stations, and large industrial systems. Equipment grounds, depending on size and length of grounding conductor, should be only fractionally higher than system ground.

3.5 CABLES - 600V

A. Visual and Mechanical Inspection
1. Inspect cables for physical damage and proper connection in accordance with single-line diagram.
2. Test cable mechanical connections to manufacturer's recommended values using a calibrated torque wrench.
3. Check cable color coding with applicable engineer's specifications and National Electrical Code standards.

B. Electrical Tests
1. Perform insulation-resistance test on each feeder on the riser diagram with respect to ground and adjacent conductors. Applied potential shall be 1000 volts dc for 1 minute.
2. Perform continuity test to insure proper cable connection.

C. Test Values
1. Evaluate results by comparison with cables of same length and type. Investigate any values less than 50 megohms.

END OF SECTION 26 08 00

SECTION 26 24 16

PANELBOARDS

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work required under this section of the specifications consists of the furnishing, installation, and connection of lighting and appliance panelboards and distribution type panelboards and accessories.

B. Panelboards designated as HDA, DA, etc., or indicated on the drawings are distribution type panelboards. Those designated as HA, A, etc., are lighting and appliance type panelboards.

C. Definitions: The term panelboard, as used in this specification or on the drawings, shall mean the complete assembly including the enclosure, bus work, trim hardware and circuit breaker or fused devices. The words panel and panelboard are used synonymously in these documents.

1.2 QUALITY ASSURANCE

A. Industry Referenced Standards. The following specifications and standards are incorporated into and become a part of this Specification by reference.
1. Underwriters' Laboratories, Inc. (UL) Publications:
   a. No. 50 Cabinets and Boxes, Electrical
   b. No. 67 Panelboards
   c. No. 489 Molded Case Circuit Breakers and Circuit Breaker Enclosure
2. National Electrical Manufacturer's Association (NEMA) Publications:
   a. No. PB-1 Panelboards
   b. No. AB-3 Molded Case Circuit Breakers
3. National Fire Protection Association (NFPA) Publications:
   a. No. 70 National Electric Code (NEC)
4. National Electrical Contractors' Association (NECA):
   a. Standard of Installation

B. Acceptable Manufacturers. Products by the following manufacturers which conform to this specification are acceptable.
1. Eaton
2. General Electric
3. Siemens
4. Square D

1.3 SUBMITTALS

A. Refer to BASIC ELECTRICAL REQUIREMENTS for submittal requirements.

B. Manufacturers Product Data: Submit material specifications and installation data for circuit breakers, Panelboards, and (where indicated) fused switch devices

C. Shop Drawings: Submit shop drawings to indicate information not fully described by the product data to indicate compliance with the contract drawings.

1. Include electrical characteristics and ratings for each panelboard with dimensions, mounting, bus material, voltage, ampere rating, mains, poles and wire connection, and any accessories. Indicate method of ground bus attachment to enclosure.
2. Include front elevation bussing diagram indicating each bussing circuit breaker position.
3. Provide a schedule indicating circuit breaker type, trip and size, poles, frame type, and interrupting capacity.
4. Nameplate identification designation schedule.

D. Record Drawings. Include in each set:
1. A complete set of panelboard manufacturers product data and shop drawings indicating all post bid revisions and field changes.
2. A copy of each panelboard directory incorporating all post bid revisions and field changes.

PART 2 - PRODUCTS

2.1 GENERAL MATERIALS REQUIREMENTS

A. Provide all materials under this section of the specifications.

B. All panels and circuit breakers shall be UL listed and bear a UL label. Where panel serves as service entrance equipment, panel shall bear a UL label indicating listing as service equipment.

C. Panels shall be of the dead front safety type.

D. Provide panels complete with factory assembled circuit breakers connected to the bus bars. Unless shown otherwise on the drawings, position circuit breakers in panelboards with single pole breakers, equally divided, occupying top positions with two and three pole breakers occupying lower positions.in the positions shown on the panel schedules or bus diagrams as indicated on the drawings.

E. Number all panelboard circuits in the following sequence: Circuits No. 1 and 2, Phase A; Circuits No. 3 and 4, Phase B; Circuits No. 5 and 6, Phase C. Connect two pole breakers to phase indicated on the drawings.

2.2 MATERIALS DESCRIPTION

A. Panelboard Bussing and Interiors
1. Main lugs and main breakers shall be UL approved for copper conductors and shall be of a size range for the conductors indicated on the drawings. Each panel shall contain an equipment grounding bus. Each lighting and appliance panelboard shall contain a full size insulated neutral bus. Distribution type panelboard neutral bus shall be insulated and full size, unless otherwise indicated on the drawings.
2. The neutral and ground busses shall have a sufficient number of lugs to singularly terminate each individual conductor requiring a connection.
3. The ground bus shall be factory brazed, riveted or installed on studs welded or bolted to the panel enclosure or panel frame. The ground bus shall not be attached to the panel interior.
4. Where designated on panel schedule as "space", include all necessary bussing, device support and connections for installation of future devices compatible with panel. Provide blank cover for each space.

5. Where indicated, provide sub-feed lugs adjacent to the mains or feed-through lugs opposite the mains and increase box heights to provide additional cable bending and termination space. Lugs shall be the same size and capacity as mains.
6. Where indicated, insulated ground bus for isolation receptacle grounding shall be solid copper, mounted in panel enclosure on insulated stand off mounts.

B. Panelboard Enclosures
1. Provide panelboard gutters and bending space at terminals to conform to the National Electrical Code. Wiring gutters shall be oversized if necessary to provide sufficient space for taps, etc., as necessary.
2. Cabinets shall have full sized single doors. Doors more than 48 inches high shall have three point latching mechanisms.
3. Door locks shall be provided and shall be chromium plated combination cylinder lock and catch. Key slots shall be in the vertical position when locked. Locks shall be keyed alike and furnished with two keys per lock.
4. Trims, clamps and hinges on flush mounted 20 or 22 inch wide panelboards shall be completely concealed when the door is closed. Trims shall have adjustable trim clamps and shall not be removable with the door locked.
5. Panelboard width shall not be less than 20", nor more than 22" unless specific width is indicated on the drawings. Panelboard depth shall not exceed 5-3/4". Distribution panelboard width shall not be less than 31" and the depth shall not exceed 14".
6. The directory card shall be filled in using a typewriter with circuit wording adequately identifying circuits/loads as indicated. Spares and spaces shall be labeled as such using pencil in a neat and legible printed lettering.
7. For flush mounted panels, provide concealed captive clamping devices, concealed hinges and lock for all flush mounted panels. Key all panels throughout project alike.
8. All surface mounted panels shall be provided with door-in-door hinged cover trims. Trims shall be secured by piano hinges to enclosure and secured closed by two trim clamps.
9. Where two section panels are required, both sections shall have fully rated bus and separate cabinets connected by conduit nipples. Interconnect sections with copper conductors with ampacity equal to rating of main bus. Route phase and neutral conductors together between panels. Provide separate trims and card holder with each section.
10. Where indicated on the drawings or required for the environmental conditions, provide a NEMA 3R/12 enclosure.

C. Panelboard Circuit Breakers
1. Interrupting rating of all circuit breakers in panelboards operating on 208Y/120 volt system shall have UL rating of not less than 10,000 RMS symmetrical amps at system voltage. Panelboards for use on 480Y/277 volt system shall contain circuit breakers with UL interrupting rating of not less than 14,000 RMS symmetrical amps at system voltage. Provide circuit breakers with higher interrupting capacity when indicated on the drawings.
2. Series Ratings: Lighting and appliance panels and associated circuit breakers tested and listed in accordance with UL 67 and bearing an integrated short circuit rating shall be acceptable where system designs call for short circuit ratings of 65,000 AIC at system voltages. Note that series-rating may be with upstream fuses or circuit breakers. Provide evidence of series rating with shop drawing submittals. Provide permanently mounted plaque on panel labeled as follows: “CAUTION: Replace circuit breakers with devices rated 65kAIC only.”
3. Circuit breakers shall be provided with trip rating, poles and minimum interrupting rating as indicated on the drawings or specified herein.

4. Multi-pole breakers shall be common trip and common reset; tie handle connection between single pole breakers is not acceptable.
5. Branch circuit breakers in lighting and appliance panels shall be quick-make, quick-break, thermal magnetic type bolted to the bus. Circuit breakers in distribution type panelboards shall be bolted to the bus.
6. Molded case circuit breakers shall have automatic, trip free, non-adjustable, inverse time, and instantaneous magnetic trips.
7. Circuit breakers serving multi-motor equipment such as roof top units, compressor racks, etc.; or where required by equipment manufacturer, provide HACR type breaker.
8. Provide the following special devices and accessories when indicated on the drawings, specified herein, or required by the NEC.
    a. Ground fault interrupting circuit breaker (GFI).
    b. Provide handle lock-off device to prevent manually turning off device without removal. Install on all circuit breakers serving exit lighting, egress lighting, fire alarm system, security system, communications system, refrigeration equipment, and indicated on the panel schedules.
    c. Provide UL listed "SWD" switching duty circuit breakers on the devices serving unswitched lighting loads, or where indicated on the drawings.
    d. Provide shunt trip device for electrically tripping circuit breakers located underneath kitchen hoods or where indicated on the drawings. Shunt trip shall be for operation on a 120V source and have integral coil clearing contacts to de-energize coil after operation. Connect shunt trip to circuit indicated on the drawings.

D. Separately enclosed molded case circuit breakers: Where separately enclosed molded case circuit breakers are shown on the drawings, provide circuit breakers in accordance with the applicable requirements of those specified for panelboards.

E. Where existing panelboards are incorporated into the project, provide circuit breakers which comply with the specifications listed herein, and which are compatible in mounting and electrical characteristics with the existing circuit breakers in the associated panels. New circuit breaker AIC ratings shall match or exceed the rating of the highest-rated existing circuit breaker.

F. Fusible Switch Devices
1. Protective devices shall be quick-make, quick-break fusible switches. Fusible switches rated 30 to 600 amperes shall have fuse clips suitable for Class R fuses and shall be UL listed at 100,000 AIC. Fusible switches 800 amperes through 1200 amperes shall be furnished with Class L fuse clips and UL labeled for 200,000 AIC. Switches shall incorporate safety cover interlocks to prevent opening of the cover with a switch in the "on" position or prevent placing the switch in the "on" position with a cover open-provide defeater for authorized personnel. Handles shall have provisions for padlocking and shall clearly indicate the "on" or "off" position. Front cover doors shall be padlockable in the closed position.
2. Where shown on the drawings, provide a UL listed shunt trip attachment 120 volt with 480 volt to 120 volt fused primary and secondary control power transformer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Panelboards shall be mounted with the top of cabinet or enclosure 6'-6" above the finished floor, but with bottom of cabinet not closer than 6 inches to the floor.

B. Lace and group conductors installed in panels with nylon tie straps. Only one conductor shall be installed under terminal of individual circuit breakers. Form and train conductors in panel enclosure neatly parallel and at right angles to sides of box. Uninsulated conductor shall not extend beyond one-eights inch from terminal lug.

C. Do not splice conductors in panels. Where required, install junction box adjacent to panel and splice or tap conductors in box. Size box in accordance with conductor conduit limitation requirements of the National Electrical Code as defined in the Wires and Cables section of the specifications.

D. Mounting and Support
   1. Mounting: Enclosures shall be mounted where indicated on the drawings or specified herein. Support from the structure with fastening device specified.
      a. Enclosure shall be secured to structure by a minimum of four (4) fastening devices. A 1.5" minimum diameter round washer shall be used between head of screw or bolt and enclosure.
      b. Attach enclosure directly to masonry, concrete, or wood surfaces.
      c. Mount enclosure on metal channel (strut), which is connected to structure with fastening device specified, for installations on steel structure or sheet rock walls.

E. Conductors not terminating in panelboard shall not extend through or enter panel enclosure.

F. Typewritten circuit directory mounted on interior of panel door shall reflect any field changes or additions.

G. The trim covers of all flushed mounted panelboards shall be field painted. Refer to the Painting section of the specifications. Do not paint locks and exposed trim clamps.

H. Install six 3/4" empty conduits from each flush mounted panelboard into an accessible ceiling cavity.

I. Install push-in knock-out closure plugs in any unused knock-out openings.

J. Identification: Panelboards and individually mounted circuit breakers shall be identified. Refer to the BASIC ELECTRICAL REQUIREMENTS section of these specifications for identification requirements.

K. Where isolated ground receptacles are indicated, provide an isolated ground bar in the appropriate panel. Only one wire shall be terminated per a terminal lug.

L. Where new circuit breakers are installed in existing panels, confirm that the new breaker is securely mounted to the existing panel interior before energizing.

3.2 CLEANING AND ADJUSTMENT

A. After completion, clean the interior and exterior of dirt, paint and construction debris.

B. Touch up paint all scratched or marred surfaces with factory furnished touch up paint of the same color as the factory applied paint.

C. Adjust and align panelboard interior and trim in accordance with manufacturers recommendations, and to eliminate gaps between the two.

3.3 FIELD QUALITY CONTROL

A. Contractor shall verify in the field that all factory-made connections and terminations are torqued to manufacturer's recommended tolerances.

B. Coordination: Coordinate installation with architectural and structural features, equipment installed under other sections of the specifications and electrical equipment to insure panel access and insure that clearance minimums are provided.

C. Refer to the ELECTRICAL ACCEPTANCE TESTING section of this specification.

END OF SECTION 26 24 16

SECTION 26 24 20

DISCONNECT SWITCHES

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work required under this section of the specifications consists of the furnishing, installation, and connection of disconnect switches for electrical equipment, and the fuses mounted in the disconnect switches.

B. Provide disconnect switches for any of the following conditions:
1. Where a motor is located out-of-sight of its motor controller.
2. Where an electrical resistance heater is provided.
3. Where required by the National Electrical Code.
4. Where indicated on the drawings.

1.2 QUALITY ASSURANCE

A. Industry Referenced Standards. The following specifications and standards are incorporated into and become a part of this Specification by reference.
1. Underwriters' Laboratories, Inc. (UL) Publications:
   a. Enclosed Switches
   b. 198C High Interrupting Capacity Fuses, Current Limiting Type
   c. 198E Class R Fuse
   d. Product Directory - Electrical Construction Materials
2. National Electrical Manufacturers' Association (NEMA) Standards:
   a. KS-1 Enclosed Switches
3. National Fire Protection Association (NFPA) Publications:
   a. National Electrical Code
4. National Electrical Contractors' Association (NECA) Publication:
   a. Standards of Installation
5. American National Standards Institute (ANSI) Standards:
   a. C97.1 Low Voltage Cartridge Fuses 600 Volts or Less

B. Acceptable Manufacturers. Products by the following manufacturers which conform to this specification are acceptable.
1. Disconnect Switches: Eaton, General Electric, Siemens, Square D
2. Fuses: Bussman, General Electric, Shawmut

1.3 COORDINATION

A. Coordinate installation with architectural and structural features and equipment installed under other sections of the specifications to ensure disconnect switch accessibility and ensure that working clearance minimums are provided.

PART 2 - PRODUCTS

2.1 GENERAL MATERIALS REQUIREMENTS

A. Provide all materials under this section of the specifications.

B. All disconnect switches and fuses shall be UL listed and bear a UL label.

2.2 MATERIALS DESCRIPTION

A. Switches
1. Provide 600 volt rated switches for use on 480Y/277V systems and 250 volt rated switches for use on 240V or 208Y/120V systems.
2. Switches shall be heavy duty rated and shall be horsepower rated when used on circuits serving motor loads.
3. Provide switches with number of poles as required to disconnect all ungrounded conductors. Provide with a solid neutral where installed in a circuit which contains a neutral conductor.
4. Provide an equipment grounding conductor termination lug bonded to the enclosure. This lug shall be dedicated to equipment grounding and shall be used for no other purpose.
5. Switching mechanism shall be quick-make, quick-break type, with arc chutes for each pole.
6. Provide line terminal shields in all switches.
7. Provide means for padlocking of switches.
8. Provide door interlocks to prevent door from being opened when energized. Provide inconspicuous means to defeat door interlock.
9. Provide permanent nameplate indicating switch rating in volts, amperes, and horsepower. Provide plastic laminated nameplate with machine stenciled lettering 1/4" in height indicating equipment being served and the circuit designation.
10. Enclosures shall be NEMA 1 in all interior dry locations and NEMA 3R in all damp, wet, or exterior locations, unless otherwise indicated on the drawings.
11. Switches shall be non-fusible unless fusible type is indicated on the drawings. Where fusible type is indicated, provide as follows:
    a. Fusible switches rated 600 ampere and below shall be provided with rejection clips for Class RK1 or RK5 fuses. Larger switches shall accept Class L fuses only. Provide a complete set of fuses for each fusible disconnect switch.

B. Fuses
1. Fuses shall be heavy duty, horsepower rated for the motor load served.
2. Fuses shall be current-limiting, with an interrupting rating of 200,000 RMS symmetrical amperes.
3. Provide fuses of types, sizes, ratings, and average time-current and peak let-through current characteristics indicated, which comply with manufacturers' standard design, and are constructed in accordance with published product information and with industry standards and configurations.
4. All fuses shall be from one manufacturer, and shall have a 200,000 ampere RMS symmetrical interrupting rating, unless otherwise noted.
5. For control power circuits/transformers, fuses shall be dual element, time delay, 250 volt rated, with a 10,000 ampere RMS symmetrical interrupting rating.
6. Fuses for sizes up to and including 600 amperes shall be UL Class RK-1.
7. Fuses for sizes above 600 amperes shall be UL Class L time-delay.
8. Except for control power applications, or where the service voltage(s) to the project is less than 250 volts, all fuses shall be 600 volt rated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install switches to maintain line of sight from item served and to maintain working clearances and accessibility required by the National Electrical Code. Locate switches adjacent to equipment served unless otherwise indicated.

B. Mounting
1. Secure enclosure to structure with four fastening devices. Provide round washer (1.5" diameter minimum) between fastening device and enclosure.
2. Attach directly to wood, masonry, or concrete surfaces.
3. Mount on galvanized steel channel system mounted to structure where enclosure is attached to sheet rock walls, steel structure, or sheet metal.
4. Where indicated as free-standing, mount enclosure to galvanized steel channel structure secured to floor, pad, or other appropriate building component.
5. Mount such that operating handle is between 42" and 60" above floor or grade, unless otherwise indicated.

C. Only one conductor shall be installed under each terminal. Uninsulated conductor shall not extend more than 1/8" inch from terminal lug. Train conductors neatly inside enclosure, parallel and at right angles to box.

D. Do not splice conductors in enclosure. If required, install junction box or wireway adjacent to disconnect switch and splice within box. Conductors not terminated on switch shall not enter disconnect enclosure.

E. Provide push-in plugs to close any unused knockout openings.

F. Install fuses in fusible switches. Provide to Owner three spare fuses of each type/voltage/ampere size. Verify from nameplate data the recommended fuse sizes for all project equipment requiring fusible disconnects.

3.2 FIELD QUALITY CONTROL

A. Upon completion of installation of switches, and after circuitry has been energized with power source, operate each switch and verify that each are functioning properly. Correct malfunctioning units at site, then retest to demonstrate compliance.

B. After completion, clean the enclosure interior and exterior of dirt, dust, paint overspray, and construction debris. Any scratched or marred surfaces shall be touched up with factory-supplied paint to match the original finish.

END OF SECTION 26 24 20

SECTION 26 27 26

WIRING DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work required under this section of the specifications consists of the installation of wiring devices, i.e. switches, receptacles, and device plates. All materials shall be provided under this section of the specifications.

B. The catalog numbers listed herein for switches and receptacles are not intended to represent finish color of device. Regardless of catalog numbers, the switches and receptacles provided on this project shall have finish color as selected by the Owner's Representative, unless otherwise indicated. All special purpose receptacles shall be provided in black finish.

1.2 QUALITY ASSURANCE

A. The following standards are incorporated into and become a part of this specification by reference:
1. NEMA WD-1 General Purpose Wiring Devices
2. NEMA WD-5 Specific Purpose Wiring Devices

1.3 ACCEPTABLE MANUFACTURERS

A. The manufacturers' catalog numbers listed herein for switches and receptacles are not intended to represent the only available source of the device, they are intended to establish a level of quality. Devices as manufactured by the following which comply with this specification are acceptable, unless otherwise indicated:
1. NEMA configuration:
   a. Arrow Hart
   b. Eagle
   c. General Electric
   d. Hubbell
   e. Pass & Seymour
2. Pin-and-sleeve, hazardous-location rated, or other configuration:
   a. Crouse-Hinds
   b. Appleton
   c. Killark
   d. Russelstoll

PART 2 - PRODUCTS

2.1 SWITCHES

A. Select switches from the following:
1. Single pole, 20 amp 120/277 volt switch: Hubbell 1221/3/4 series
2. Incandescent Dimmer, 120V: Lutron N-series, selected to exceed the connected load
3. Weatherproof, 20 amp 120/277 volt switch: Hubbell 1281/3 series
4. Single pole, 20 amp 120/277 volt key switch: Arrow Hart 1191/3 series
5. Single pole, 20 amp 120 volt switch, pilot light in handle: Arrow Hart 2999 series.
6. Switch in narrow door jamb: Arrow Hart QST series

2.2 RECEPTACLES

A. Select general purpose receptacles from one of the following:
   1. 15 amp, 125 volt grounded duplex receptacle (NEMA 5-15R): Hubbell 5262
   2. 20 amp, 125 volt grounded duplex receptacle (NEMA 5-20R): Hubbell 5362
   3. Clock receptacle (NEMA 5-15R): Arrow Hart 5708
   4. Ground Fault Interrupter (GFI) 20 amp, 125 volt duplex receptacle: Hubbell GF-5362. GFCI receptacles shall be flush mounting, straight blade, rated 125 volts, and 15 amperes, unless otherwise indicated. Receptacles shall have a self-grounding mounting strap feature. Wiring terminal screws shall be brass metal. Ground Fault circuit Interrupted (GFCI) receptacles shall be U.L. listed as providing protection for personnel against line-to-ground shock hazard. The GFCI device shall continuously monitor current in the phase and neutral conductors and shall interrupt the circuit for a current differential of more than 5mA to the outlet(s). The device shall be solid state with test button and indicator, a reset button, labeled and with printed instructions. The GFCI receptacle shall be the end-of-line type

B. Select hospital grade receptacles from one of the following:
   1. 15 amp, 125 volt grounded duplex receptacle (NEMA 5-15R): Hubbell 8200.
   2. 20 amp, 125 volt grounded duplex receptacle (NEMA 5-20R): Hubbell 8300.
   3. Clock receptacle (NEMA 5-15R): Hubbell 5235.
   4. Ground Fault Interrupter (GFI) 20 amp, 125 volt duplex receptacle: Hubbell GF-8300.
   5. Isolated Ground 20 amp, 125 volt grounded duplex receptacle (NEMA 5-20R): Hubbell IG-8300.
   6. Tamper resistant 15 amp, 125 volt grounded duplex receptacle (NEMA 5-15R): Hubbell SG62H.
   7. Operating room Isolation Power System panel receptacles, 20 amp, 125 volt non-grounded: Hubbell 23000. Two devices mounted in a three gang box with face plate.

2.3 DEVICE PLATES

A. Device plates shall be one piece single or multi-gang type selected to match the device or combination of devices. Device plates for flush mounted devices shall be same color as devices unless indicated otherwise. Provide tamper proof screws where indicated.
   1. Device plates for use with flush devices shall be jumbo type. Device plates for surface mounted devices shall be for use with the type of outlet box in which the device is mounted. All devices installed in areas exposed to the weather and where indicated on the drawings shall be provided with a weatherproof device plate.
   2. Areas identified as wet locations or defined as wet locations by NEC 100 or as designated as weatherproof (“WP”) on the drawings shall have a weatherproof enclosure listed as weatherproof when in use.
   3. Where engraved device plates are indicated on the drawings or specified, lettering shall be 1/8" high and shall be black unless other contrasting color is specified.

2.4 SPECIAL PURPOSE RECEPTACLES

A. Special purpose receptacles shall be of the type indicated by either NEMA designation or other designation shown on the drawings. Furnish one matching plug for the Owner’s use with every special purpose receptacle indicated.

2.5 ATTACHMENT PLUGS AND CONNECTORS

A. Attachment plugs shall be U.L. listed and shall have the following basic features:
1. Dead-front construction, back-wired.
2. Heavy duty, solid brass blades with standard end of blade located detent hole.
3. Solid brass terminal screws.
4. Cord grip.
5. Grounding blade (unless otherwise specified).

2.6 ISOLATED GROUND (IG) RECEPTACLES

A. Isolated ground receptacles shall be standard line style, flush mounting, straight blade, rated 125 volts, and 15 amperes unless otherwise indicated, with mounting straps fully insulated from the grounding path created through metal wall boxes. Such receptacles shall be identified by orange-colored faces and shall be grounded only through their grounding terminal screws or grounding lead. Receptacles shall be flush mounting. Wiring terminal screws shall be brass metal.

2.7 FLOOR MOUNTED RECEPTACLES AND COMMUNICATIONS OUTLETS

A. Floor mounted outlets shall include the devices indicated on the drawings as shall be as manufactured by FSI, Inc., Hubbell, Steel City, or Walker/Wiremold. Fittings shall have a base-plate that allows a 3/4-inch adjustment to either side of center.

B. Cover plates shall be provided for each device furnished or installed. Cover plates and devices shall be of matching finish, unless otherwise specified or indicated.

C. Devices shall be mounted recessed for flush installations, unless otherwise indicated.

D. Refer to CONDUITS AND BOXES specification section.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. Unless otherwise indicated or directed by the Owner's Representative, wiring devices shall be installed in a vertical orientation with center-of-box distances from finished floors as indicated in the drawings and between 18 and 48 inches, to meet handicapped access requirements. Device outlets in concrete block, brick or tile shall be above or below a joint such that the center-of -box is between 18 and 48 inches.

B. Review Architectural Drawings for any device requiring specific location or mounting height. Install devices above countertops with major axis horizontal above the backsplash. Receptacles above counter tops shall be installed with top-of-box at 12 inches above the counter and with bottom of box above any splash plate. Other special mounting height devices shall be installed as indicated or required. Devices indicated located in the same approximate position on one section of wall, floor, column, etc. shall be grouped to create a functional and pleasing appearance. Similar outlet groups throughout the job shall be similarly grouped. Unless indicated otherwise, groups shall be developed as follows where applicable:
1. Devices at different levels shall be aligned vertically.

2. Devices at the same level shall, where possible, be grouped using sectional gang boxes.
3. Devices or device groups occurring in architectural features, i.e., wall sections, etc. shall be accurately centered in the feature(s), unless indicated or functionally required otherwise.
4. Wall switches shall be located on the strike side of a door, six (6) inches from the door opening, unless otherwise functionally required or indicated.

C. Device Plates:
1. Cover plates for flush, dry, ordinary locations shall be standard configuration, one piece standard size plates with matching screws, unless otherwise indicated.
2. Wall cover plate styles, material and finishes shall be as scheduled by the plans.
3. Cover plates with labeling shall be the engraved type, unless otherwise indicated.
4. Unless indicated otherwise, wall cover plates shall be the device strap mounting type.
5. Cover plate mounting screws shall be tightened to a snug tension and aligned with any screw slot in a vertical position.

D. Furnish and install suitable attachment plugs for installed equipment not provided with appropriate plug(s). Where attachment plugs are furnished but are for any reason not suitable, remove the plugs and/or cord and replace same with suitable devices and cord. Attachment plugs shall be the straight body, dead-front grounding type, unless otherwise indicated or required.

E. Install a green insulated bonding jumper between receptacles and grounded outlet boxes, and provide other grounding per the requirements of the GROUNDING section. Where provided, isolated ground receptacles shall be grounded only through their isolated grounding means, with grounding connection (bond) only at the separately derived electrical source. Raceways with wiring for such devices shall be metal and effectively grounded to the equipment and enclosure grounding system for the building.

END OF SECTION 26 27 26

SECTION 26 50 00

LIGHTING FIXTURES

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work required under this section of the specifications consists of the provision of all lighting fixtures for the project, including mounting hardware, poles, and lamps.

B. Provide complete lighting systems, including luminaires, controls, indicators, power and control wiring, ceiling reinforcements, mounting supports, hardware and other items as specified, noted by the plans, required for operation, or otherwise indicated.

1.2 QUALITY ASSURANCE

A. Industry Referenced Standards. The following specifications and standards are incorporated into and become a part of this Specification by reference.
1. Underwriters' Laboratories, Inc. (UL) Publications pertaining to lighting fixtures.
2. National Electrical Manufacturers' Association (NEMA) Standard Publications LE 1 and LE 2 pertaining to lighting equipment.
3. National Fire Protection Association (NFPA) Publications NFPA-70 and NFPA-101 pertaining to lighting fixtures.
4. American National Standards Institute (ANSI) / Illuminating Engineering Society (IES) Standard ANSI 132.1 pertaining to interior lighting fixtures.
5. National Electrical Contractors' Association (NECA) Standards of Installation.
6. American Society of Testing Materials (ASTM).
7. American Association of State Highway Transportation Officers (AASHTO).

B. Acceptable Manufacturers.
1. Lighting Fixtures: The drawings indicate lighting fixture selections by referencing one or more fixture manufacturers and product catalog numbers for each type. The fixtures were used as the basis of design. Any alternate manufacturer must be equal or better than the basis of design fixtures with respect to construction, aesthetics, and photometric values. Where not deemed equal by the engineer and/or architect, the basis of design fixtures shall be supplied and installed. Fixture submittals must provide adequate information to show equivalence, including but not limited to, photograph or isometric drawing of fixture, photometric data, dimensional data, optional features listing, and information on construction, type of finish, etc.
2. Lamps: Products of the following, which comply with these specifications, are acceptable.
   a. General Electric
   b. Venture
   c. Osram-Sylvania
   d. Philips

C. Verification: Verify with fixture manufacturers that scheduled fixture descriptions and catalog numbers are in agreement and complete, and that fixtures are furnished with the proper trims, frames, supports, hangers, and other miscellaneous appurtenances to properly coordinate with the project requirements as indicated and by actual ceiling systems to be installed.

PART 2 - PRODUCTS

2.1 GENERAL MATERIALS REQUIREMENTS

A. Provide all materials under this section of the specifications.

2.2 MATERIALS DESCRIPTION

A. General:
1. Fixtures shall be listed and labeled by Underwriter's Laboratories (UL) or assembled from UL labeled components.
2. Factory Assembly and Test: Fixtures shall be fully assembled and wired by the factory and ready for installation as shipped.
3. Fixture supports and hardware shall be suitable metal unless otherwise indicated. Support studs used for indoor fixture or component support shall be galvanized steel or malleable iron; diecast studs shall not be used.

B. Ballasts:
1. Ballasts shall be suitable for operation on 60 hertz branch circuits protected at 20 amperes. Ballasts shall be rated for the voltage and circuiting indicated for each fixture type. Generally, fluorescent ballasts shall be high power factor, with sound rating "A", and with class "P" integral thermal protection having automatic reset feature. Ballasts shall be UL labeled.
2. Ballast manufacturer shall warrant ballasts to be free from defects in material or workmanship for at least five (5) years from date of manufacture under normal conditions of use. Any ballast failing within the guarantee period shall be replaced by the manufacturer at no expense to the Owner.
3. Unless otherwise indicated, ballasts for HID fixtures shall be the constant wattage, high power factor, encapsulated typed. Ballasts for outdoor locations shall be designed for cold starting at -20ºC. High pressure sodium ballasts shall be auto regulator type with minimum power factor of 0.92.
4. Electronic ballasts shall:
   a. Be provided with documentation showing that manufacturer has at least ten (10) years' experience manufacturing electronic ballasts with a documented failure rate of less than 5 percent of units in service.
   b. Be specifically designed to operate rapid-start T8 lamps, unless otherwise noted.
   c. Be electronic type and operate lamps at a frequency above 20 kHZ from an input of 60 HZ.
   d. Consistently start and operate lamps (with a light output which does not vary) from a supply voltage of plus or minus 10 percent about the center design voltage of 120 or 277 volts.
   e. Provide installed light level equivalent to C.B.M. certified electromagnetic ballast (plus or minus 5 percent).
   f. Be capable of operating remaining lamp(s) if one or more of the companion lamps fail or are removed.
   g. Comply with A.N.S.I. and I.E.E.E. standards for total harmonic distortion (THD). THD shall be less than 20%.
   h. Have input power factor greater than or equal to 92% (.92).
   i. Provide starting sequence consistent with lamp manufacturers' recommendations and provide full rated lamp life.
   j. Have lamp current crest factor (ratio of peak to R.M.S. lamp current) of 1.5 or less per lamp manufacturers' recommendation.
   k. Comply with F.C.C. requirements governing electromagnetic and radio frequency interference.
   l. Comply with I.E.E.E. standards for line voltage transient protection.
   m. Be compatible with occupancy sensors specified, where applied.

C. Lenses: Plastic lenses shall be manufactured and tested to conform with SBC 2604 “Light-Transmitting Plastics & NFPA 101 Chapter 6. Lenses shall meet all of the following:
1. Fall from their mounting at an ambient temperature of at least 200 degree F(93 degree C) below the ignition temperature of the plastic material as measured by ASTM D 1929.
2. Remain in place at ambient room temperature of 175degree F(79 degree C) for a period of not less than 15 minutes.
3. The maximum length of any single plastic panel shall not exceed 10 ft(3048mm) and the maximum area of any single light diffuser shall not exceed 30 sq ft (2.8 sq m)

D. Lamps: Unless otherwise indicated, linear fluorescent lamps shall be rapid-start, T8, 3500K white, CRI of 75 or greater. Compact fluorescent lamps shall be 2700K-3000K white, with tube configuration as indicated. Incandescent lamps shall be coated. Metal halide and high pressure sodium lamps shall be clear, with burning position coordinated with fixture. Metal halide lamps in non-lensed fixtures shall have self-extinguishing feature.

E. Fixtures:
1. Fluorescent:
   a. Fixtures shall be suitable for individual or continuous row installation. Fixtures installed in continuous rows shall maintain nominal spacing.
   b. Fixtures shall be listed and labeled for their intended application on the project. Fixtures shall be suitable for indoor locations, or for outdoor locations where indicated. Fixture housings shall be metal finished with high gloss baked white enamel of 85% minimum reflectance. Reflectors shall be highly specular. Ballasts and wiring shall be totally enclosed. Fixtures for indoor dry or damp locations may have steel or aluminum housings. Fixtures for outdoor or wet locations shall have aluminum or nonmetallic housings.
2. Incandescent:
   a. Fixtures shall be suitable for connection to 120 volts, 60 hertz, single phase distribution systems.
   b. Unless otherwise indicated, recessed mounted incandescent fixtures shall have thermal overload protection to protect against overheating. Fixtures installed in direct contact with insulation shall also be rated for such direct contact.

F. Occupancy Sensors: Occupancy sensors shall:
1. Be motion detectors that provide coverage without gaps within the detection area.
2. Be specifically designed to detect types of motion found in offices, conference rooms, classrooms, bathrooms, etc.
3. Have crystal controlled operating frequency to within 0.005 percent. Sensors shall be available with different operating frequencies to allow individual control of adjacent areas.
4. Have field adjustable controls for "sensitivity" and "time delay." Timing circuitry shall provide user adjustable "time of light off" delay from 0.5 to 12 minutes.
5. Provide constant coverage after sensitivity control has been set.
6. Be U.L. listed.
7. Be provided with an easily visible indicator light to verify that motion is being detected.
8. Be specifically designed for the size of the area in which they will be used.
9. Operate on Class 2 wiring supplied by a switchpack (ceiling mounted units).
10. Operate silently, except when actually switching the load.
11. Withstand the inrush of power required to start the lamp. The sensor shall be designed for use with the ballast supplied.
12. Be provided with a manual override switch in the sensor to allow the load to be turned on without tools in the event of a Sensor failure.
13. Have electronics which shall be replaceable, upon failure, without disturbing the hardwiring or Sensor mounting.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fixtures shall be installed in accordance with UL listing restrictions and local codes and ordinances.

B. Fixtures shall be located in a manner coordinated with any suspended acoustic ceiling pattern, and in accordance with patterns as shown on the Architectural Drawings.

C. In areas of acoustic tile ceiling, centerlines of incandescent and fluorescent fixtures shall coincide with tile centerline or joint, unless otherwise indicated.

D. Lighting fixtures shall be properly and rigidly supported and aligned. Fixtures shall be supported independently of the ceiling support framing, except where framing is not smaller than 1-1/2-inch trade size channel or inverted tee and approval for support of the specific category of fixture is given in writing by the Owner's Representative.

E. Fixture supports shall be standard type bar hangers, or other accepted method. Lay-in type troffers shall be secured to the ceiling support frame by an earthquake clip similar to Caddy #515/515A.

F. Plaster rings shall be provided for recessed fixtures in plastered ceilings of any type.

G. Fixtures above accessible type suspended grid ceilings shall be wired with flexible metal conduit to a nearby junction box. The flexible conduit shall be between four and six feet in length, unless otherwise required by Code.

H. Any fixtures requiring complete installation prior to installation of the ceiling shall be identified by the Contractor and so installed.

I. Verify that only lamp types approved by the fixture manufacturer are installed in fixtures.

J. Verify the final ceiling opening dimensions required as recommended by the manufacturer and shall provide for installation to these dimensions.

K. Verify that fixtures, including wiring and service access methods, are acceptable to the local inspecting authorities having jurisdiction.

L. Fixtures shall have metal parts, glassware, plastic diffusers, etc. free from scratches, chips, cracks, and other defects.

3.2 FIELD QUALITY CONTROL

A. Upon completion of installation of fixtures, and after circuitry has been energized with power source, verify operation of all fixtures, lamps, and associated controls. Correct malfunctioning units, then retest to demonstrate compliance.

END OF SECTION 26 50 00

SECTION 270000
COMMUNICATIONS

PART 1. GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of General Requirements/Provisions shall be considered a part of this section and shall have the same force as if printed herein full. In addition, all information related to communications infrastructure that is documented in the architectural, structural, mechanical, and electrical drawings/documents shall be included as part of the Communications documents.

1.02 QUALITY ASSURANCE

A. Specifications, Standards and Codes: All work shall be in accordance with the following:
1. The current edition of the National Electrical Code (NFPA 70)
2. American National Standards Institute (ANSI)
3. National Electrical Manufacturers Association (NEMA)
4. Telecommunications Industries Association (TIA)
5. Electronic Industries Association (EIA)
6. Institute of Electrical & Electronics Engineers (IEEE)
7. Underwriters Laboratories (UL)
8. American Standards Association (ASA)
9. Federal Communications Commission (FCC)
10. Occupational Safety and Health Administration (OSHA)
11. American Society of Testing Material (ASTM)
12. Americans with Disabilities Act (ADA)
13. Local city and county ordinances governing electrical work
14. In the event of conflicts, the more stringent provisions shall apply

1.03 SCOPE

A. The work to be done under this section of the Specifications shall include furnishing labor, material, equipment and tools required for the complete installation of the work indicated on the Drawings or as specified herein.

B. All materials, obviously a part of the Communications Infrastructure and necessary to its proper operation, but not specifically mentioned or shown on the Drawings, shall be furnished and installed without additional charge.

C. The Drawings and Specifications are complementary to each other and what is called for by one shall be as binding as if called for by both. If a discrepancy exists between the Drawing and Specifications, the higher cost shall be included, and the engineer shall be notified of the discrepancy.

1.04 WORK INCLUDED

A. The Communications Infrastructure installed and work performed under this Division of the Specifications shall include but not necessarily be limited to the following:

B. Structured Cabling Infrastructure

C. Communications conduits, raceways, cable tray, racks, cabinets and equipment mounting boards

D. Grounding and Bonding

E. Underground raceway excavation, backfill, and compaction

F. Concrete work for duct banks, maintenance holes, handholes, vaults and restoration (where applicable)

1.05 DEFINITIONS

A. Terms: The following definitions of terms supplement those of the General Requirements and are applicable to Division 27 - Communications:

B. Provide: As used herein shall mean “furnish, install and test (if applicable) complete.”

C. Infrastructure: As used herein shall mean cable, conduit, raceway, cable tray or j-hooks with all required boxes, fittings, connectors, and accessories; completely installed.

D. Work: As used herein shall be understood to mean the materials completely installed, including the labor involved.

1.06 DRAWINGS

A. Drawings are generally diagrammatic and show the arrangement and location of pathways, outlets, support structures and equipment. The Contractor shall carefully investigate the structural and finish conditions affecting his work and arrange his work accordingly. Should conditions on the job make it necessary to make adjustments to pathways or materials, the Contractor shall so advise the Engineer and secure approval before proceeding with such work.

B. Where exact locations are required by equipment for stubbing-up and terminating conduit concealed in floor slabs, the Contractor shall request shop drawings, equipment location drawings, foundation drawings, and any other data required by him to locate the concealed conduit before the floor slab is poured.

C. Materials, equipment or labor not indicated but which can be reasonably inferred to be necessary for a complete installation shall be provided. Drawings and Specifications do not undertake to indicate every item of material, equipment, or labor required to produce a complete and properly operating installation.

D. The right is reserved to make reasonable changes in locations of equipment indicated on Drawings prior to rough-in without increase in contract cost.

E. The Contractor shall not reduce the size or number of conduit runs indicated on the Drawings without the written approval of the Engineer.

F. Any work installed contrary to Contract Drawings shall be subject to change as directed by the Engineer, and no extra compensation will be allowed for making these changes.

G. The location of equipment, support structures, outlets, and similar devices shown on the Drawings are approximate only. Do not scale Drawings. Obtain layout dimensions for equipment from Architectural plans unless indicated on Communications plans.

H. Schematic diagrams shown on the Drawings indicate the required functions only. The technology of a particular manufacturer may be used to accomplish the functions indicated without exact adherence to the schematic Drawings shown. Additional labor and materials required for such deviations shall be furnished at the Contractor's expense.

I. Verify the ceiling type, ceiling suspension systems, and clearance above hung ceilings prior to ordering cabling and associated hardware. Notify the Engineer of any discrepancies.

J. Review all architectural drawings for modular furniture.

K. Portions of these Drawings and Specifications are abbreviated and may include incomplete sentences. Omissions of words or phrases such as “the Contractor shall,” “shall be,” “as indicated on the Drawings,” “In accordance with,” “a,” “the” and “all are intended” shall be supplied by inference.

1.07 SUBMITTALS

A. Submit for approval, details of all materials, equipment and systems to be furnished. Work shall not proceed without the Owner and/or the Project Manager's approval of the submitted items. Three (3) copies 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 as a whole. 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.
2. Contractor shall generate shop drawings. Modify reviewed and accepted shop drawings to include revisions based upon completion of work. Submit shop drawings with record drawings on hard copy.
3. Shop drawings shall include equipment racks, patch panels, termination blocks, connection details, rack mounting details and any other details not included in the construction drawings.

B. Any materials and equipment listed that are not in accordance with Specification requirements may be rejected.

C. The approval of material, equipment, systems and shop drawings 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 shop drawing errors. The Contractor shall carefully check and correct all shop drawings prior to submission for approval.

D. Refer to spec section 27080 for close out requirements.

1.08 QUALITY ASSURANCE

A. Equipment and materials required for installation under these Specifications shall be the current model and new (less than one [1] year from the date of manufacture), unused and without blemish or defect.

B. Equipment shall bear labels attesting to Underwriters Laboratories, where subject to label service. Manufacturers of equipment and materials pertinent to these items shall have been engaged in the manufacture of said equipment a minimum of three (3) years and, if so directed by the Owner, be able to furnish proof of their ability by submitting affidavits and descriptive data about their product including size and magnitude comparable to requirements specified herein.

1.09 CONTRACTOR QUALIFICATIONS

A. The Contractor shall have total responsibility for the coordination and installation of the work shown and described in the Drawings and Specifications. The Contractor shall be a company specializing in the design, fabrication and installation of integrated communications systems.

B. Communications Systems specified shall be installed under the direction of a qualified Contractor. Qualification requirements shall include submittal by the Contractor to the Owner of the following:

1. List of previous projects of this scope, size and nature; including names and sizes of projects, description of work, and time of completion and names of contact persons for reference.
2. Shall certify that they are manufacturer-authorized for work to be performed. Submit Certifications with qualification certification package.
3. Shall certify that contractor has employed at least one (1) full-time Registered Communications Distribution Designer (RCDD). Submit certification with qualification certification package.

1.10 COORDINATION WITH OTHER TRADES

A. The Contractor shall coordinate communications work with that of other sections as required to ensure that the entire communications work will be carried out in an orderly, complete and coordinated fashion.

1.11 SITE INVESTIGATION

A. Prior to submitting bids of the project, visit the site of the work to become aware of existing conditions that may affect the cost of the project. Where work under this project requires

extension, relocation, reconnections or modifications to existing equipment or systems, the existing equipment or systems, shall be restored to their original condition before the completion of this project.

1.12 PERMITS

A. Obtain all permits and inspections for the installation of this work and pay all charges incident thereto. Deliver to the Owner all certificates of said inspection issued by authorities having jurisdiction.

PART 2. PRODUCTS

2.01 SUBSTITUTIONS

A. Product substitutions are not allowed unless noted as, “Or Approved Equal (by Owner).” The Engineer's decision as to whether the submitted equipment is acceptable shall be final and binding.

B. All changes necessary to accommodate the substituted equipment shall be made at the Contractor's expense, and shall be as approved by the Engineer. Detailed drawings indicating the required changes shall be submitted for approval at the time the substitution is requested. Follow division 0 and division 1 in submitting substitution request.

C. If substitutions are made in lieu of device specified; form, dimension, design and profile shall be submitted to the Engineer for approval.

D. Submit request for approval of substitute materials in writing to the Owner and Engineer at least ten days prior to bid opening.

2.02 MATERIALS

A. All materials used in this work shall be new and shall bear the inspection label of Underwriters' Laboratories Inc. or certification by other recognized laboratory.

B. The published standards and requirements of the Telecommunications Industries Association (TIA), National Electrical Manufacturers Association (NEMA), the American National Standard Institute (ANSI), the Institute of Electrical and Electronic Engineers (IEEE), and the American Society of Testing Materials (ASTM), are made a part of these Specifications and shall apply wherever applicable.

C. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, for which replacement parts are available.

D. When more than one unit of the same class of equipment or material is required, such units shall be the products of a single manufacturer or partner manufacturers that offer a certified solution.

E. Components of an assembled unit need not be products of the same manufacturer, but must offer a certified end-to-end solution.

F. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.

G. Components shall be compatible with each other and with the total assembly for the intended service.

PART 3. EXECUTION

3.01 EXAMINATION OF CONDITIONS

A. Prior to the start of work, the Contractor shall carefully inspect the installed work of other trades and verify that such work is complete to the point where installation may properly commence. Start of work indicates acceptance of conditions.

B. Install equipment in accordance with applicable codes and regulations, the original design and the referenced standards.

C. In the event of a discrepancy, immediately notify the Project Manager.

D. Do not proceed with installation until unsatisfactory conditions and discrepancies have been fully resolved.

3.02 PROTECTION OF SYSTEMS AND EQUIPMENT

A. Protect materials and equipment from damage during storage at the site and throughout the construction period. Equipment and materials shall be protected during shipment and storage against physical damage, dirt, theft, moisture, extreme temperature and rain.

B. Damage from rain, dirt, sun and ground water shall be prevented by storing the equipment on elevated supports and covering the sides with securely fastened protective rigid or flexible waterproof coverings.

C. During installation, equipment shall be protected against entry of foreign matter on the inside and be vacuum cleaned both inside and outside before testing, operating or painting.

D. As determined by the Project Manager, damaged equipment shall be fully repaired or shall be removed and replaced with new equipment to fully comply with requirements of the Contract Documents. Decision of the Project Manager shall be final.

E. Damaged paint on equipment and materials shall be repainted with painting equipment and finished with the same quality of paint and workmanship as used by the manufacturer.

3.03 ACCESS TO EQUIPMENT

A. Equipment shall be installed in location and manner that will allow convenient access for maintenance and inspection.

B. Working spaces shall be not less than specified in the National Electrical Code (NEC) for voltages specified.

C. Where the Project Manager determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled, one time only, as directed by the Project Manager, at no additional cost to the Owner. “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 duct work.

3.04 CLEANING

A. During construction, and prior to Owner acceptance of the building, remove from the premises and dispose of packing material and debris caused by communications work.

B. Remove dust and debris from interiors and exteriors of electrical equipment. Clean accessible current carrying elements prior to being energized.

3.05 COMPLETION

A. General: Upon completion of the work, remove excess debris, materials, equipment, apparatus, tools and similar items. Leave the premises clean, neat and orderly.

B. Results Expected: Systems shall be complete and operational and controls shall be set and calibrated. Testing, start-up and cleaning work shall be complete.

C. Maintenance Materials: Special tools for proper operation and maintenance of the equipment provided under this Specification shall be delivered to the Owner.

3.06 TESTING AND VERIFICATION

A. See specific Division 27 sections for testing parameters of sub-systems.

B. The Contractor shall verify that requirements of this Specification are met. Verification shall be through a combination of analyses, inspections, demonstrations and tests, as described below.

C. Verification by inspection includes examination of items and comparison of pertinent characteristics against the qualitative or quantitative standard set forth in the Specifications. Inspection may require moving or partially disassembling the item to accomplish the verification, included as part of the work at no additional cost to the Owner.

D. The Contractor shall verify by formal demonstrations or tests that the requirements of this Specification have been met. The Contractor shall demonstrate that the communications systems, components and subsystems meet Specification requirements in the “as-installed” operating environment during the “System Operation Test.” Even though no formal environmental testing is required, the Contractor shall measure and record temperature, humidity and other environmental parameters and the environmental conditions, which were encountered during the “System Operation Test.”

E. The Contractor shall carefully plan and coordinate the final acceptance tests so that tests can be satisfactorily completed. The Contractor shall provide necessary instruments, labor and materials required for tests, including the equipment manufacturer's technical representative and qualified technicians in sufficient numbers to perform the tests within a reasonable time period.

F. The Contractor shall satisfy all items detailed in the final acceptance check-off list (punch list). The list shall be a complete representation of specified installation requirements. At the time of final acceptance punch list items shall be corrected until the system is found to be acceptable to the Owner and the Project Manager.

G. After the Contractor systems have been installed and tested, the completed test plan shall be signed by the Communications Contractor Project Manager and submitted for approval.

END OF SECTION 270000

SECTION 270510

FIRESTOPPING FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the products and execution requirements relating to Firestopping for Communications Systems.

C. Product specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

1.02 SUBMITTALS

A. Provide product data from manufacturer's specifications.

1.03 WORK INCLUDED

A. The work included under this Specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

PART 2 PRODUCTS

2.01 APPROVED PRODUCTS

A. Approved Firestopping Manufacturer(s)
1. Hilti (Firestop Devices, Putties, Caulks, Sealants, etc.)
2. STI Firestop Products (Firestop Devices, Putties, Caulks, Sealants, etc.)
3. 3M Firestop Products (Firestop Devices, Putties, Caulks, Sealants, etc.)
4. Flamestopper Thru-Wall Fitting - Wiremold Company (Firestop Devices)
5. Unique Firestop Products (Firestop Devices)

2.02 TYPES OF PRODUCTS

A. Sealants
1. Intumescent Firestop Sealants and Caulks
2. Latex Firestop Sealant
3. Acrylic Water-Based Sealant
4. Silicone Firestop Sealants and Caulks
5. Firestop Putty
6. Firestop Collars
7. Firestop Sleeves
8. Wrap Strips
9. 2-Part Silicone Firestop Foam
10. Firestop Mortar
11. Firestop Pillows
12. Elastomeric Spray
13. Accessories:
14. Forming/Damming Materials: Mineral fiberboard or other type as per manufacturer recommendation

B. Firestop Devices
1. Thru-Wall Fitting
2. The firestop device box shall be constructed of 16 gage G90 steel.
3. The firestop device intumescent block shall be constructed of a graphite base material with expansion starting at 375°F and an unrestrained expansion between 6 to 12 times.

The intumescent block shall be held securely by the box in order to prevent tampering and damage during installation.

4. The firestop device shall have doors which can be adjusted to prevent materials from penetrating the device if the device is empty or completely full. The doors shall be constructed of 16 gage G90 steel with No. 10-32 screws use to adjust opening size.
5. The firestop device shall be available for 2" and 4" trade size EMT conduit.
6. The firestop device shall be available in safety yellow powder coat, custom colors and an unpainted galvanized finish.
7. Threaded Firestop Device
8. Threaded steel sleeve device incorporating flat washers secured by threaded device shall be installed around cables. The device shall be available in 1, 2 and 4-inch sizes. Maximum diameter of the wall penetration for 1, 2 and 4-inch sizes shall be 1-1/4, 2-7/16 and 4-1/2 inches respectively. All sleeve devices to be provided with gang plates. Size gang plate per number of sleeves. Utilize manufacturer specific gang plate per sleeves installed.
9. Smooth Firestop Device
10. Smooth steel sleeve device incorporating flat washers secured by sliding compression couplers. The device shall be available in 1, 2 and 4-inch sizes. Maximum diameter of the wall penetration for 1, 2 and 4-inch sizes shall be 1-1/4, 2-7/16 and 4-1/2 inches respectively. All sleeve devices to be provided with gang plates. Size gang plate per number of sleeves. Utilize manufacturer specific gang plate per sleeves installed.
11. Split-Sleeve Firestop Device
12. Threaded steel sleeve halves incorporating split couplings and slotted washers to fit the specific diameter of the opening. The device shall be available in 1, 2 and 4-inch sizes. Maximum diameter of the wall penetration for 1, 2 and 4-inch sizes shall be 1-1/4, 2-7/16 and 4-1/2 inches respectively. All sleeve devices to be provided with gang plates. Size gang plate per number of sleeves. Utilize manufacturer specific gang plate per sleeves installed.
13. Sleeves shall be capable of being sealed with built-in intumescent mesh.
14. Fire Rated Cable Pathway
15. Fire rated cable pathway device modules shall be comprised of steel raceway with intumescent foam pads allowing 0-100 percent cable fill.

2.03 UL CLASSIFICATION

A. Thru-Wall Fitting - The firestop device for use in through-penetration firestop systems shall have been examined and tested by Underwriters Laboratories Inc. to UL1479 (ASTM E 814) and bear the U.S. and Canadian UL Classification Mark.

B. Threaded, Smooth and Split-Sleeve Firestop Devices - Firestopping sealants and devices shall be used together as a firestop system. All firestop systems shall bear a UL Classification system number. UL Classification system numbers are as follows:

1. Threaded Firestop System
2. Block Wall - W-J-3049
3. Dry Wall - W-L-3138
4. Threaded Firestop System (Vertical)
5. Slab - F-A-3010
6. Smooth Firestop System
7. Block Wall - W-J-3048
8. Dry Wall - W-L-3137
9. Split-Sleeve Firestop System
10. Block Wall - W-J-3047
11. Dry Wall - W-L-3136

2.04 FIRESTOPPING SYSTEMS

A. Thru-Wall Fitting Firestop System:

1. The device shall be classified for use in one-, two-, three, and four-hour rated gypsum, concrete and block walls and provide a maximum L rating of six cfm. The devices shall also been tested by Underwriters Laboratories Inc. to UL2043 and determined to be suitable for use in air handling spaces.

B. Threaded, Smooth and Split-Sleeve Firestop Systems:
1. Shall conform to both Flame (F) and Temperature (T) ratings as required by local building codes and as tested by nationally accepted test agencies per ASTM E814 or UL 1479 fire tests in a configuration that is representative of field conditions.
2. The F rating must be a minimum of one (1) hour but not less than the fire resistance rating of the assembly being penetrated. T rating when required by code authority shall be based on measurement of the temperature rise on penetrating item(s). The fire test shall be conducted with a minimum positive pressure differential of 0.01 inches of water column.
3. For joints, must be tested to UL 2079 with movement capabilities equal to those of the anticipated conditions.

C. Firestopping materials and systems must be capable of closing or filling through-openings created by 1) the burning or melting of combustible pipes, cable jacketing, or pipe insulation materials, or 2) deflection of sheet metal due to thermal expansion (electrical & mechanical duct work).

D. Firestopping material shall be asbestos and lead free and shall not incorporate nor require the use of hazardous solvents.

E. Firestopping sealants must be flexible, allowing for normal pipe movement.

F. Firestopping materials shall not shrink upon drying as evidenced by cracking or pulling back from contact surfaces.

G. Firestopping materials shall be moisture resistant, and may not dissolve in water after curing.

PART 3 EXECUTION

3.01 CONDITIONS REQUIRING FIRESTOPPING

A. General
1. Provide firestopping for conditions specified whether or not firestopping is indicated, and if indicated, whether such material is designed as insulation, or otherwise.

B. Through-Penetrations
1. Firestopping shall be installed in all open penetrations and in the annular space in all penetrations in any bearing or non-bearing fire-rated barrier.

C. Membrane-Penetrations
1. Where required by code, all membrane-penetrations in rated walls shall be protected with firestopping products that meet the requirements of third party time/temperature testing.

D. Construction Joints/Gaps
1. Firestopping shall be provided between the edges of floor slabs and exterior walls, between the tops of walls and the underside of floors, in the control joint in masonry walls and floors and in expansion joints.

E. Smoke-Stopping
1. As required by the other sections, smoke-stops shall be provided for through-penetrations, membrane-penetrations, and construction gaps with a material approved and tested for such application.

3.02 EXAMINATION

A. Examine the areas and conditions where firestops are to be installed and notify the Architect of conditions detrimental to the proper and timely completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected.

B. Verify that environmental conditions are safe and suitable for installation of firestop products.

C. Verify that all pipes, conduit, cable, and other items that penetrate fire-rated construction have been permanently installed prior to installation of firestops.

3.03 INSTALLATION

A. General
1. Installation of firestops shall be performed by an applicator/installer qualified and trained by the manufacturer. Installation shall be performed in strict accordance with manufacturer's detailed installation procedures.
2. Apply firestops in accordance with fire test reports, fire resistance requirements, acceptable sample installations, and manufacturer's recommendations.
3. Unless specified and approved, all insulation used in conjunction with through-penetrants shall remain intact and undamaged and may not be removed.
4. Seal holes and penetrations to ensure an effective smoke seal.
5. In areas of high traffic, protect firestopping materials from damage. If the opening is large, install firestopping materials capable of supporting the weight of a human.
6. Insulation types specified in other sections shall not be installed in lieu of firestopping material specified herein.
7. All combustible penetrants (e.g. non-metallic pipes or insulated metallic pipes) shall be firestopped using products and systems tested in a configuration representative of the field condition.

B. Dam Construction
1. When required to properly contain firestopping materials within openings, damming or packing materials may be utilized. Combustible damming material must be removed after appropriate curing. Noncombustible damming materials may be left as a permanent component of the firestop system.

3.04 FIELD QUALITY CONTROL

A. Prepare and install firestopping systems in accordance with manufacturer's printed instructions and recommendations.

B. Follow safety procedures recommended in the Material Safety Data Sheets.

C. Finish surfaces of firestopping that are to remain exposed in the completed work to a uniform and level condition.

D. All areas of work must be accessible until inspection by the applicable Code Authorities.

E. Correct unacceptable firestops and provide additional inspection to verify compliance with this Specification.

3.05 CLEANING

A. Remove spilled and excess materials adjacent to firestopping without damaging adjacent surfaces.

B. Leave finished work in a neat and clean condition with no evidence of spill-overs or damage to adjacent surfaces.

3.06 IDENTIFICATION

A. Refer to Section 27 05 53 - Identification for Communications Systems for labeling details.

END OF SECTION 270510

SECTION 270526

GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the products and execution requirements relating to Grounding and Bonding for Communications Systems.

1. Product specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

1.02 SUBMITTALS

A. Provide product data from manufacturer's specifications.

1.03 WORK INCLUDED

A. The work included under this Specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

B. The work shall include, but not be limited to the following:

1. Furnish and install all Grounding Conductors.
2. Furnish and install all Grounding Lugs and Hardware.

C. A licensed electrical contractor shall perform installation and termination of the main bonding conductor to the building service entrance ground.

PART 2 PRODUCTS

2.01 APPROVED PRODUCTS

A. Approved Equipment Grounding Conductor Manufacturer(s)

1. Southwire
2. West Penn
3. Belden

B. Approved Grounding Lug Manufacturer(s)

1. Burndy
2. Thomas & Betts
3. Chatsworth Products, Inc.
4. Harger
5. Hubbell

C. Approved Grounding Busbar Manufacturer(s)

1. Chatsworth Products, Inc.
2. Hubell
3. Thomas & Betts
4. Burndy
5. Harger

2.02 GROUNDING CONDUCTORS

A. Grounding Conductor

1. Construction shall be Type THHN copper conductors, insulated with heat and moisture resistant PVC over which a UL listed jacket is applied.
2. Jacket color shall be green.

2.03 GROUNDING LUGS

A. Grounding Lugs and Hardware

1. Grounding lugs shall be 2-hole and installed with a crimper that when properly executed the die of the crimper impresses the die # on the lug base. All lugs shall be sleeved with clear heat-shrink to allow for inspection of the crimp. Silicon bronze or stainless steel bolts and washers shall be used to install lugs to equipment. Exothermic welding is also allowed.

2.04 GROUNDING BUSBARS

A. Grounding Busbar

1. The grounding busbar shall be made of 1/4" thick solid copper, pre-drilled.
2. The grounding busbar shall be installed with minimum clearance, 1" offsets and 1-1/2" insulators.
3. The grounding busbar shall be pre-drilled and accommodate 2-hole compression lugs.
4. The grounding busbar shall meet or exceed ANSI/TIA-607-C requirements.
5. TMGB shall be minimum .25” thick by 4” wide and minimum 20” Length. Size Length of Busbar to accommodate all required grounding connections.
6. TGB shall be minimum .25” thick by 2” wide and minimum 12” Length. Size Length of Busbar to accommodate all required grounding connections.
7. All Grounding Busbars must be approved BICSI & ANSI/EIA/TIA Grounding Busbars.

PART 3 EXECUTION

3.01 GROUNDING

A. The facility shall be equipped with a Telecommunications Bonding Backbone (TBB). This backbone shall be used to ground all communications cable shields, equipment, racks, cabinets, raceways, and other associated hardware that has the potential to act as a current carrying conductor. The TBB shall be installed independent of the building's electrical and building ground and shall be designed in accordance with the recommendations contained in the ANSI/TIA-607-C Telecommunications Bonding and Ground Standard. The Telecommunications Bonding Backbone shall be a continuous conductor, not daisy-chained or segmented in any way.

B. The main entrance facility/equipment room in each building shall be equipped with a telecommunications main grounding busbar (TMGB). Each telecommunications room (TR) shall be provided with a telecommunications ground busbar (TGB). The TMGB shall be connected with a Telecommunications Bonding Conductor (TBC) to ac grounding electrode system via the ac main service entrance panelboard. The TBC should always be as short as possible and never be longer than 30 ft.

C. The Telecommunications Bonding Backbone(s) shall be connected on the top floor and every third floor between the top and bottom floor with a Backbone Bonding Conductor (BBC). The BBC shall be sized to match the largest size (AWG) TBB.

D. The gauge of the connecting ground/earth cable, known as the Telecommunications Bonding Backbone (TBB), Grounding Equalizer (GE), and the Telecommunications Bonding Conductor (TBC) to the main building electrical entrance facility will follow ANSI/TIA- 607-C guidelines, as is shown in the table below. The TBB shall be one continuous conductor as shown on one-line drawings.

Sizing of the TBB	
TBB Length in Linear (feet)	TBB Size (AWG)

Less than (13)	6
(14-20)	4
(21-26)	3
(27-33)	2
(34-41)	1
(42-52)	1/0
(53-66)	2/0
(67-84)	3/0
(85-105)	4/0
(106-125)	250 kcmil
(126-150)	300 kcmil
(151-175)	350 kcmil
(176-250)	500 kcmil
(251-300)	600 kcmil
(301+)	750 kcmil

E. All racks, cabinets, metallic enclosures, conduits, metallic backboards, cable sheaths, metallic strength members, splice cases, cable trays, etc. entering or residing in the MC/IC/TC shall be grounded to the respective TGB or TMGB using a minimum #6 AWG stranded copper bonding conductor and compression lugs.

F. Every equipment rack and cabinet shall be provided with a rack bonding busbar (RBB). Each RBB shall be bonding the TMGB/TGB with a Telecommunications Equipment Bonding Conductor (TEBC).

G. All wires used for communications grounding purposes shall be identified with a green insulation. All cables and busbars shall be identified and labeled in accordance with the ANSI/TIA-606-B.

H. See Section 270543 - Underground Ducts and Raceways for Communications Systems for underground duct and raceway systems ground requirements.

3.02 IDENTIFICATION

A. Refer to Section 270553 - Identification for Communications Systems for labeling details.

END OF SECTION 270526

SECTION 270528
PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.01 GENERAL REQUIREMENT

A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the products and execution requirements relating to Pathways for Communications Systems.

C. Product specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

1.02 SUBMITTALS

A. Provide product data from manufacturer's specifications.

1.03 WORK INCLUDED

A. The work included under this specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

PART 2 PRODUCTS

2.01 APPROVED PRODUCTS

A. Rigid/Intermediate Conduit Manufacturer(s)
   1. Allied
   2. Triangle
   3. Wheatland
   4. Youngstown
   5. Or Approved Equal (by Design Engineer)

B. Non-Metallic (PVC) Manufacturer(s)
   1. Carlon
   2. Or Approved Equal (by Design Engineer)

C. Electrical Metallic Tubing (EMT) Manufacturer(s)
   1. Allied
   2. Triangle
   3. Wheatland
   4. Youngstown
   5. Or Approved Equal (by Design Engineer)

D. EMT Fittings Manufacturer(s)
   1. Thomas & Betts
   2. Steel City
   3. Or Approved Equal (by Design Engineer)

E. Innerduct/Inner-Conduit Channel Manufacturer(s)
   1. MaxCell
   2. Carlon
   3. Endot Industries
   4. Petroflex
   5. Eastern
   6. Or Approved Equal (by Design Engineer)

F. Metallic Communications Outlet Box Manufacturer(s)

1. Steel City
2. Raco
3. Or Approved Equal (by Design Engineer)

G. Pull Box Manufacturer(s)
1. Hoffman
2. OZ Gedney
3. Or Approved Equal (by Design Engineer)

H. Approved Cable Tray System Manufacturer(s)
1. B-Line
2. Or Approved Equal (by Design Engineer)
3. CABLOFIL Inc**.**

I. Approved Cable Hanger Manufacturer(s)
1. Erico Products – Caddy
2. B-Line
3. Or Approved Equal (by Design Engineer)
4. CABLOFIL Inc**.**

J. Approved Tie Wrap/Velcro Strap Manufacturer(s)
1. Leviton
2. Panduit
3. Siemon
4. Commscope
5. Or Approved Equal (by Design Engineer))
6. Ortronics / Legrand

K. Approved Surface Mounted Raceway Manufacturer(s)
1. Coordinate with Division 26 (Electrical Contractor). Refer to Drawings.

2.02 CONDUIT

A. Rigid and Intermediate Conduit
1. Rigid conduit, intermediate conduit, couplings, locknuts, bushings, elbows and connectors shall be standard thread. All materials shall be steel. Set screw or non-threaded fittings are not permitted.

B. Non-Metallic (PVC) Conduit
1. Non-metallic conduit shall be heavy wall, Schedule 40 PVC.
2. Couplings and connectors for non-metallic conduit shall be of the same material and be the product of the same manufacturer of the conduit furnished.

C. Electrical Metallic Tubing (EMT)
1. Electrical metallic tubing (EMT), couplings and connectors shall be steel. Malleable iron, pressure-cast or die-cast fittings are not permitted.
2. Fittings for 2" EMT and smaller shall be steel set screw type, except where otherwise noted. Fittings for 2.5" and larger shall be steel set screw type with two (2) screws for connectors and four (4) screws for couplings. All connectors shall be insulated throat type.

D. Conduit Support
1. Individual conduit hangers shall be galvanized spring steel specifically designed for the purpose and sized appropriately for the conduit type and diameter. Support individual conduits 1-1/2 inch and smaller with 1/4 inch threaded steel rods and use 3/8 inch rods for 2 inch and larger.
2. Conduit support channels shall be 14 gauge galvanized (or equivalent treatment) channel sized for the amount of conduit to be supported. Channel suspension shall be 3/8" threaded steel rods. Attach suspension rods to structure with swivel type connectors. Conduit straps shall be spring steel type compatible with channel.

3. Conduit straps shall be single hole cast metal type or two hole galvanized metal type. Conduit clamps shall be spring steel type for use with exposed structural steel.

E. Innerduct/Inner-Conduit Channel
1. Innerduct shall be corrugated plastic equipped with pull-string or mule tape.
2. Inner-conduit channel (MaxCell) shall be 3-channel with each channel equipped with mule tape.
3. See Drawings for innerduct / inner-conduit channel (MaxCell) details.

2.03 METALLIC COMMUNICATIONS OUTLET BOXES

A. Metallic outlet boxes and device covers shall be galvanized steel not less than 1/16" thick.

B. The dimensions of the metallic outlet box shall be 4 -11/16” square with a minimum depth of 2-1/8".

C. Metallic outlet boxes shall be equipped with single device covers (or two-device covers where needed). Where installed in plaster, gypsum board, etc., covers shall be raised to compensate for the thickness of the wall finish.

D. Where metallic outlet boxes are to be empty for future use, blank coverplates shall be used.

2.04 PULL BOXES

A. Pull boxes shall be constructed of galvanized steel with flat, removable covers fastened with plated steel screws.

B. Pull boxes shall be equipped with keyhole screw slots in the cover to permit removal of the cover without extracting the screws.

C. Pull boxes shall have provisions for grounding.

2.05 TELECOM ROOM LADDER RACK

A. Ladder Rack System
1. See Drawings for ladder rack system details.
2. The ladder rack system shall be securely mounted with hardware designed for use in ladder rack systems.
3. End caps shall be installed on the exposed ends of the ladder racks, channel supports and bolts. Protective covers shall be installed on threaded rods that come in contact with cabling plant.
   1) Ladder Rack System color shall be black.

2.06 CABLE HANGERS

A. J-Hooks
1. J-hooks shall provide a bearing surface of sufficient width to comply with required bend radii of high-performance cables. J-hook shall be cULus Listed.
2. J-hooks shall have flared edges to prevent damage while installing cables.
3. J-hooks sized 1 5/16" and larger shall have a cable retainer strap to provide containment of cables within the hanger. The cable retainer strap shall be removable and reusable and be suitable for use in air handling spaces.
4. J-hooks should be metallic. Plastic J-hooks are not acceptable.

2.07 TIE WRAPS AND VELCRO STRAPS

A. Velcro Straps
1. Cables shall be fastened to support structures with Velcro straps.
2. Velcro straps installed in air handling spaces must be plenum rated.
   1) Non-plenum Tie Wrap color shall be black.
   2) Plenum Tie Wrap color shall be red.
   3) Non-plenum Velcro strap color shall be black.
   4) Plenum Velcro strap color shall be red.
3. Tie wraps are not permitted

2.08 SURFACE MOUNTED RACEWAY

A. Surface Mounted Raceway
   1. Coordinate with Division 26 (Electrical Contractor). Refer to Drawings.

PART 3 PART 3 - EXECUTION

3.01 PENETRATIONS

A. Holes through concrete and masonry in new and existing structures shall be cut with a diamond core drill or concrete saw upon approval of the structural engineer of record for the base of building. Pneumatic hammer, impact electric, hand or manual hammer type drills shall not be allowed, except where permitted by the Project Manager as required by limited working space. X-ray all floor penetrations accordingly.

B. Holes shall be located so as not to affect structural sections such as ribs or beams.

C. Holes shall be laid out in advance. The Project Manager shall be advised prior to drilling through structural sections, for determination of proper layout.

D. Structural Penetrations: Where conduits, wireways and other raceways pass through fire partitions, fire walls or walls and floors provide a code compliant effective barrier against the spread of fire, smoke and gases.

E. All penetrations where conduit is not used shall be sleeved.

F. No gaps or rough edges shall be allowed between wall and conduit/sleeve.

3.02 CONDUIT SYSTEM

A. Provide metallic conduit for cabling in exposed areas, mechanical spaces, food service areas, and elevator control rooms.

B. Leave all empty conduits with a 200 pound test nylon cord pull line.

C. Flattened, dented, or deformed conduits are not permitted and shall be removed and replaced.

D. Fasten conduit support device to structure with wood screws on wood, toggle bolts on hollow masonry, anchors as specified on solid masonry or concrete, and machine bolts, clamps, or spring steel clips, on steel.

E. Install conduit with wiring, including homeruns as indicated on the Drawings. Any change resulting in a savings in labor or materials is to be made only in accordance with a contract change. Deviations shall be made only where necessary to avoid interferences and when approved by Engineer by written authorization.

F. Conduit shall be run parallel or at right angles to existing walls, ceilings, and structural members.

G. Attach backbone conduits larger than one-inch trade diameter to or from structure on intervals not exceeding twelve feet with conduit beam clamps, one-hole conduit straps or trapeze type support.

H. Where conduits must pass through structural members obtain approval of Architect or Engineer.

I. Install all conduits or sleeves penetrating or routed within rated firewalls or fire floors to maintain fire rating of wall or floor. Conduit shall not be installed in rated floors or walls if it compromises or violates the fire rating of floor or wall. Refer to architectural documents.

J. Provide expansion and deflection coupling where conduit passes over a building expansion joint.

K. Service entrance conduits and feeder conduits in direct contact with earth shall be schedule 40, heavy wall PVC. All service entrance conduit elbows shall be galvanized rigid steel. Service entrance conduits installed exposed or concealed in walls or above ceilings shall be galvanized rigid steel (G.R.S.) or intermediate metal conduit (IMC). Provide concrete encasement where required or as indicated on Drawings.

L. All other conduit, unless specified herein, shall be electrical metallic tubing (EMT). PVC conduit is not allowed in exposed or concealed areas, but only within concrete.

M. Conduit Installations Within Slab/Floor
   1. Conduit shall be run following the most direct route between points.
   2. Conduit shall not be installed in concrete where the outside diameter is larger than 1/3 of the slab thickness.
   3. Conduits shall not be installed within shear walls unless specifically indicated on the Drawings. Conduit shall not be run directly below and parallel with load bearing walls.
   4. Protect each metallic conduit installed in concrete slab or conduits 1-1/2 inch and smaller passing through a concrete slab against corrosion where conduit enters and leaves concrete by wrapping conduit with vinyl all-weather electrical tape.
   5. Protect all conduits entering and leaving concrete floor slabs from physical damage during construction.
   6. Provide expansion fittings in all conduits where length or run exceeds 200 feet or where conduits pass through building expansion joints.
   7. Install all conduits penetrating or routed within rated fire floors to maintain the fire rating of the floor. Conduit shall not be installed in rated floors or walls if it compromises or violates the fire rating of floor or wall. Refer to architectural documents.
   8. Conduits installed within concrete floor slabs which are in direct contact with grade or which penetrate the building roof shall be galvanized rigid steel (G.R.S.), intermediate metal conduit (I.M.C.) or Schedule 40, heavy wall PVC.

N. Communications cables shall not occupy conduits with power cables.

O. Metallic conduits shall be grounded in accordance with ANSI/TIA-607-C.

P. Conduit runs shall not have more than two (2) 90-degree bends or an aggregate of 180-degress of bends between pull points.

Q. Conduit runs shall not exceed 100-feet between pulling points.

R. Communications conduit system shall contain no condulets (also know as an LB).

S. Rigid metal conduit (RMC) or intermediate metal conduit (IMC) shall be used for entrance conduits that exceed 50 feet into the building.

3.03 Horizontal Conduits

A. Support horizontal conduits at intervals not exceeding ten feet and within three feet of each outlet, junction box, backboard, enclosure or cabinet. Support conduits from structural steel members with spring steel type or beam conduit clamps and to non-metallic structural members with one-hole conduit straps. For exposed conduits and where conduits must be suspended below structure, single conduit runs shall be supported from structure by hanger rod and conduit clamp assembly, and multiple conduits shall be supported by trapeze type support suspended from structure. Do not attach conduits to ceiling suspension system channels or suspension wires.

B. For runs that total more than 100 feet in length, insert pull boxes so that no segment between boxes exceeds the 100 feet limit.

C. Size conduit per NEC 40% fill requirements.
   1. All conduit and sleeve ends shall have snap in bushing at each end for cable protection.

3.04 COMMUNICATIONS OUTLET BOXES

A. Exact locations of the outlet boxes shall be coordinated with the electrical contractor and other trades.

B. Non-metallic communications outlet boxes shall not be used.

C. The approximate locations of the outlets are indicated on the Drawings. The exact locations of outlets shall be determined at the building. The right is reserved to change, without additional cost, the exact location of any outlet, a maximum of 10' before it is permanently installed.

D. Orientation of outlet boxes (horizontal or vertical) shall be as indicated on the architectural elevations. Contractor shall match orientation of adjacent power receptacle.

E. Location of outlet boxes (horizontal and vertical) shall be coordinated with electrical and architectural plans.

F. Install all outlet boxes in finished areas flush with the wall. Maintain 1/4" or less space between outlet box front and finished wall surface.

G. Outlet boxes shall be firmly anchored in place and shall not depend on the coverplate to hold it secure to the wall.

H. Outlet boxes installed back-to-back in fire-rated walls shall be separated horizontally by a minimum of 24".

3.05 PULL BOXES

A. Pull boxes shall be secured, independent of the conduit entries into the box. Pull boxes shall be secured to the building structure. In ceiling applications, pull boxes shall not be supported with ceiling wires.

B. Conduits entering pull boxes shall connect to pull boxes using die-cast zinc connectors.

C. Pull boxes shall be free from burrs, dirt and debris.

D. Pull boxes shall be installed in accordance with ANSI/TIA-569-B.

E. Pull boxes shall be grounded in accordance with ANSI/TIA-607-C.

3.06 CABLE TRAY SYSTEM

A. Install trays in accordance with recognized industry practices, to ensure that the cable tray equipment complies with requirements of the NEC.

B. All open trays shall be installed a minimum of six (6) inches away from any light fixture.

C. Provide external grounding strap at expansion joints, sleeves, crossover and other locations where tray continuity is interrupted.

D. Support all pathways from building construction. Do not support pathways from ductwork, piping or equipment hangers.

E. Install cable tray level and straight.

F. Provide all hardware, accessories, fasteners, anchors, threaded rods and support channels required to provide a complete cable tray system.

G. Cable trays shall not be used to house both low voltage and power cables.

H. Cable tray system shall be grounded in accordance with ANSI/TIA-607-C.

I. Cable Tray shall be trapeze style supported with unistrut and threaded rod. Where trapeze style is not possible, tray shall be wall supported with steel L-brackets. All supports shall meet requirements of manufacturer specific tray.

J. Cable Tray shall be supported in accordance with manufacturer specific recommendations for max loading capacities.

3.07 CABLE HANGERS

A. J-hooks shall only be permitted in closed, accessible ceiling spaces.

B. Installation and configuration shall conform to the requirements of ANSI/TIA-568-C.0, ANSI/TIA-568-C.1 & ANSI/TIA-569-B, NFPA 70 (National Electrical Code), applicable local codes, and to the manufacturer's installation instructions.

C. Install cables using techniques, practices, and methods that are consistent with Category 6A or higher requirements and that supports Category 6A or higher performance of completed and linked signal paths, end to end.

D. Install cables without damaging conductors, shield, or jacket.

E. Do not bend cables, in handling or in installing, to smaller radii than minimums recommended by manufacturer.

F. Pull cables without exceeding cable manufacturer's recommended pulling tensions. Use pulling means that will not damage media.

G. Do not exceed load ratings specified by manufacturer.

H. Adjustable non-continuous support sling shall have a static load limit of 100 lbs.

I. To avoid electromagnetic interference (EMI), pathways shall provide minimum clearances of four feet from motors or transformers, one foot from conduit and cables used for electrical power distribution, and five inches from fluorescent lighting. Pathways shall cross perpendicular to fluorescent lighting and electrical power cables or conduits.

3.08 VELCRO STRAPS

A. Velcro straps shall be installed around cables at intervals of 12" minimum.

B. Velcro Straps shall secure cables to cable trays using an "X" pattern.

C. Do not over-cinch cables.

3.09 IDENTIFICATION

A. Refer to Section 270553 - Identification for Communications Systems for labeling details.

END OF SECTION 270528

SECTION 270543

UNDERGROUND DUCTS AND RACEWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the products and execution requirements relating to Underground Ducts and Raceways for Communications Systems.

C. Product specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

1.02 SUBMITTALS

A. Provide product data from manufacturer's specifications.

1.03 WORK INCLUDED

A. The work included under this specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

PART 2 PRODUCTS

2.01 APPROVED PRODUCTS

A. Rigid/Intermediate Conduit Manufacturer(s)
   1. Allied
   2. Triangle
   3. Wheatland
   4. Youngstown
   5. Or Approved Equal (by Design Engineer)

B. PVC/HDPE Conduit Manufacturer(s)
   1. Carlon
   2. FiberTel
   3. Or Approved Equal (by Design Engineer)

C. Innerduct/Inner-Conduit Channel Manufacturer(s)
   1. Maxcell
   2. Endot Industries
   3. Carlon
   4. Petroflex
   5. Or Approved Equal (by Design Engineer)

D. Marker Tape Manufacturer(s)
   1. William Frick & Associates
   2. Or Approved Equal (by Design Engineer)

E. Approved Maintenance Hole/Handhole Manufacturer(s)
   1. Old Castle
   2. Pencell (Handholes Only)
   3. Quazite (Handholes Only)
   4. Or Approved Equal (by Design Engineer)

F. Approved Conduit Plug/Cap Manufacturer(s)
   1. Jack Moon
   2. Or Approved Equal (by Design Engineer)

2.02 CONDUIT SYSTEM

A. PVC conduit for concrete encasement shall be Type DB, UL Labeled for 90 degrees C cables. Fittings shall be Type DB, solvent type, and from the same manufacturer as the conduit.

B. Concrete shall have a minimum strength of 2,500 psi at 28 days.

C. PVC conduit for direct burial shall be Schedule 40, UL Labeled for 90 degrees C cables. Fittings shall be Schedule 40, solvent type, and from the same manufacturer as the conduit.

D. Rigid and Intermediate Conduit
   1. Rigid conduit, intermediate conduit, couplings, locknuts, bushings, elbows and connectors shall be standard thread. All materials shall be steel. Set screw or non-threaded fittings are not permitted.
   2. Galvanized rigid steel conduit shall be hot dipped galvanized inside and outside, in 10 foot lengths and threaded on both ends. Fittings and bushings shall be threaded, cast or malleable iron, and hot dipped galvanized inside and outside.

E. Non-Metallic Conduit
   1. Non-metallic conduit shall be heavy wall, Schedule 40 PVC / HDPE.
   2. Couplings and connectors for non-metallic conduit shall be of the same material and be the product of the same manufacturer of the conduit furnished.

F. Conduit Support
   1. Conduit straps shall be single-hole cast metal type or two hole galvanized metal type.
   2. Conduit clamps shall be spring steel type for use with exposed structural steel.

G. Innerduct/Inner-Conduit Channel
   1. Innerduct shall be non-corrugated PVC equipped with mule tape.
   2. Inner-conduit channel (MaxCell) shall be 3-channel with each channel equipped with mule tape.
   3. See Drawings for innerduct/inner-conduit channel (MaxCell) details.

H. Marker Tape
   1. Marker tape shall be detectable, orange for communications, and labeled to indicate the type of circuit buried below.

2.03 MAINTENANCE HOLES/HANDHOLES

A. Maintenance Holes
   1. Maintenance holes shall be pre-cast or cast in place concrete with a strength of 3,500 psi at 28 days, and steel reinforced.
   2. Maintenance holes shall include a cast iron frame with cover, a hot dipped galvanized steel ladder, and hot dipped galvanized pulling eyes embedded in the concrete opposite each duct entrance and in the floor beneath the cover.
   3. Maintenance holes shall be equipped with grounding busbar.
   4. Maintenance holes shall be equipped with racking for cable storage.
   5. Ground splices and connections at maintenance holes shall be exothermic welds, copper or bronze compression ground fittings, or bolted compression ring lugs.
   6. The cover for maintenance holes shall have the lettering, “COMMUNICATIONS.”

B. Handholes
   1. Handholes shall be non-conductive and shall not require grounding for safety.
   2. Handholes shall be unaffected by freeze/thaw and resistant to sunlight and chemicals.
   3. Handholes shall be pre-cast polymer concrete, heavy duty rated and bottomless.
   4. Handholes shall be equipped with racking for cable storage.
   5. Handholes shall have the word “COMMUNICATIONS” molded in the cover by the manufacturer. The cover shall be attached with penta-head stainless steel bolts.
   6. Handholes shall be able to withstand 10,000 lbs minimum.
   7. See Drawings for handhole dimensions and locations.

2.04 CONDUIT PLUGS/CAPS

A. Conduit Plugs/Caps
   1. Conduit plugs shall provide a watertight seal at expose ends of conduits.
   2. Conduit plugs shall be conduit size specific.
   3. Triplex and Quadplex duct plugs shall provide a watertight seal between the conduit and innerduct(s).
   4. Simplex duct plugs shall provide a watertight seal between the innerduct and the cable that occupies it.
   5. TDUX inflatable bladders shall be used to seal conduits equipped with MaxCell.

PART 3 EXECUTION

3.01 CONDUIT SYSTEM

A. Excavation and Backfill
   1. Contractor shall call underground utilities locator company before digging.
   2. Barricades shall be provided around open holes and trenches. Temporary bridges shall be provided over trenches cut through major sidewalk routes. Major sidewalk routes shall not be closed to pedestrian traffic.
   3. Barriers shall be provided to protect landscaping adjacent to the excavation area.
   4. When rocks, concrete or other debris are encountered during excavation, remove completely.
   5. Where sidewalk sections must be removed for installation of underground ducts, remove the sidewalk sections completely from joint to joint.
   6. Where asphalt must be removed for installation of underground ducts, saw cut the asphalt in two, straight, parallel lines.
   7. Backfill excavations in 6-inch layers and mechanically compact to 98 percent compaction.
   8. Excavated materials may be used as backfill only if the backfill is sand or clean dirt that is free of rocks and debris over 3/4" in diameter.
   9. In landscaped areas, backfill and mechanically compact to a depth of 6 inches below grade.
   10. Backfill the last 6 inches with clean topsoil. Reseed lawn areas.
   11. Restore concrete sidewalks and asphalt.
   12. The Contractor shall perform all excavation to install the electrical work herein specified and as indicated on Drawings. During excavation, material for backfilling shall be piled back from the banks of the trench to avoid overloading and to prevent slides and cave-ins. All excavated materials not to be used for backfill shall be removed and disposed of by the Contractor. Grading shall be done to prevent surface water from flowing into trenches and others excavation and any water accumulating therein shall be removed by pumping. All excavation shall be made by open cut.
   13. The bottom of the trenches shall be graded to provide uniform bearing and support for conduits, cables, or duct bank on undisturbed soil at every point along its entire length. Overdepths shall be backfilled with loose, granular, moist earth, tamped. Remove unstable soil that is not capable of supporting equipment or installation and replace with specified material for a minimum of 12" below invert of equipment or installation.
   14. The trenches shall be backfilled with the excavated materials approved for backfilling, consisting of earth, loam, sandy clay, sand and gravel or soft shale, free from large clods of earth and stones, deposited in 6" layers and rammed until the installation has a cover of not less than the adjacent ground but not greater than 2" above existing ground. The backfilling shall be carried on simultaneously on both sides of the trench so that injurious pressures do not occur. The compaction of the filled trench shall be at least equal to 95% of the maximum density as determined by the Standard Proctor Test. Settling the backfill with water will not be permitted. Reopen any trenches not meeting compaction requirements or where settlement occurs, refill, compact, and restore the surface to the grade and compaction indicated, mounded over and smoothed off

B. Duct Banks

1. Duct banks shall be sloped downward toward maintenance holes/handholes and away from buildings a minimum of 6 inches per 100 feet. Duct banks shall not route water from maintenance holes handholes into buildings. Duct banks shall not contain traps between maintenance holes/handholes where water may accumulate.
2. Directional changes in duct banks shall be made with 20' minimum radius bends. Duct banks and direct buried ducts shall be supported on undisturbed soil or on piers extending down to undisturbed soil.
3. Where power and communications duct banks run in parallel, they shall be separated by a minimum of 12 inches.
4. Prior to concrete encasement, ducts, reinforcing steel and ground wires shall be secured with nonmetallic straps or cable ties to nonmetallic duct spacers at intervals not exceeding 8 feet. Duct spacers shall be sized for the ducts being held, and shall provide the minimum spacing between ducts required for concrete flow and by the NEC. Duct spacers shall be anchored to the ground using nonmetallic bands and stakes.
5. Duct banks shall have a minimum of 3 inches of concrete cover on all sides.
6. Where duct banks enter maintenance holes or buildings, they shall be constructed as integral to the wall.
7. Duct bank shall extend to the inside surfaces of the walls, and the duct bank reinforcing shall be integrated with the wall reinforcing.
8. Bell ends shall be provided on ducts where the ducts enter maintenance holes or buildings.
9. Direct buried ducts and fittings shall have bend radii greater than the minimum bend radii of the cables enclosed, and shall not be smaller than the radii of standard manufactured elbows.
10. Direct buried ducts shall be installed parallel to or at right angles to building lines and site features, and as close to curbs and sidewalks as possible to avoid interferences with future landscaping.
11. Where direct buried PVC ducts cannot be buried deep enough to meet the NEC minimum cover requirements, rigid steel conduits shall be installed instead, or a concrete cover shall be poured over the ducts.
12. An orange detectable marker tape (for communications) shall be buried in the backfill approximately 12 inches above duct banks or direct buried cables for the entire length of the duct run.
13. A flexible mandrel and a stiff bristled brush shall be pulled through the ducts to clean them prior to cable pulling.
14. Ducts shall be identified in the maintenance holes and at both ends.

C. Additional OSP Conduit Requirements

1. Leave all empty conduits with a 200-pound test nylon cord pull line.
2. Install a #14 AWG tracer wire in one conduit for the entire length of each duct run.
3. Flattened, dented, or deformed conduits are not permitted and shall be removed and replaced.
4. Install conduit, including homeruns as indicated on the Drawings. Any change resulting in a savings in labor or materials is to be made only in accordance with a contract change. Deviations shall be made only where necessary to avoid interferences and when approved by Engineer by written authorization.
5. Where conduits must pass through structural members obtain approval of Architect or Engineer.
6. Install all conduits or sleeves penetrating or routed within rated firewalls or fire floors to maintain fire rating of wall or floor. Conduit shall not be installed in rated floors or walls if it compromises or violates the fire rating of floor or wall. Refer to architectural documents.
7. Provide expansion and deflection coupling where conduit passes over a building expansion joint.
8. Service entrance conduits and feeder conduits in direct contact with earth shall be schedule 40, heavy wall PVC/HDPE. All service entrance conduit elbows shall be

galvanized rigid steel. Service entrance conduits installed exposed or concealed in walls or above ceilings shall be galvanized rigid steel (GRS) or intermediate metal conduit (IMC). Provide concrete encasement where required or as indicated on Drawings.

9. Seal all conduits entering building to prevent entrance of moisture.
10. Conduit fittings shall be gland and ring compression type for all conduit exposed to outdoor environments.
11. Below Grade Conduit Installations
    1) Install top of conduits 24 inches minimum below finished grade or as indicated on Drawings.
    2) Install top of conduits 6 inches minimum below bottom of building slabs.
    3) Where transition is made from below grade PVC installation to a metallic conduit system above grade or slab.
12. Communications cables shall not occupy conduits with power cables.
13. All metallic conduits shall be grounded in accordance with ANSI/TIA-607-C.
14. For runs that total more than 400 feet in length, insert handholes/maintenance holes so that no segment exceeds the 400 feet limit.
15. Conduit runs shall not have more than two (2) 90-degree bends or an aggregate of 180-degree bends between pull points.
16. Communication conduit system shall contain no condulets (also known as an LB).

3.02 MAINTENANCE HOLES/HANDHOLES

A. Maintenance holes/handholes shall be installed on a base of pea gravel at least 12 inches deep.

B. Tops of maintenance holes/handholes shall be level with the existing grade.

C. Ducts should enter as perpendicular to the wall surface as possible.

D. Maintenance holes shall be grounded with four 3/4 inch diameter by 8 foot long ground rods, one driven inside of the maintenance hole at each corner. Connect the ground rods and any duct bank ground conductors together with a No. 4/0 AWG bare, stranded copper ground wire loop. A No. 2 AWG bare stranded copper pigtail from the ground wire loop shall be used to ground the maintenance hole cover frame, ladder support bracket, any metallic concrete inserts and metallic cable racks, and the shields of any cables that are spliced in the maintenance hole.

3.03 CONDUIT PLUGS/CAPS

A. Protect conduits against dirt, plaster, and foreign debris with conduit plugs. Plugs shall remain in place until ready for use.

B. Simplex, triplex or quadplex duct plugs shall be installed in conduits to house and seal cables.

C. TDUX inflatable bladders shall be used to seal conduits equipped with MaxCell.

3.04 IDENTIFICATION

A. Refer to Section 270553 - Identification for Communications Systems for labeling details.

END OF SECTION 270543

SECTION 270553

IDENTIFICATION FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the equipment and execution requirements relating to Identification for Communications Systems.

C. Equipment specifications, general considerations, and guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

1.02 WORK INCLUDED

A. The work included under this Specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete installation. The Contractor will provide and install all of the required materials whether specifically addressed in the Specification or not.

PART 2 LABELING

2.01 LABELING REQUIREMENTS

A. Labeling shall be done in accordance with the recommendations made in the ANSI/TIA-606-B document, manufacturer's recommendations and best industry practices.

B. All spaces, pathways, outlets, cables, termination hardware, grounding system and equipment shall be labeled with machine-generated labels.

C. All labels shall be clear with black text.

D. All cables shall be labeled with machine generated, wrap around labels.

E. A total of three (3) labels per horizontal cable are required at the following locations: 6" from outlet, 18" from outlet, and 12" from termination block/patch panel.

F. Labeling scheme shall be alphanumeric.

END OF SECTION 270553

SECTION 270800
COMMISSIONING OF COMMUNICATIONS

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the equipment and execution requirements relating to Commissioning of Communications.

C. Equipment specifications, general considerations, and guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

1.02 WORK INCLUDED

A. The work included under this specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

PART 2 TESTING

2.01 TESTING REQUIREMENTS

A. General

1. All cables and termination hardware shall be 100% tested for defects in installation and to verify cabling system performance under installed conditions according to the requirements of ANSI/TIA-568-C.0, ANSI/TIA-568-C.1, and/or ANSI/TIA-1152. All conductors/strands of each installed cable shall be verified prior to system acceptance. Any defect in the cabling system installation including but not limited to cable, connectors, feed through couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100% useable conductors/strands in all cables installed.

B. Copper Testing

1. All twisted-pair copper cable links shall be tested for continuity, pair reversals, shorts, opens and performance as indicated below. Additional testing is required to verify Category 6A performance. Horizontal balanced twisted pair cabling shall be tested using a level III and/or IV test unit for category 6A performance compliance.
2. Continuity - Each pair of each installed cable shall be tested using a test unit that shows opens, shorts, polarity and pair-reversals, crossed pairs and split pairs. The test shall be recorded as pass/fail as indicated by the test unit and referenced to the appropriate cable identification number and circuit or pair number. Any faults in the wiring shall be corrected and the cable re-tested prior to final acceptance.
3. Length - Each installed cable link shall be tested for installed length using a TDR type device. The cables shall be tested from patch panel to patch panel, block to block, patch panel to outlet or block to outlet as appropriate. The cable length shall conform to the maximum distances set forth in the ANSI/TIA-568-C.2 Standard. Cable lengths shall be recorded, referencing the cable identification number and circuit or pair number. For multi-pair cables, the shortest pair length shall be recorded as the length for the cable.

C. Approved tester is as follows:

1. Fluke DTX

D. Fiber Testing

1. All fiber testing shall be performed on all fibers in the completed end-to-end system. There shall be no splices unless clearly defined in the RFP and/or Drawings. These tests also include continuity checking of each fiber.

2. Singlemode
   1) Test the optical fiber cable bi-directionally with an OTDR and uni-directionally with a power meter/light source. Fiber must be tested at both 1310nm and 1550nm. Maximum attenuation dB/Km @ 1310nm/1550nm shall be 0.5/0.5 for outside plant and 1.0/1.0 for inside plant. Maximum attenuation per connector pair shall be .75 dB. Attenuation testing shall be performed with a stable launch condition using one-meter or two-meter jumpers to attach the test equipment to the cable plant. The light source shall be left in place after calibration and the power meter moved to the far end to take measurements. Test set-up and performance shall be conducted in accordance with ANSI/TIA-568-C.3, and to the manufacturer's application guides.

E. Approved optical fiber test equipment manufacturers are as follows:
1. Power Meters & Light Sources
   1) Optical Wavelength Laboratories (OWL)
   2) Noyes
   3) Photonix
   4) Fluke
   5) Agilent

2. Optical Time Domain Reflectometers (OTDR)
   1) GN Nettest
   2) Agilent
   3) Fluke
   4) Anritsu
   5) Tektronix

F. Test Results
1. Test documentation shall be provided on disk as part of the as-built package. The disk shall be clearly marked on the outside front cover with the words “Project Test Documentation,” the project name, and the date of completion (month and year). The results shall include a record of test frequencies, cable type, conductor pair (or strand) and cable (or outlet) I.D., measurement direction, reference setup, and crew member name(s). The test equipment name, manufacturer, model number, serial number, software version and last calibration date will also be provided at the end of the document. Unless the manufacturer specifies a more frequent calibration cycle, an annual calibration cycle is anticipated on all test equipment used for this installation. The test document shall detail the test method used and the specific settings of the equipment during the test as well as the software version being used in the field test equipment.
2. The field test equipment shall meet the requirements of ANSI/TIA-568-C.2, ANSI/TIA-568-C.3, and/or ANSI/TIA-1152.
3. Printouts generated for each cable by the wire (or fiber) test instrument shall be submitted as part of the documentation package. Alternately, the Contractor may furnish this information in electronic form (CD). These CDs shall contain the electronic equivalent of the test results as defined by the Specification and be of a format readable from Microsoft Word.
4. When repairs and re-tests are performed, the problem found and corrective action taken shall be noted, and both the failed and passed test data shall be documented.

PART 3 DOCUMENTATION, AS-BUILTS, TRAINING AND RECORDS

3.01 DOCUMENTATION & AS-BUILTS

A. As-Built record documentation for communications work shall include:
1. Cable routing and identification
2. System function diagrams

3. Manufacturers' description literature for equipment
4. Connection and programming schedules as appropriate
5. Equipment material list including quantities
6. Spare parts list with quantities
7. Details not on original Contract Documents
8. Test results
9. Warranties
10. Release of liens

B. The Contractor shall provide and maintain at the site a set of prints on which shall be accurately shown the actual installation of all work under this section, indicating any variation from contract drawings, including changes in pathways, sizes, locations and dimensions. All changes shall be clearly and completely indicated as the work progresses.

C. Progress prints shall be available for inspection by the Owner or any of his representatives and may be used to determine the progress of communications infrastructure work.

D. At the completion of the work, prepare a new set of as-built drawings, of the work as actually noted on the marked-up prints, including the dimensioned location of all pathways.

E. Furnish as-built drawings and documentation to the Project Manager. As-built drawings shall be generated in AutoCad 2012 or later. Submit as-built drawings electronically and hard copy.

3.02 OPERATIONS AND MAINTENANCE MANUAL

A. After completion of the work, the Contractor shall furnish and deliver to the Engineer three (3) copies of a complete Operations & Maintenance Manual. A system wiring diagram shall be furnished for each separate system.

B. The manual shall be subdivided into separate sections with tab dividers to identify subsystems of the integrated system. Reference appropriate Specification sections.

C. Provide the following additional information for each electronic system. Information shall be edited for this project where applicable.

1. Operations manuals for components and for systems as a whole
2. Maintenance manuals for components and for system as a whole
3. Point-to-point diagrams, cabling diagrams, construction details and cabling labeling details
4. List of spare parts, materials and suppliers of components. Provide name, address and telephone number for each supplier.
5. Emergency instructions for operational and maintenance requirements
6. Delivery time frame for replacement of component parts from suppliers
7. Recommended inspection schedule and procedures for components and for system as a whole
8. List of spare parts, materials and suppliers of components. Provide name, address and telephone number for each supplier.
9. Complete “reviewed” shop drawings and product data for components and system as a whole
10. Troubleshooting procedures for each system and for each major system component

3.03 TRAINING

A. The Contractor shall be responsible for training of facility personnel. Training shall take place after occupancy and before acceptance and shall include programs for on-site operations and maintenance of technology and communications systems. Training shall be for not more than ten (10) people, shall be held at the Owner's site and shall be of sufficient duration and depth to ensure that the trained personnel can operate the installed systems and can perform usual and customary maintenance actions.

3.04 WARRANTY

A. General

1. All equipment is to be new and warranted free of faulty workmanship and damage.

2. Replacement of defective equipment and materials and repair of faulty workmanship within 24 hours of notification, except emergency conditions (system failures), which must be placed back in service within eight (8) hours of notification, all at no cost to the Owner.
3. The minimum warranty provisions specified shall not diminish the terms of individual equipment manufacturer's warranties.

B. Structured Cabling
1. Manufacturer(s) shall provide a minimum 25-year warranty for components used in the installed Structured Cabling System. Defective and/or improperly installed products shall be replaced and/or correctly installed at no cost to the Owner.

C. Pathway & Support Infrastructure
1. Manufacturer(s) shall provide a minimum 1-year warranty for components used in the installed Pathway & Support Infrastructure. Defective and/or improperly installed products shall be replaced and/or correctly installed at no cost to the Owner.

END OF SECTION 270800

SECTION 271113
COMMUNICATIONS ENTRANCE PROTECTION

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the products and execution requirements relating to Communications Entrance Protection.

C. Product specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

1.02 SUBMITTALS

A. Provide product data from manufacturer's specifications.

1.03 WORK INCLUDED

A. The work included under this specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

PART 2 PRODUCTS

2.01 APPROVED PRODUCTS

A. Approved Building Entrance Protector Terminal Manufacturer(s)
1. Circa
2. Marconi
3. Porta Systems
4. Or Approved Equal (by Design Engineer)

B. Approved Bonding Shield Connector Manufacturer(s)
1. 3M
2. Or Approved Equal (by Design Engineer)

2.02 BUILDING ENTRANCE PROTECTOR TERMINALS

A. Indoor Building Entrance Protector Terminal
1. The indoor building entrance protector terminal shall be equipped with 110-connector inputs and outputs and shall accommodate industry standard 5-pin protection modules.
2. The indoor building entrance protector terminal shall protect up to 100-pairs and shall be equipped with an internal fuse link.
3. The indoor building entrance protector terminal shall be wall or frame mountable, and able to be stacked for future expansion.
4. The indoor building entrance protector terminal shall be equipped with external ground connectors that accept 6-14 AWG ground wire.

B. Solid State Surge Protection Modules
1. The solid-state surge protector module shall be 5-pin and shall provide transient and power fault protection for standard telephone line applications.
2. The solid-state surge protector module shall be designed to provide a balanced configuration to protect against line-to-line metallic surges.
3. The solid-state surge protector module shall feature an external failsafe mechanism, which permanently grounds module under sustained high current conditions.
4. The solid-state surge protector module shall feature nanosecond response time and safe mode operation in adverse situations.
5. The solid-state surge protector module shall be UL & cUL Listed.

C. BONDING SHIELD CONNECTOR
   1. Shield Connector
   2. The purpose of the bonding shield connector is to make a stable, low resistant electrical connection between the shield of a communications cable and a ground conductor.
   3. The bonding shield connector shall be tin-plated tempered brass.

PART 3 EXECUTION

3.01 BUILDING ENTRANCE PROTECTOR TERMINALS

A. All copper circuits shall be provided with protection between each building with an entrance cable protector panel. All building-to-building circuits shall be routed through this protector. The protector shall be connected with a #6 AWG copper bonding conductor between the protector ground lug and the telecommunications room (TR) busbar.

B. Building entrance protector shall be installed in accordance with the recommendations contained in the ANSI/TIA-607-C Telecommunications Bonding and Ground Standard.

C. Building entrance protector panels shall be installed as per the requirements specified by the manufacturer's installation guidelines.

3.02 BONDING SHIELD CONNECTOR

A. Bonding shield connector shall be installed in accordance with the recommendations contained in the ANSI/TIA-607-C Standard.

B. Bonding shield connector shall be installed as per the requirements specified by the manufacturer's installation guidelines.

3.03 IDENTIFICATION

A. Refer to Section 27 05 53 - Identification for Communications Systems for labeling details.

END OF SECTION 271113

SECTION 271116
COMMUNICATIONS RACKS AND ENCLOSURES

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the products and execution requirements relating to Communications Cabinets, Racks and Enclosures.

C. Product specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

1.02 SUBMITTALS

A. Provide product data from manufacturer's specifications.

1.03 WORK INCLUDED

A. The work included under this specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

PART 2 PRODUCTS

2.01 APPROVED PRODUCTS

A. Approved Equipment Rack/Cabinet Manufacturer(s)
   1. Chatsworth Products, Inc.
   2. Hoffman
   3. Middle Atlantic
   4. Panduit
   5. Hammond
   6. Or Approved Equal (by Design Engineer)
   7. Legrand

B. EQUIPMENT RACKS/CABINETS
   1. Free Standing Equipment Racks
      1) The equipment rack shall be constructed of high strength, lightweight aluminum or high strength steel.
      2) The vertical rails of the equipment rack shall be equipped with the EIA hole pattern.
      3) Rack shall be: 4-post adjustable.
      4) Rack shall be: 84"H x 19"W x 32"D floor mounted
      5) Rack color shall be: Black

C. WALL MOUNT RACKS
   1. Wall mount rack to be heavy duty wall-mount equipment rack designed to hold up to 350lbs.
   2. Rack to include #12-24 mounting screws and be painted black.
   3. Rack to be high-strength, light-weight aluminum.
   4. Rack to be 40U in height with 19" EIA width & 24" depth.

PART 3 EXECUTION

3.01 EQUIPMENT RACKS

A. Equipment racks shall be securely attached to the concrete floor using minimum 3/8" hardware or as required by local codes.

B. Equipment racks/cabinets shall be placed with a minimum of 40-inch clearance from the walls from the front and rear of the rack or as indicated on Drawings.

C. All equipment racks/cabinets shall be grounded to the telecommunications ground bus bar.

D. Mounting screws not used for installing patch panels and other hardware shall be bagged and left with the rack upon completion of the installation.

E. Contractor shall provide one (1) 25-count bag of rack screws per rack for IT Department personnel. These screws are in addition to what will be used by the contractor to mount the equipment that they are contracted to install.

3.02 BACKBOARDS

A. Backboards shall be 3/4" void free Grade AC plywood. Size of backboard shall be 4' x 8' unless noted differently on Drawings. Backboards shall be painted with two (2) coats of gray fire-retardant paint.

B. Mount Plywood 8” AFF with side Grade C facing the wall.

C. When mounting backboards to concrete walls, contractor to provide and install two layers of 3/4” void free Grade AC plywood.

3.03 IDENTIFICATION

A. Refer to Section 270553 - Identification for Communications Systems for labeling details.

END OF SECTION 271116

SECTION 271119

COMMUNICATIONS TERMINATION BLOCKS AND PATCH PANELS

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the products and execution requirements relating to Communications Termination Blocks and Patch Panels.

C. Product specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

1.02 SUBMITTALS

A. Provide product data from manufacturer's specifications.

1.03 WORK INCLUDED

A. The work included under this specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

PART 2 PRODUCTS

2.01 APPROVED PRODUCTS

A. Approved Patch Panel Manufacturer(s)
   1. Berk-Tek Leviton
      1) Patch Panel – QuickPort Series
      2) Jacks – Atlas-X1 Cat. 6A
      3) Jacks – Atlas X1 Cat. 6
   2. Panduit – Mini-Com (Enterprise Solution)
      1) Patch Panel – Modular CPP Series
      2) Jacks – Mini-Com TX6 PLUS
      3) WiFi Jacks – Mini-Com TX6A 10Gig
   3. CommScope – Systimax
      1) Patch Panel – Systimax 360 GigaSPEED XL/X10D
      2) Jacks – GigaSPEED X10D MGS600 Cat. 6A
      3) Jacks – GigaSPEED XL MGS400 Series Cat. 6
   4. Siemon – Z-Max
      1) Patch Panel – Z-Max 6/6A
      2) Jacks – Z-MAX 6
      3) Jacks – Z-MAX 6A
   5. Legrand & Superior Essex equal

B. Approved Optical Fiber Enclosure Manufacturer(s)
   1. Leviton
      1) Rack Mount - 1000i SDX
      2) Wall Mount – SDX Series
   2. Panduit
      1) Rack Mount - Opticom FRME
      2) Wall Mount – Opticom FWME
   3. CommScope – Systimax
      1) Rack Mount SD-2U/SD-4U
      2) Wall Mount
   4. Siemon

1) Rack Mount – RIC3
2) Wall Mount – SWIC3

5. Legrand

C. Approved Termination Block Manufacturer(s)
1. Leviton
2. Panduit
3. CommScope
4. Siemon
5. Legrand

2.02 PATCH PANELS

A. Category 6 Patch Panel (Data & Video Surveillance)
1. The Category 6 patch panel shall be modular in design and equipped with Cat 6 jacks.
2. The Category 6 patch panel shall be compatible with 19" equipment racks, cabinets or wall mount brackets.
3. The Category 6 patch panel shall be 2U, angled, high density type.
4. The Category 6 patch panel shall be equipped with front labeling space to facilitate port identification.
5. All Jacks shall be component–rated.
6. The connector module shall exceed the Category 6 performance criteria per ANSI/TIA-568-C.2.
   1) Icons shall be used if offered from the manufacturer.
   2) Jack/Icon colors shall be:
      1. Green for Video Surveillance
      2. Blue for Data

B. Category 6A Patch Panel (WiFi)
1. The Category 6A patch panel shall be modular in design and equipped with Cat 6A jacks.
2. The Category 6A patch panel shall be compatible with 19" equipment racks, cabinets or wall mount brackets.
3. The Category 6A patch panel shall be 2U, angled, high density type.
4. The Category 6A patch panel shall be equipped with front labeling space to facilitate port identification.
5. All Jacks shall be component–rated.
6. The connector module shall exceed the Category 6A performance criteria per ANSI/TIA-568-C.2.
   1) Icons shall be used if offered from the manufacturer.
   2) Jack/Icon colors shall be:
      1. Yellow for WiFi

C. Voice-Grade Patch Panel (Voice)
1. The Voice-Grade patch panel shall be modular in design and equipped with Cat 3 jacks.
2. The Voice-Grade patch panel shall be compatible with 19" equipment racks, cabinets or wall mount brackets.
3. The Voice-Grade patch panel shall be 1U, flat, voice-grade, standard density type, 24 port.
4. The Voice-Grade patch panel shall be equipped with front labeling space to facilitate port identification.
5.
6. Icons shall be used if offered from the manufacturer.
7. Jack/Icon colors shall be:
   1) Gray For Voice

D. OPTICAL FIBER PANELS/ENCLOSURES
1. Rack Mount Optical Fiber Panel/Enclosure

1) The rack mount optical fiber panel/enclosure shall be equipped with either a swing out mechanism or a sliding drawer to access fibers.
2) The rack mount optical fiber panel/enclosure shall be capable of terminating tight-buffered or loose tube optical fiber cable.
3) The rack mount optical fiber panel/enclosure shall provide for bend radius control throughout the panel as well as storage space for slack cabling.
4) The panel/enclosure shall meet or exceed the performance criteria per ANSI/TIA-568-C.3.
5) The rack mount optical fiber panel/enclosure shall be equipped with optical fiber adapter panels from same manufacturer.
   1. The optical fiber adapter panels shall accommodate singlemode terminated optical fiber.
   2. The optical fiber adapter panels shall be compatible with LC connectors.
   3. Singlemode adaptors shall be blue in color and equipped with zirconia ceramic sleeves.

E. Wall Mount Optical Fiber Panel/Enclosure
1. The wall mount optical fiber panel/enclosure shall have a hinged door for access, with locking available for security.
2. The wall mount optical fiber panel/enclosure shall be capable of terminating tight-buffered or loose tube optical fiber cables and all popular connector types.
3. The wall mount optical fiber panel/enclosure shall provide for bend radius control throughout the panel as well as storage space for slack cabling.
4. The panel/enclosure shall meet or exceed the performance criteria per ANSI/TIA-568-C.3.
5. The wall mount optical fiber panel/enclosure shall be equipped with optical fiber adapter panels from same manufacturer.
   1) The optical fiber adapter panels shall accommodate singlemode terminated optical fiber.
   2) The optical fiber adapter panels shall be compatible with LC connectors.
   3) Singlemode adaptors shall be blue in color and equipped with zirconia ceramic sleeves.

2.03 TERMINATION BLOCKS

A. 110 Type Wiring Blocks/Cross-Connect Kits:
1. The 110-type wiring blocks shall be available in 100- and/or 300-pair configurations.
2. The 110-type wiring block shall be Category 6 for backbone terminations.
3. The cross-connect kits shall include all the components required to complete a wall-mounted 110 cross-connect installation and be available in both 100-pair and 300-pair configurations (Includes 110-blocks, connecting blocks and designation strips).
4. The termination block shall meet or exceed the performance criteria per ANSI/TIA-568-C.2.
5. Backbone blocks shall use 5-pair connecting blocks on each 25-pair row.

B. 66-Blocks
1. The 66-type wiring block shall be a 50-pair configuration.
2. The 66-type wiring block shall have a split clip system using bridge clips to connect incoming pairs to outgoing pairs.
3. The 66 block's labeling system shall use designation strips or covers to accommodate labels.

PART 3 EXECUTION

3.01 PATCH PANELS

A. Cables shall be dressed and terminated in accordance with the recommendations made in ANSI/TIA-568-C.0 and/or ANSI/TIA-568-C.1, manufacturer's recommendations and best industry practice.

B. Pair untwist at the termination shall not exceed 13 mm (0.5 inch).

C. Bend radius of the cable in the termination area shall not exceed 4 times the outside diameter of the cable.

D. Cables shall be neatly bundled and dressed to their respective patch panel. Each patch panel shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.

E. Each cable shall be clearly labeled on the cable jacket behind the patch panel at a location that can be viewed without removing the bundle support ties. Cables labeled within the bundle, where the label is obscured from view shall not be acceptable.

3.02 OPTICAL FIBER PANELS/ENCLOSURES

A. Cables shall be dressed and terminated in accordance with the recommendations made in ANSI/TIA-568-C.0 and/or ANSI/TIA-568-C.1, manufacturer's recommendations and best industry practices.

B. Each cable shall be individually attached to the respective splice enclosure by mechanical means. The cables strength member shall be securely attached the cable strain relief bracket in the enclosure.

C. Bend radius of the optic fiber cable in the panel/enclosure shall not exceed 10 times the outside diameter of the cable.

D. Each fiber bundle shall be stripped upon entering the splice tray and the individual fibers routed in the splice tray.

E. Each cable shall be clearly labeled at the entrance to the splice enclosure. Cables labeled within the bundle shall not be acceptable.

F. A maximum of 12 strands of fiber shall be spliced in each fiber splice tray.

G. All spare strands shall be installed into spare splice trays.

H. Fiber slack shall be neatly coiled within the fiber splice tray or enclosure. No slack loops shall be allowed external to the fiber panel.

3.03 TERMINATION BLOCKS

A. Cables shall be dressed and terminated in accordance with the recommendations made in ANSI/TIA-568-C.0 and/or ANSI/TIA-568-C.1, manufacturer's recommendations and best industry practice.

B. Pair untwist at the termination shall not exceed 13 mm (0.5 inch).

C. Bend radius of the cable in the termination area shall not exceed 4 times the outside diameter of the cable.

D. Cables shall be neatly bundled and dressed to their respective termination block. Each termination block shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.

E. Each cable shall be clearly labeled on the cable jacket within 12" of the termination block at a location that can be viewed without removing the bundle support ties. Cables labeled within the bundle, where the label is obscured from view shall not be acceptable.

F. Wall mounted termination block fields shall be mounted on communications backboard.

G. Wall mounted termination block fields shall be installed as per the requirements specified by the manufacturer's installation guidelines.

3.04 IDENTIFICATION

A. Refer to Section 270553 - Identification for Communications Systems for labeling details.

END OF SECTION 271119

SECTION 271123

COMMUNICATIONS CABLE MANAGEMENT AND LADDER RACK

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the products and execution requirements relating to Communications Cable Management and Ladder Rack.

C. Product specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

1.02 SUBMITTALS

A. Provide product data from manufacturer's specifications.

1.03 WORK INCLUDED

A. The work included under this specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

PART 2 PRODUCTS

2.01 APPROVED PRODUCTS

A. Approved Horizontal Cable Management Manufacturer(s)
1. Leviton
2. Panduit
3. CommScope - Systimax
4. Chatsworth Products, Inc. (CPI)
5. Siemon
6. Legrand

B. Approved Vertical Cable Management Manufacturer(s)
1. Leviton
2. Panduit
3. CommScope - Systimax
4. Chatsworth Products, Inc. (CPI)
5. Legrand

C. Approved Ladder Rack System Manufacturer(s)
1. Chatsworth Products, Inc. (CPI)
2. Hoffman
3. Or Approved Equal (Owner)
4. Legrand

D. Approved C-Ring/D-ring Manufacturer(s)
1. Chatsworth Products, Inc. (CPI)
2. Or Approved Equal (Owner)
3. Legrand

2.02 CABLE MANAGEMENT - HORIZONTAL

A. Horizontal Cable Management
1. The horizontal wire manager shall be compatible with 19-inch equipment racks, cabinets or wall mount brackets.
2. The horizontal cable manager shall provide support for patch cords at the front of the panel.

3. The horizontal cable manager shall be 2 rack-units in height when matched with a 2 rack-unit patch panel or switch.
4. The horizontal cable manager shall be 1 rack-unit in height when matched with a 1 rack-unit patch panel or switch.
5. See Drawings for Requirements.

2.03 CABLE MANAGEMENT - VERTICAL

A. Vertical Cable Management
1. The vertical cable manger shall be double-sided.
2. The vertical cable manager shall provide support for patch cords at the front of the rack and wire management at the rear of the rack.
3. The vertical cable manager shall be a minimum width of 6" for end of rows and 10” for between two racks.
4. Vertical cable manager color shall be black.
5. Vertical Cable Manger shall be 84” in height.
6. See Drawings for Requirements.

2.04 LADDER RACKS

A. Ladder Rack System
1. See Drawings for ladder rack system details.
2. The ladder rack system shall be securely mounted with hardware designed for use in ladder rack systems.
3. End caps shall be installed on the exposed ends of the ladder racks, channel supports and bolts. Protective covers shall be installed on threaded rods that come in contact with cabling plant.
4. Provide vertical sections of ladder rack to support vertical cabling spans greater than 4 feet.
5. Ladder Rack System color shall be black.

2.05 VELCRO STRAPS

A. Velcro Straps
1. Backbone cables shall be fastened to support structures with Velcro straps.
2. Horizontal cables shall be fastened to support structures with Velcro straps.
3. Velcro Strap color shall be black (or red in plenum spaces).
4. Tie Wraps shall not be permitted.

2.06 C-RINGS/D-Rings

A. C-Rings/D-rings
1. C-rings/D-rings shall be used on backboards to support cables, patch cords and cross-connect wire.
2. C-rings/D-rings shall be made of high-strength, fire-retardant material with rounded edges to prevent damage to cable and wire insulation.

PART 3 EXECUTION

3.01 CABLE MANAGEMENT - HORIZONTAL

A. Horizontal cable managers shall be installed as indicated on Drawings.

3.02 CABLE MANAGEMENT - VERTICAL

A. Vertical cable managers shall be installed on both sides of a single equipment rack. Where two (2) or more racks are positioned in a row, vertical cable managers shall be installed between each rack and each end of the row.

3.03 LADDER RACKS

A. Ladder rack system shall be installed straight, level and perpendicular to walls and ceiling slabs.

B. Ladder racks shall be supported at 5' intervals maximum.

C. Provide all hardware, accessories, fasteners, anchors, threaded rods and support channels required to provide a complete ladder rack system.

D. See Drawings for ladder rack system details.

E. Provide cable radius protection (turn-downs/ waterfalls) at each location within telecom room where cabling transitions from horizontal to vertical routing from the ladder rack.

F. Provide vertical section of cable runway to support vertical cabling spans greater than 3’.

3.04 VELCRO STRAPS

A. Velcro straps shall be installed around cables at intervals of 12" minimum.

B. Velcro straps shall secure cables to ladder racks using an “X” pattern.

C. Do not over-cinch cables.

3.05 C-RINGS/D-RINGS

A. C-ring/D-rings shall be installed on 3/4" backboard, straight and level.

3.06 IDENTIFICATION

A. Refer to Section 270553 - Identification for Communications Systems for labeling details.

END OF SECTION 271123

SECTION 271313

COMMUNICATIONS COPPER BACKBONE

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the products and execution requirements relating to Communications Copper Backbone.

C. Product specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

1.02 SUBMITTALS

A. Provide product data from manufacturer's specifications.

1.03 WORK INCLUDED

A. The work included under this specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

PART 2 PRODUCTS

2.01 APPROVED PRODUCTS

A. Approved Copper Backbone Cable (Inside Plant) Manufacturer(s)
   1. Berk-Tek
   2. General
   3. CommScope
   4. Siemon
   5. Superior Essex

B. Approved Copper Backbone Cable (Outside Plant) Manufacturer(s)
   1. General
   2. Berk-tek
   3. Commscope
   4. Siemon
   5. Superior Essex
   6. Or Approved Equal (by Design Engineer)

2.02 COPPER BACKBONE CABLE (INSIDE PLANT)

A. 100-Ohm Balanced Twisted Pair Building Backbone Cables (Inside Plant)
   1. Generic Characteristics
      1) The inside plant, balanced twisted pair building backbone cable shall meet the 25-Ohm balanced twisted pair backbone requirements per the latest issue of ANSI/TIA-568-C.2.
      2) The inside plant, 100-Ohm balanced twisted pair cable shall be CMR or CMP rated (according to the space it occupies).
      3) The inside plant, balanced twisted pair building backbone cable core shall consist of 25-pair sub-units.

2.03 COPPER BACKBONE CABLE (OUTSIDE PLANT)

A. 100-Ohm PE-89 Backbone Cables (Outside Plant)
   1. Generic Characteristics
      1) The outside plant backbone cable shall be assigned the RDUP designation of PE-89.
         1. The outside plant backbone cable core shall consist of 25-pair sub-units.

2. The outside plant backbone cable shall contain water-blocking gel and have a jacket made of polyethylene.

PART 3 EXECUTION

3.01 BACKBONE CABLES (INSIDE PLANT)

A. Cables shall be dressed and terminated in accordance with the recommendations made in ANSI/TIA-568-C.0 and/or ANSI/TIA-568-C.1, manufacturer's recommendations and best industry practices.

B. Backbone cables shall be installed separately from horizontal distribution cables

C. A plastic or nylon pull cord with a minimum test rating of 90 Kg (200 lb.) shall be co-installed with all cable installed in any conduit.

D. Where cables are housed in conduits, the backbone and horizontal cables shall be installed in separate conduits

E. Exposed cables must be CMP or MMP rated if installed in an air return plenum. CMR rated cables shall be installed in metallic conduit if installed in an air return plenum.

F. Where backbone cables and distribution cables are installed in a cable tray or wireway, backbone cables shall be installed first and bundled separately from the horizontal distribution cables.

G. Leave 10' of slack on each end of copper backbone cable.

H. Backbone cables spanning more than three floors shall be securely attached at the top of the cable run with a wire mesh grip and on alternating floors or as required by local codes.

I. Vertical runs of cable shall be supported to messenger strand, cable ladder, or other method to provide proper support for the weight of the cable.

J. Large bundles of cables and/or heavy cables shall be attached using metal clamps and/or metal banding to support the cables.

K. The cable's minimum bend radius and maximum pulling tension shall not be exceeded. Refer to manufacturer's requirements.

L. Copper cables shall be neatly bundled and dressed to their respective panels or blocks. Each panel or block shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.

M. Each copper cable shall be clearly labeled on the cable jacket behind the patch panel or block at a location that can be viewed without removing the bundle support ties. Cables labeled within the bundle, where the label is obscured from view shall not be acceptable.

N. Copper backbone cables shall be installed separately from horizontal distribution cables

3.02 BACKBONE CABLES (OUTSIDE PLANT)

A. All OSP cables brought to the Entrance Facilities shall have 15 ft of slack coiled and secured to the wall in the proximity of the termination field.

B. All cables shall be tagged and identified within each handhole/maintenance hole.

C. Place initial cables in bottom conduits to facilitate easy subsequent cable placement.

D. Place leader guard in the duct before placing cable to prevent damaging the cable sheath on the sharp edge of the duct.

E. Ventilate maintenance where gas has been detected before entering the maintenance hole.

F. A 600 lb. break-away swivel, along with a slip clutch capstan winch that shows the dynamometer (pulling tension) reading, shall be used at all times during pulling.

G. At each splice location the cable ends will be sealed watertight at all times. Reels will be continuously manned during cable installation.

H. Copper backbone cables shall be bonded and grounded in accordance with the recommendations made in the ANSI/TIA-607-C standard, manufacturer's recommendations and best industry practice.

3.03 IDENTIFICATION

A. Refer to Section 270553 - Identification for Communications Systems for labeling details.

END OF SECTION 271313

SECTION 271323

COMMUNICATIONS OPTICAL FIBER BACKBONE CABLING

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the products and execution requirements relating to Communications Optical Fiber Backbone Cabling.

C. Product specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

1.02 SUBMITTALS

A. Provide product data from manufacturer's specifications.

1.03 WORK INCLUDED

A. The work included under this specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

PART 2 PRODUCTS

2.01 APPROVED PRODUCTS

A. Approved Optical Fiber Backbone Cable (Inside Plant) Manufacturer(s) (must be matched with connectivity and provided with manufacturer-based 25 year warranty.)

1. Berk-Tek
2. General Cable
3. CommScope
4. Siemon
5. Corning
6. Superior Essex

B. Approved Optical Fiber Backbone Cable (Outside Plant) Manufacturer(s) (must be matched with connectivity and provided with manufacturer-based 25 year warranty.)

1. Berk-Tek
2. General Cable
3. CommScope
4. Siemon
5. Corning
6. Superior Essex

C. Approved Optical Fiber Connectivity Manufacturer(s) (must be matched with cabling and provided with manufacturer-based 25 year warranty.)

1. Leviton
2. Panduit
3. CommScope
4. Siemon
5. Corning
6. Legrand

D. Approved Splice Case Manufacturer(s)

1. Commscope
2. 3M
3. Corning

2.02 OPTICAL FIBER BACKBONE CABLE (INSIDE PLANT)

A. Riser - Indoor 8.3/125-micron, Singlemode Optical Fiber Conductive (OFCR) (OS2)

1. Generic Characteristics
   1) The indoor optical fiber cable with up to twelve 250-micron coated fibers placed in a color-coded sub-unit bundle.
   2) The indoor optical fiber cable shall meet or exceed the performance criteria found in ANSI/TIA-568-C.3.
   3) All singlemode fibers shall be pigtail spliced into a rack mounted optical fiber panel or wall-mounted enclosure.
   4) The loss of fiber shall not exceed 0.50 dB per kilometer @ 1550 nm and 0.50 dB per kilometer @ 1310 nm.
   5) All Indoor Fiber shall be armored.

2.03 OPTICAL FIBER BACKBONE CABLE (OUTSIDE PLANT)

A. Indoor/outdoor 8.3/125-micron, Singlemode Optical Fiber Non-Conductive (OFNR) (OS2)

1. Generic Characteristics
   1) The indoor/outdoor optical fiber cable with up to twelve 250-micron coated fibers placed in a color-coded sub-unit bundle with moisture-blocking gel.
   2) The indoor/outdoor optical fiber cable shall meet or exceed the performance criteria found in ANSI/TIA-568-C.3.
   3) The indoor/outdoor optical fiber cable shall have sequential length markings printed on the cable jacket.
   4) All singlemode fibers shall be pigtail spliced into a rack mounted optical fiber enclosure or wall-mounted enclosure.
   5) The loss of fiber shall not exceed 0.50 dB per kilometer @ 1550 nm and 0.50 dB per kilometer @ 1310 nm.

2.04 OPTICAL FIBER CONNECTORS

A. Singlemode Fiber Connectivity

1. The optical fiber connector shall be LC.
2. The optical fiber connector and pigtail assembly shall meet or exceed the performance criteria found in ANSI/TIA-568-C.3.
3. The method of terminating singlemode fiber is pigtail splicing into a rack mounted optical fiber panel or wall-mounted enclosure. Pigtails shall be factory terminated and 3 meters in length. A fiber enclosure with slack storage trays must be used when pigtail-splicing method is used.
4. The splice loss through each connector pair shall not exceed 0.50 dB.
5. Singlemode fiber connector color shall be blue.

2.05 SPLICE CASES

A. Canister Splice Case

1. Splice cases shall be water tight and designed for outside plant applications.
2. All splice trays, seals and hardware shall be from the same manufacturer as the splice case.
3. Splice trays shall utilize heat-shrink seals.
4. See Drawings for size requirements.

PART 3 EXECUTION

3.01 BACKBONE CABLES (INSIDE PLANT)

A. Cables shall be dressed and terminated in accordance with the recommendations made in ANSI/TIA-568-C.0 and/or ANSI/TIA-568-C.1, manufacturer's recommendations and best industry practices.

B. Backbone cables shall be installed separately from horizontal distribution cables

C. A plastic or nylon pull cord with a minimum test rating of 90 Kg (200 lb.) shall be co-installed with all cable installed in any conduit.

D. Where cables are housed in conduits, the backbone and horizontal cables shall be installed in separate conduits

E. Exposed cables must be OFNP rated if installed in an air return plenum. Riser rated cables shall be installed in metallic conduit if installed in an air return plenum.

F. Where backbone cables and distribution cables are installed in a cable tray or wireway, backbone cables shall be installed first and bundled separately from the horizontal distribution cables.

G. Leave 10' of slack on each end of fiber backbone cable.

H. Backbone cables spanning more than three floors shall be securely attached at the top of the cable run with a wire mesh grip and on alternating floors or as required by local codes.

I. Vertical runs of cable shall be supported to messenger strand, cable ladder, or other method to provide proper support for the weight of the cable.

J. Large bundles of cables and/or heavy cables shall be attached using metal clamps and/or metal banding to support the cables.

K. The cable's minimum bend radius and maximum pulling tension shall not be exceeded. Refer to manufacturer's requirements.

L. Each optical fiber cable shall be individually attached to the respective enclosure by mechanical means. The cables strength member shall be securely attached the cable strain relief bracket in the enclosure.

M. Each optical fiber cable shall be clearly labeled at the entrance to the enclosure. Cables labeled within the bundle shall not be acceptable.

N. Each fiber bundle shall be stripped upon entering the splice tray and the individual fibers routed in the splice tray.

O. A maximum of 12 strands of fiber shall be spliced in each splice tray

P. All spare fiber strands shall be installed into spare splice trays.

Q. Fiber slack shall be neatly coiled within the fiber splice tray or enclosure. No slack loops shall be allowed external to the fiber panel.

3.02 BACKBONE CABLES (OUTSIDE PLANT)

A. All OSP cables brought to the Entrance Facilities shall have 15 ft of slack coiled and secured to the wall in the proximity of the fiber enclosure.

B. All cables shall be tagged and identified within each handhole/maintenance hole.

C. Place initial cables in bottom conduits to facilitate easy subsequent cable placement.

D. Place leader guard in the duct before placing cable to prevent damaging the cable sheath on the sharp edge of the duct.

E. Ventilate maintenance where gas has been detected before entering the maintenance hole.

F. To ensure that the optical fiber cable's qualities and characteristics are not degraded during installation, excessive pulling tensions and short bending radii will not be allowed. The maximum pulling tension is 600 lbs. The minimum bending radius for cable under tension is 20 times the outside diameter of the cable and for cable at rest is 10 times the outside diameter of the cable.

G. A 600 lb. break-away swivel, along with a slip clutch capstan winch that shows the dynamometer (pulling tension) reading, shall be used at all times during pulling.

H. At each splice location the cable ends will be sealed watertight at all times. Reels will be continuously manned during cable installation.

I. Contractor shall coil 60 feet of spare optical fiber cable in each handhole/maintenance hole without a splice and 75 feet of each optical fiber cable in each handhole/maintenance hole with a splice. Cable coils shall have at least two points of support on the optical fiber racking system.

J. When mounting the optical fiber slack coils, the minimum bend radius shall not be exceeded; this radius is equal to 10 times the outside diameter of the cable in a static application and 20 times the outside diameter in a dynamic application. At anytime during the entire handling process of the optical fiber cable, as much care as possible should be maintained and all the manufacturer's recommendations should be followed.

3.03 OPTICAL FIBER CONNECTIVITY / SPLICING

A. Optical fiber connectors shall be installed as per the requirements specified by the manufacturer's installation guidelines.

B. All splicing shall be of the fusion type made under Light Injection and Detection Mode, whenever applicable. The Contractor shall provide certified and experienced personnel for splicing.

C. Contractor's tools and equipment shall be in excellent working order. Any worn or improperly working tools shall be discarded and not used on this project. All fusion splicers shall be calibrated and labeled according to the manufacturer's specifications. Contractor shall submit certification of calibration for the fusion splicers to the Engineer.

3.04 SPLICE CASES

A. Splice Cases shall be installed as per the requirements specified by the manufacturer's installation guidelines.

3.05 IDENTIFICATION

A. Refer to Section 270553 - Identification for Communications Systems for labeling details.

B. Refer to Section 270800 – Commissioning of Communications for Testing Requirements.

END OF SECTION 271323

SECTION 271513
COMMUNICATIONS COPPER HORIZONTAL CABLING

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the products and execution requirements relating to Communications Copper Horizontal Cabling.

C. Product specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

1.02 SUBMITTALS

A. Provide product data from manufacturer's specifications.

1.03 WORK INCLUDED

A. The work included under this specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

PART 2 PRODUCTS

2.01 APPROVED PRODUCTS – Must be matched with connectivity hardware and provided manufacturer-based 25 year warranty.

A. Approved CATEGORY 6 Horizontal Copper Cable Manufacturer(s)
1. Berk-Tek – LANmark 2000
2. General – GenSPEED 6500 Premium
3. CommScope / Systimax 360 – GigaSPEED XL
4. Siemon – Premium 6 UTP Cable
5. Superior Essux – NextGain Category6eX

B. Approved CATEGORY 6A Horizontal Copper Cable Manufacturer(s)
1. Berk-Tek – LANmark XTP
2. General – GenSPEED 10
3. CommScope / Systimax – GigaSPEED X10D
4. Siemon – Category 6A GT UTP
5. Superior Essux – 10Gain XP

2.02 CATEGORY 6A HORIZONTAL COPPER CABLE

A. 100 OHM Category 6A Balanced Twisted Pair Cable
1. The horizontal balanced twisted pair cable shall exceed the Category 6A transmission characteristics per issue of ANSI/TIA-568-C.2.
2. Cable shall have maximum OD size of .29 inch.
3. Cable jacket shall be CMP/CMR rated, according to the space it occupies.
4. Jacket color shall be: White for Wifi

2.03 CATEGORY 6 HORIZONTAL COPPER CABLE

A. 100 OHM Category 6 Balanced Twisted Pair Cable
1. The horizontal balanced twisted pair cable shall exceed the Category 6A transmission characteristics per issue of ANSI/TIA-568-C.2.
2. Cable jacket shall be CMP/CMR rated, according to the space it occupies.
3. Jacket color shall be:
   1) Green for Video Surveillance.
   2) Blue for Data

PART 3 EXECUTION

3.01 HORIZONTAL CABLES

A. Cable shall be installed in accordance with manufacturer's recommendations and best industry practices.

B. A plastic or nylon pull cord with a minimum test rating of 90 Kg (200 lb.) shall be co-installed with all cable installed in any conduit.

C. Cable raceways shall not be filled greater than the ANSI/TIA-569-B maximum fill for the particular raceway type.

D. Cables shall be installed in continuous lengths from origin to destination (no splices) except for transition points, or consolidation points.

E. Where transition points or consolidation points are allowed, they shall be located in accessible locations and housed in an enclosure intended and suitable for the purpose.

F. The cable's minimum bend radius and maximum pulling tension shall not be exceeded. Refer to manufacturer's requirements.

G. If a J-hook or trapeze system is used to support cable bundles all horizontal cables shall be supported at a maximum of 48 to 60 inch (1.2 to 1.5 meter) intervals. At no point shall cable(s) rest on acoustic ceiling grids or panels.

H. Horizontal distribution cables shall be bundled in groups of no more than 50 cables. Cable bundle quantities in excess of 50 cables may cause deformation of the bottom cables within the bundle and degrade cable performance.

I. Cable shall be installed above fire-sprinkler systems and shall not be attached to the system or any ancillary equipment or hardware. The cable system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.

J. Cables shall not be attached to ceiling grid or lighting fixture wires. Where support for horizontal cable is required, the Contractor shall install appropriate carriers to support the cabling.

K. Any cable damaged or exceeding recommended installation parameters during installation shall be replaced by the Contractor prior to final acceptance at no cost to the Owner.

L. Cables shall be dressed and terminated in accordance with the recommendations made in the ANSI/TIA-568-C.2 document, manufacturer's recommendations and best industry practices.

M. Leave a minimum of 12" of slack for twisted pair cables at the outlet. Cables shall be coiled in the in-wall box, surface-mount box or modular furniture raceway if adequate space is present to house the cable coil without exceeding the manufacturers bend radius. Excess slack shall be loosely coiled and stored in the ceiling above each drop location when there is not enough space present in the outlet box to store slack cable.

N. Cables shall be neatly bundled and dressed to their respective termination device. Each terminating device shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.

O. Each cable shall be clearly labeled on the cable jacket behind the termination device at a location that can be viewed without removing the bundle support ties. Cables labeled within the bundle, where the label is obscured from view shall not be acceptable.

3.02 IDENTIFICATION

A. Refer to Section 270553 - Identification for Communications Systems for labeling details.

B. Refer to Section 270800 - Commissioning of Communications for Testing Requirements.

END OF SECTION 271513

SECTION 271543 - COMMUNICATIONS FACEPLATES AND CONNECTORS

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the products and execution requirements relating to Communications Faceplates and Connectors.

C. Product specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

1.02 SUBMITTALS

A. Provide product data from manufacturer's specifications.

1.03 WORK INCLUDED

A. The work included under this Specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

PART 2 PRODUCTS

2.01 APPROVED PRODUCTS

A. Approved Cat. 6 Copper Connectivity Manufacturer(s**)** (must be matched with cabling and provided with manufacturer-based 25 year warranty.)
   1. Leviton – Atlas X1 Cat. 6
   2. Panduit - Mini-Com TX6 PLUS
   3. Siemon – Z-MAX 6
   4. CommScope / Systimax 360 – GigaSPEED XL MGS400
   5. Legrand – KT2J6-XX

B. Approved Category 6A Copper Connectivity Manufacturer(s**)** (must be matched with cabling and provided with manufacturer-based 25 year warranty.)
   1. Leviton – Atlas X1 – Cat. 6A
   2. Panduit - Mini-Com TX6A 10Gig
   3. Siemon – Z-MAX 6A UTP
   4. CommScope / Systimax 360 – MGS600
   5. Legrand – KT2J6A-XX

C. Approved Faceplate Manufacturer(s)
   1. Leviton
   2. Panduit
   3. Siemon
   4. CommScope
   5. Legrand

D. Approved Surface Mount Box manufacturer(s)
   1. Leviton
   2. Panduit
   3. Siemon
   4. CommScope
   5. Legrand

E. Approved Harsh-Environment Faceplate Manufacturer(s)
   1. Leviton
   2. Panduit

3. Commscope
4. Siemon
5. Legrand

2.02 CATEGORY 6 COPPER CONNECTIVITY

A. Category 6, 8-Position, 8-Contact (8P8C) Modular Jack
1. The connector module shall exceed the Category 6 performance criteria per ANSI/TIA-568-C.2.
2. The eight-position connector module shall accommodate six-position modular plug modular cords without damage to either the cord or the module.
3. The connector module shall be designed for use at the work area (WA), communications room (TR) and/or equipment room (ER) without modification.
4. The connector module shall be available in both the T568A and T568B wiring configurations within the same module.
5. The connector module shall have an insulation displacement connection featuring insulation slicing of 22 to 24 AWG plastic-insulated solid copper conductors forming a gas-tight connection.
6. Icons shall be used if offered from the manufacturer.
7. All Jacks shall be component–rated.
8. Jack/Icon colors shall be:
   1) Gray for Voice
   2) Blue for Data

2.03 CATEGORY 6A COPPER CONNECTIVITY

A. Category 6A, 8-Position, 8-Contact (8P8C) Modular Jack
1. The connector module shall exceed the Category 6A performance criteria per ANSI/TIA-568-C.2.
2. The eight-position connector module shall accommodate six-position modular plug modular cords without damage to either the cord or the module.
3. The connector module shall be designed for use at the work area (WA), communications room (TR) and/or equipment room (ER) without modification.
4. The connector module shall be available in both the T568A and T568B wiring configurations within the same module.
5. The connector module shall have an insulation displacement connection featuring insulation slicing of 22 to 24 AWG plastic-insulated solid copper conductors forming a gas-tight connection.
6. Icons shall be used if offered from the manufacturer.
7. All Jacks shall be component–rated.
8. Jack/Icon colors shall be:
   1) White for WiFi

2.04 Field Terminated Direct Attach Plug

A. All WIFI and Video Surveillance shall be field terminated with Direct Attach Plugs.

B. Components must comply with ANSI/TIA-863 Building Automation Standard

C. UTP Cable Connecting Hardware shall be a Field Terminated Direct Attach Category 6A RJ-45 Plug. The RJ-45 Plug shall utilize the printed circuit board technology to insure Cat-6A (WIFI) performance. The Field Terminated plug shall utilize IDC connections with a compression cap method for termination.

D. Testing shall be completed using the manufacturer approved testing device and adapter cord.

2.05 FACEPLATES

A. Faceplates
1. Faceplates shall be stainless steel.
2. The faceplate housing the connector modules shall have no visible mounting screws.

3. It shall be possible to install the connector modules in wall-mounted single- and dual-gang electrical boxes, utility poles and modular furniture (cubicle) access points using manufacturer-supplied faceplates and/or adapters.
4. The faceplate housing the connector modules shall have the option of being mounted on adapter boxes for surface mount installation.
5. The faceplate housing the connector modules shall have a labeling capability using built-in labeling windows, to facilitate outlet identification and ease network management.
6. The faceplate housing the connector modules shall provide flexibility in configuring multimedia workstation outlets that respond to present or future network needs such as audio, video, coaxial and optical fiber applications.

2.06 SURFACE MOUNT BOXES

A. The surface mount box shall accommodate connections of any type, UTP, optical fiber or coax.

B. The surface mount box shall have internal storage space for slack cabling and a built-in spool for controlling cable bend radius.

C. Color shall be same as electrical faceplates.

2.07 HARSH ENVIRONMENT FACEPLATES

A. The harsh environment faceplate shall provide a dust and watertight seal connector to house a Cat 6A jack. It shall feature a housing that uses a twist-lock system to secure the patch cord to the jack.

B. The harsh environment faceplate shall be IP67 rated.

C. Harsh environment faceplate shall be stainless steel.

PART 3 EXECUTION

3.01 COPPER CONNECTIVITY

A. 8-position, 8-contact (8P8C) modular jacks shall be installed in accordance with manufacturer's recommendations and installation guides, and best industry practices.

B. Pair untwist at the termination shall not exceed 13 mm (0.5 inch).

3.02 FACEPLATES

A. Blank inserts shall be installed where ports are not used.

B. The same orientation and positioning of jacks and connectors shall be used throughout the installation.

C. Faceplates shall be installed straight and level.

D. Faceplates shall be installed at the same heights and orientation as electrical faceplates.

3.03 SURFACE MOUNT BOXES

A. Blank inserts shall be installed where ports are not used.

B. The same orientation and positioning of jacks and connectors shall be used throughout the installation.

C. Surface mount boxes shall be installed straight and level.

D. Surface mount shall be installed at heights as electrical receptacles.

3.04 HARSH ENVIRONMENT FACEPLATES

A. Housing with connector cap shall be installed where ports are not used.

B. Faceplates shall be installed straight and level.

C. Faceplates shall be installed at the same heights as electrical faceplates.

3.05 IDENTIFICATION

A. Refer to Section 270553 - Identification for Communications Systems for labeling details.

END OF SECTION 271543

SECTION 271619
COMMUNICATIONS PATCH CORDS

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the products and execution requirements relating to Communications Patch Cords.

C. Product specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

1.02 SUBMITTALS

A. Provide product data from manufacturer's specifications.

1.03 WORK INCLUDED

A. The work included under this specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

PART 2 PRODUCTS

2.01 APPROVED PRODUCTS

A. Approved Cat. 6 Copper Patch Cord Manufacturer(s)
1. Leviton – Extreme Cat 6 SlimLine
2. Panduit – TX6
3. Siemon – SkinnyPatch 6 UTP
4. CommScope / Systimax 360 – GigaSPEED XL GS8E
5. Legrand – Q-Series C6 Slim Line

B. Approved Cat. 6A Copper Patch Cord Manufacturer(s)
1. Leviton – Atlas-X1 Cat 6A SlimLine
2. Panduit – TX6A-10 Gig
3. Siemon – Z-MAX 6A UTP
4. CommScope / Systimax 360 – GigaSPEED X10D
5. Legrand – Q-Series C6 Slim Line

C. Approved Harsh-Environment Patch Cord Manufacturer(s)
1. Leviton – DuraPort
2. Or Approved Equal (Owner)
3. Legrand

D. Approved Fiber Patch Cord Manufacturer(s)
1. Leviton
2. Panduit
3. OCC
4. CommScope
5. Legrand

2.02 COPPER PATCH CORDS

A. Category 6 Patch Cords
1. The Category 6 patch cord shall be 4-pair, with 24 AWG stranded copper conductors and 8-position modular plug.
2. The Category 6 modular cord cable shall be UL Listed as Type CMR.
3. The Category 6 Patch Cords shall be Slim (small OD) style.

4. The Category 6 patch cord shall exceed the requirements of ANSI/TIA-568-C.2.
5. Lengths shall be 1’, or greater as required by the application.
6. All Patch Cables shall be component–rated.
7. The Category 6 patch cord color shall be:
   1) Gray for Voice
   2) Blue for Data

2.03 COPPER PATCH CORDS

A. Category 6A Patch Cords
1. The Category 6A patch cord shall be 4-pair, with 24 AWG stranded copper conductors and 8-position modular plug.
2. The Category 6A modular cord cable shall be UL Listed as Type CMR.
3. The Category 6A patch cord shall exceed the requirements of ANSI/TIA-568-C.2.
4. The Category 6A Patch Cords shall be Slim (small OD) style.
5. Lengths shall be 1’ or greater as required by the application.
6. All Patch Cables shall be component–rated.
7. The Category 6A patch cord color shall be:
   1) White for WIFI

2.04 HARSH ENVIRONMENT PATCH CORDS

A. The harsh environment patch cord shall provide a dust and watertight seal when used with a harsh environment faceplate. It shall feature a housing that uses a twist-lock system to secure the patch cord to the jack. The harsh environment patch cord shall be Cat 6A rated.

B. The harsh environment patch cord shall be IP67 rated.

2.05 FIBER PATCH CORDS

A. Singlemode Fiber Patch Cords
1. 8.3/125-micron singlemode fiber patch cord (OS1):
   1) The 8.3/125-micron fiber used in the singlemode fiber patch cord shall have a maximum attenuation of 1.0 dB/km @ 1310 nm and 1.0 dB/km @ 1550 nm.
   2) The optical fiber cord connector shall have a maximum insertion loss of 0.5 dB and a reflectance of -30 dB.
   3) The 8.3/125-micron singlemode fiber patch cord shall meet or exceed the requirements of ANSI/TIA-568-C.3.
   4) The optical fiber cord connector shall be LC.
   5) The singlemode fiber patch cord assembly shall be dual zip jacketed.
   6) Lengths shall be 1m, 2m, and/or 3m as required by the application.

PART 3 EXECUTION

3.01 COPPER PATCH CORDS

A. Copper patch cords shall be installed as per the requirements specified by the manufacturer's installation guidelines.

3.02 FIBER PATCH CORDS

A. Fiber patch cords shall be installed as per the requirements specified by the manufacturer's installation guidelines.

3.03 IDENTIFICATION

A. Refer to Section 27 0553 - Identification for Communications Systems for labeling details.

END OF SECTION 271619

SECTION 27 4000
AUDIO VISUAL SYSTEMS GENERAL

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. The work required under this section of the specifications consists of the furnishing, installation, and programming of independent audio visual systems for the Telico Ranger Station building. Reference floor plan drawings for audio visual equipment locations. In addition to all audio visual components, the contractor shall be required provide coordination with the data infrastructure systems and cable television systems. Also, the contractor shall coordinate with the electrical contractors for all raceway to support the audio visual systems.

B. The audio visual scope of work will require the contractor to provide a complete, quality operating system which will display, playback, and route computer, video, and audio signals as well as control signals to each noted space of the building. A factory-approved representative shall complete all system connections. A factory approved and factory trained representative of the contractor shall complete all onsite programming of equipment.

1. The contractor shall provide all labor, materials, equipment, and supervision to install specified systems. The installation, testing, and commissioning of all equipment shall be the full responsibility of the audio visual contractor for this project.

1.02 QUALITY CRITERIA AND STANDARDS

A. All audio visual wiring, devices, and equipment shall comply with applicable UL, NEC, and NEMA code standards. All audio visual equipment shall be UL-listed and labeled.

B. Audio visual wiring systems shall conform to established trade and industry standards. The following specifications and standards are incorporated into and become a part of this Specification by reference:

1. AES14-1992 (s2014): – AES Standard for Professional Audio Equipment
2. AES26-2001 (r2011)– AES Recommended Practice for Professional Audio
3. NFPA 70 National Electric Code (Current Adopted Edition)
4. NFPA 70 70 National Electric Code
5. UL 50 Enclosures for Electrical Equipment.

C. All Installer's Qualifications:

1. Firm with at least 3 years of successful application, installation, and testing experience on specified systems and equipment.
2. The Audio Visual Contractor must show proof of being in the audio visual trade for a minimum of three years and provide three (3) references with contact names and telephone numbers regarding successful completion of audio visual projects of similar scope and size.
3. The Audio Visual contractor must be an authorized dealer for all of the equipment specified.
4. All supervisors and installers assigned to the installation of this system or any of its components shall have factory certification from each equipment manufacturer that they are qualified to install and test the provided products. Unqualified staff shall not be used for the installation of the equipment, system cables, and associated hardware.
5. All installers assigned to the installation of this system or any of its components shall have a minimum of 3 years' experience in the installation of the specified audio visual equipment and components.
6. All Audio Visual Contractor staff assigned to this project shall be full-time employees and having been in the employ of the Audio Visual Contractor for at least 12-months. The proposed use of newly hired staff must be disclosed in advance of any work to the Owner/General Contractor and references and certifications submitted for their approval. No more than 25% of the assigned staff for the project and its components can be newly hired.

7. The Audio Visual contractor shall always have a minimum of one CTS certified personnel on site while work is being performed.
8. Audio Visual Contractors are limited in their use of subcontractors to no more than 20% of the assigned staff for the project and its components. In addition, the proposed use of subcontractors must be disclosed in advance of any work to the Owner/General Contractor and references, certifications and insurance submitted for their approval.

1.03 SUBMITTALS:

A. Product Data: Audio Visual contractor shall provide a numbered equipment list of the systems devices he is providing. The list shall include quantity of items, manufactures product number, description of item and audio visual specification that it represents. Submit manufacturer's technical product technical data sheet for each item of systems equipment in order of the numbered equipment list. Submittal shall include drawings that contain complete floor plans and reflected ceiling plans, wiring and schematic diagrams and other details required to demonstrate that the system has been coordinated and will function as a complete system. Drawings shall include vertical riser diagrams, equipment rack details, elevation drawings, connector faceplate details, sizes, and type of all cables and raceway.

B. Shop Drawings: Include drawings that contain complete floor plans and reflected ceiling plans, wiring and schematic diagrams and other details required to demonstrate that the System has been coordinated and will function as a complete system. Drawings shall include vertical riser diagrams, equipment rack details, elevation drawings, connector faceplate details, sizes, and type of all cables and raceway(s). All System(s) single-line diagram(s) are to have wire “Tags” on all connection points that identify the type of signal and/or cabling and a unique identifying number. System single-line drawings that require more than one sheet to properly show System functionality shall have additional wire “Flags”. Wiring Flags shall have the drawing number the signal is going to/from and a unique identifying number. Drawings must be no smaller than Architectural “C” (18-inch x 24-inch) in size and be legible to the naked eye without magnification.

C. Test Plan: Contractor shall submit a test plan that defines the tests required to ensure that the system meets technical, operational, and performance specifications, 45 days prior to the proposed test date. The test plan must be approved before the start of any testing. The test plan shall identify the capabilities and functions to be tested and include detailed instructions for the setup and execution of each test and procedures for evaluation and documentation of the results.

D. Manufacturer Certification: Submit a letter from the manufacturer's representative stating the proposed systems being submitted for review are in accordance with the recommendations of the manufacturer.

1.04 WARRANTY:

A. All equipment shall be new and shall be under warranty for a period of one (1) year, from the date of acceptance by the owner, against defects in equipment or workmanship. Failed equipment shall be replaced by the contractor at no cost to the owner. Owner's personnel may perform initial trouble investigation but replacement of failed equipment and escalated problem support will be handled by the contractor.

B. Audio Visual Contractor shall provide at project closeout a service document that shall clearly detail methods of contact for warranty service including issues categorized as “emergency” with turnaround times for return contact, on-site service and up-and-running time frame. If free loaner equipment is included while equipment is out for service or if there are fees for loaner equipment.

C. Audio Visual Contractor shall also provide details of what constitutes warranty and out of warranty service and a list of rates for out of warranty service.

D. Audio Visual Contractor shall provide the cost of an extended warranty providing the same warranty as the first year for a second year, for years two and three, and years two through five.

E. Audio Visual Contractor standard service response time shall be as follows: 24-hours from time of first contact for a verbal/electronic response, 48-hours to be on-site performing diagnostics and/or repairs.

1.05 ACCEPTABLE MANUFACTURERS – SUBSTITUTIONS

A. Reference Part 2 - Products Section of the specification for complete list of acceptable manufacturers.

B. The chosen Audio Visual Integrator may, and within reason request an equipment substitution by submitting a Substitution Request to the Architect and Audio Visual Consultant within seven (7) days of being awarded the project.

1.06 RECORD DRAWINGS

A. At the time of final inspection, provide three (3) sets of complete data on Audio visual System equipment used in this project. This data shall be in bound form and shall include all shop drawings required for this project.

B. All record drawings shall include "as built" system interconnection diagrams with major components identified and number and type of interconnecting conductors.

C. Maintenance and operating instructions on all systems.

D. Certification from system manufacturers that systems are installed in accordance with manufacturer's recommendations and are functioning correctly at the time of final inspection.

E. As-built drawings to show raceway layout and wiring for all systems.

F. Corrected point-to-point drawings for all systems with color code to show the actual as-built condition.

1.07 CONTROL SYSTEM(S)

A. Audio Visual Contractor is to coordinate with owner their required Control System(s) functionality and Graphic User Interface (GUI) layouts.

B. Audio Visual Contractor is to provide at least one (1) week in advance of System installation details of Control System functionality and complete, sample GUI pages for owner review and comment.

C. Audio Visual Contractor shall make necessary adjustments in functionality and the GUI as directed by owner after their initial review.

D. Audio Visual Contractor shall make appropriate Control System changes as necessary (and within reason) based on owner comments for no additional charge one (1) time after Audio Visual System has been in use for fourteen (14) days.

E. At Project Closeout Audio Visual Contractor is to provide owner with all Control System programming/codes/files in uncompiled format for their use and ownership including all Control System Passwords.

PART 2 PRODUCTS

2.01 RAL MATERIALS REQUIREMENTS:

A. ovide all materials under this section of the specifications. Materials and equipment shall be the manufacturers' latest standard design that has been in satisfactory use for at least 1 year prior to installation. See Part 3 - Execution specification section for additional product requirements.

2.02 Y - FIVE INCH FLAT PANEL DISPLAY

A. e LCD Screen shall be mounted as indicated in contract drawings. Audio Visual contractor to coordinate screen mounting requirements with General Contractor. Audio visual contractor to provide mounting hardware as per manufactures recommendation. Contractors to ensure that wall surface will accommodate Display weight and installation requirements. Display to be rated for commercial use capable of 24/7 operation.

B. at Panel Display specifications of equipment shall include:

1. deo
    1) reen Size: Diagonal length of TV screen 65" class.
    2) tive Resolution: 3840 X 2160 Progressive Scan
    3) namic Contrast Ratio: 1,100:1 minimum.
    4) pect Ratio: 16:9.
    5) n Refresh Rate: 60Hz.
2. dio
    1) riable line level audio output or variable speaker level audio output.
3. puts
    1) MI: Three minimum
    2) B2.0
    3) 232C
4. tputs
    1) dio Output (Mini-Jack): One
5. ntrol
    1) cepts RS-232 control. Control via serial port so that the installation of a remote infrared emitter to the front of the display is not required.
    2) twork Port for Ethernet Control.

C. sis of Design is LG 65UH7F-H, or comparable from NEC or Samsung.
1. cessories shall include:
    1) atic Wall Mount – Chief LSM1U
    2) splay mount must be able to lock from the bottom, tilted away from the wall, for servicing of the monitor, without removing from the wall.

2.03 VIDEO TRANSMITTER

A. dio Visual contractor to provide and install Video Twisted Pair Transmitter where indicated or as required by distance for transmission of audio/video signals between input location and display location. Type of STP cable utilized shall be compatible with receiver and with distance covered.

B. e Video Twisted Pair Transmitter shall meet the following specifications:
1. ximum pixel clock: 600 MHz.
2. solution range: Digital Up to 4K/60 Hz, 1920x1200* or 1080p@ 60 Hz
3. rmats: RGB and YCbCr digital video
4. andards: DVI or Dual Mode DisplayPort via cable adapter, HDMI, HDCP 2.2

C. sis of Design: Crestron DM-TX-4KZ-100-C-1G or approved comparable.

2.04 O VIDEO RECEIVER

A. dio Visual contractor to provide and install Video Twisted Pair Receiver where indicated or as required by distance for transmission of audio/video signals between input location and display location. Type of STP cable utilized shall be compatible with receiver and with distance covered.

B. e Video Twisted Pair Receiver shall meet the following specifications:
1. ximum pixel clock: 600 MHz.
2. solution range: Up to 4K/60 Hz, 1920x1200* or 1080P @ 60 Hz.
3. terconnection: One STP cables between transmitter and receiver.
4. ntrol Signal Pass-through: bidirectional RS-232.

C. sis of Design: Crestron DM-RMC-4KZ-100-C or approved comparable.

2.05 OE+) NETWORK SWITCH

A. e AV (PoE+) Network Switch shall be mounted as indicated in contract drawings.

B. (PoE+) Network shall meet the following specifications:
1. pport 10 GBPS Switching Capacity
2. pport PoE+

3. ort + Uplink - minimum

C. sis of Design: Luxul SW-100-04P or approved comparable.

2.06 BUTTON CONTROLLER – AV – CTL1

A. sh Button Controller shall be a part of a stand-alone media control system.

B. sis of Design: Crestron MPC3-102-B or approved comparable.

2.07 AMERA MIC & SOUNDBAR SPEAKER

A. B Camera Mic & Soundbar speaker shall be a part of a stand-alone media control system.

B. B Camera/Mic/Soundbar connects via USB to Owner Furnished Dedicated PC mounted behind the display for use in web-based conferencing.

C. B Camera/Mic/Soundbar shall include an analog audio connection from the display for program audio playback.

D. sis of Design: Crestron UC-SB1-CAM or approved comparable.

2.08 WARE-BASED KEYBOARD/MOUSE PC CONTROL

A. plication download that allows user to control up to 4 PC's from a single Keyboard & Mouse.

B. pported Operating Systems - Windows 10, Windows Server 2016, Windows 8.1, Windows 8, Windows Server 2012, Windows 7, Windows Server 2008 (32/64 bit). .Net 4.0 & up.

C. wnloaded and installed on each PC in the system.

D. sis of Design: Microsoft Mouse Without Borders

2.09 ETOP CABLE ENCLOSURE

A. e Tabletop Cable Enclosure shall be provided for the spaces indicated in the E AVL drawings and shall operate the in-room control systems as well as provide auxiliary connection access for the systems.

B. bletop Cable Enclosure shall meet the following specifications:

1. neral:
   1) unting: Furniture mount with included hardware.
   2) cessory Plates: various AV, Data, USB Charging and Convenience Power receptacle connector plates or cable retractors.
   3) mensions: Top plate (outer rim): 7.81"W x 4.75"D, Surface cut-out: 3 ¼"D x 7"W

C. sis of Design: Crestron FT2-202-ELEC-B

1. ckage System shall include:
2.) One FlipTop Cable Cubby – FT2-202-ELEC-B
3.) One HDMI Connection Plate
4.) One RJ-45 Female Connection Plate
5.) One USBC & USBA Charging Port Insert
6.) One Dual Outlet Convenience Power Outlets

2.10 DISPLAY BACKBOX

A. Each wall mounted display shall have an in-wall back box installed behind it to house the active electronic equipment. The backbox shall have power and data integrated into it by others. Display backbox shall feature integrated surge protection and a minimum of 4 power outlets. Backboxes shall be centered on display location and shall be installed at the height indicated on the contract drawings.

B. Display Backbox shall meet the following specifications:

1. Power outlets – QTY 4
2. Power output – 15A, 1875W continuous
3. Overall Dimensions (H x W x D) – 15.51" x 15.4" x 3.88"
4. Safety Agency Listings: UL 2416 listed for installation of AV, IT & Communication Technology Equipment

C. Basis of Design: Chief PAC526FWP4 or approved comparable.

2.11 WIRING & CONNECTORS:

A. All system wiring shall be plenum rated where not in conduit.

B. Video Transmission UTP cabling shall be at a minimum of the following requirements:
   1. Shielded Category 6A to meet or exceed the Category 6A transmission characteristics per ANSI/TIA/EA-568-C.
   2. No. of Conductors: Eight insulated conductors
   3. Install Plenum rated cabling in Plenum spaces
   4. Acceptable Manufacturers: Belden, CommScope, Legrand Ortronics, Panduit, TE Connectivity.

C. Control System and General Purpose UTP cabling shall be at a minimum of the following requirements:
   1. Shielded Category 6 to meet or exceed the Category 6 transmission characteristics per ANSI/TIA/EIA-568-C.
   2. No. of Conductors: Eight insulated conductors
   3. Install Plenum rated cabling in Plenum spaces
   4. Acceptable Manufacturers: Belden, CommScope, Legrand Ortronics, Panduit, TE Connectivity.

D. Basic speaker cables shall be single twisted pair shielded cables, minimum of 14 gauge, stranded, tinned copper, aluminum polyester shield, with stranded tinned copper drain wire. Cable shall be UL listed type 246A.

E. For balance of A/V cables and connectors, reference one-line diagram in contract documents and provide appropriate cables and connectors to ensure a fully functional audio visual system.

F. UTP cabling shall be at a minimum of CAT6 requirements or as indicated on drawings.

PART 3 EXECUTION

3.01 INSTALLATION:

A. General: System components and appurtenances shall be installed in accordance with NFPA 70, manufacturer's instructions, and as shown. Necessary interconnections, services, and adjustments required for complete and operable audio visual systems shall be provided. Components shall be labeled in accordance with TIA/EIA 606. Penetrations in fire-rated construction shall be fire-stopped. A/V cables shall not be installed in the same raceway with AC power cables. Cables not installed in conduit or wire ways shall be properly secured and neat in appearance and, if installed in plenums or other spaces used for environmental air, shall comply with NFPA 70 requirements for this type of installation.

B. No “Zip ties” are to be used for cable management. Velcro shall be in lieu of “zip-ties” both in the rack and other areas where cable management is required

C. Equipment Racks and Cabinets
   1. Open frame equipment racks shall be bolted to the floor slab. Cable guides shall be bolted or screwed to racks. Racks shall be installed level.

D. Rack Mounted Equipment
   1. Rack mounted equipment shall be securely fastened to racks by means of the manufacturer's recommended fasteners.

3.02 GROUNDING/BONDING:

A. System should follow the grounding requirements of the National Electrical Code (NEC). Frame of all metal racks should be grounded.

3.03 TESTING AND CHECK-OUT

A. Testing requirements apply to all equipment. Contractor to test each audio visual component as recommended by manufacturer. Test methods and test results shall be submitted to the owner prior to final inspection.

B. Materials and documentation to be furnished under this specification are subject to inspections and tests. All components shall be terminated prior to testing. Equipment and systems will not be accepted until the required inspections and tests have been made, demonstrating that the audio visual systems conform to the specified requirements, and that the required equipment, systems, and documentation have been provided.

3.04 TRAINING:

A. The Contractor shall include in the base Contract all costs required to train owners operating and maintenance personnel in the use and maintenance of systems provided under this section of the Specifications. Training sessions shall be conducted by instructors certified in writing by the manufacturer of the specific system.

B. Sessions shall be conducted for not less than four-hour periods during normal working hours, i.e., Monday through Friday, 8:00 AM to 5:00 PM. Training session schedules shall conform to the requirements of the owner; therefore, such schedules shall be submitted to owner for approval not less than two weeks prior to the training session. All training sessions shall be video-taped for future use. At Owner's discretion, provisions shall be made to allow up to two owner personnel to participate in final system check out of all systems.

C. Video recording shall be of professional quality for both video and audio and must be approved by the Owner/User. Provide two copies to Owner/User. Time to be included in base Contracts for specific systems shall be as follows:

1. Audio Visual Systems- 8 hours

3.05 AS-BUILT DRAWINGS AND/OR DOCUMENTATION:

A. As-built drawings shall be provided noting the exact cable path and cable labeling information. Drawings in .DWG format shall be provided by the contractor. As-builts shall be submitted to the owner on formatted CD’s, saved as .DXF or .DWG files. Redline hardcopies shall be provided as well. CAD generated as-built information shall be shown on a new layer named AS-BUILT.

1. System Acceptance: Before the owner accepts the system, the contractor shall be required to walk-through the installation with the owner's representative and the design engineer to verify proper installation and operation.
2. Contractor to provide control system programming source code (un-compiled) files to the owner at the end of the project as a deliverable.
3. Contractor to provide programming files for any programmable digital audio processors (DSP) in the system to the owner at the end of the project as a deliverable.

END OF SECTION

SECTION 28 3100
INTRUSION DETECTION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A Contract drawings, specifications, and general provisions of the Contract, including General and Supplementary Conditions, apply to this section.

1.02 SUMMARY

A **The electronic security contractor shall provide and install an Intrusion Detection System, herein referred to as the IDS, for the Tellico Ranger Station Complex.** The IDS system will be a standalone system allowing arming, disarming, and bypass functions.

B The IDS shall include a Control Panel with integrated Ethernet communications for event communication and remote service. The control panel shall support integration features with the ACS system to allow arming, disarming, and event triggering.

C Multiple IDS keypads will be installed at locations shown on the drawings for arming and disarming the IDS. The IDS will also monitor the following:

1. Designated sets of perimeter doors for forced & held open status. Designated doors will have a sounder for local alarm. In the event of an approved held open condition, a staff member will enter a code to silence the sounder. The contractor is to coordinate with the owner for the time schedules for the held open alarms.

D The electronic security contractor shall be responsible for all cabling, hardware and miscellaneous equipment required to provide a fully functional commercial Intrusion Detection System

E The electronic security contractor shall coordinate with the owner for each system's requirements for notifying security personnel or proper authorities.

1.03 ACCEPTABLE MANUFACTURERS

A See product section for approved manufactures.

B Alternates shall be submitted at least 10 days prior to bid date. All alternates shall be reviewed and approved by the Designer prior to award. Alternates purchased or installed without approval shall not be accepted.

C Contractor must be a Certified Installer of the access control system manufacturer in order to qualify for the project.

1.04 QUALITY ASSURANCE

A Industry Referenced Standards. The following specifications and standards are incorporated into and become a part of this Specification by reference.

1. National Electrical Code (NEC), edition indicated in the current Tennessee Building Code.
2. Life Safety Code (NFPA 101), edition indicated in the current Tennessee Building Code.
3. Tennessee Building Code, current edition.
4. Electronic Industry Association ANSI/EIA/TIA.
5. National Electrical Manufacturers Association (NEMA).
6. Underwriters Laboratories UL 294, UL 639, and UL 1037, UL 1076.
7. National Fire Protection Association (NFPA).
8. Federal Communications Commission (FCC) 47 CRF Part 15 and 90.
9. Applicable Federal, State and Local Laws, Regulations, and Codes.

B All materials and devices shall be installed according to the Manufacturer's requirements and specifications and shall meet all requirements of state and local codes as well as the Authority having Jurisdiction.

1.05 INSTALLER'S QUALIFICATIONS:

A Firm with at least 3 years of successful application, installation, and testing experience on specified systems and equipment. All supervisors and installers assigned to the installation of this system or any of its components shall have factory certification from each equipment

manufacturer that they are qualified to install and test the provided products. General Electric trade staff shall not be used for the installation of the electronic security system and associated hardware. All installers assigned to the installation of this system or any of its components shall have a minimum of 3 years' experience in the installation of the specified equipment.

B The responsibilities of the contractor shall include but not be limited to the following:
1. Shop drawings for all electronic security equipment.
2. Installation of all new electronic security equipment as documented in the drawings and specifications.
3. Wire and wiring termination for all electronic security equipment.
4. Assisting in the testing and check-out of ACS security equipment.
5. Testing and check out of IDS system.
6. Training for all electronic security equipment.
7. Warranty for all electronic security equipment.
8. As-Built drawings, operations, and maintenance for the complete electronic security.

1.06 SUBMITTALS

A Product Data: Submit manufacturer's technical product data, including specifications and installation instructions, for each type of system equipment. Include drawings that contain complete wiring and schematic diagrams and other details required to demonstrate that the system has been coordinated and will function properly as a system. Drawings shall include floor plan layouts showing device locations, vertical riser diagrams, equipment rack details, elevation drawings of equipment racks, sizes and type of all cables and conduits.

B Test Plan: Contractor shall submit a test plan that defines the tests required to ensure that the system meets technical, operational, and performance specifications, 30 days prior to the proposed test date. The test plan must be approved before the start of any testing. The test plan shall identify the capabilities and functions to be tested and include detailed instructions for the setup and execution of each test and procedures for evaluation and documentation of the results.

C Manufacturer Certification: Submit a letter from the manufacturer's representative stating the proposed systems being submitted for review are in accordance with the recommendations of the manufacturer.

D It is the responsibility of the contractor to meet with the appropriate Owner's representative to compare the placement and installation of proper devices with the drawings and specifications. A 100% device by device test will be conducted by the vendor under the supervision of the Architect / Engineer representative. Punch lists will be developed at that time and furnished to the contractor. All punch list items must be corrected and verified prior to acceptance of the system

1.07 CONTRACT DRAWINGS

A The Contract Drawings indicate the arrangement of the access control system doors and electronic security devices. Coordinate installation of equipment with the structural, mechanical, and electrical equipment and access thereto. Coordinate installation of recessed equipment with concealed ductwork and piping, and wall thickness.

B All raceways required for the electronic security System are not shown on the Contract Drawings.

1.08 RECORD DOCUMENTS

A At the time of final inspection, provide four (4) sets of complete data on the electronic security equipment used in this project. This data shall be in bound, hard copy form and shall include all as-built drawings required for this project. One (1) CD with complete data and drawings must also be provided. This complete data shall include the following.
1. Warranty statement (include warranty start date, service provider contact phone number and address)
2. Letters of certification from system manufacturers
3. Maintenance and operating instructions on all systems
4. As-built drawings for all systems with color code to show the actual as-built conditions.

B All record drawings shall include "as built" system interconnection diagrams with major components identified, along with number and type of interconnecting conductors. Drawings must be submitted as full-size, bound sets as well as electronic files on CD.

C Binders with maintenance and operating instructions on all systems. These binders must incorporate a cover with project name, an index and sections for each major component.

D Certification from system manufacturers that systems are installed in accordance with manufacturer's recommendations and are functioning correctly at the time of final inspection.

E Submit four (4) sets of full size (30” x 42”) of as-built drawings to show wiring for all installed equipment and one (1) electronic copy on CD. Electronic drawings must be AutoCAD “DWG” files.

F As-built drawings must incorporate point-to-point drawings for all systems with color code to show the actual as-built conditions. Copies of the contract document drawings, without modifications showing actual as-built conditions will not be accepted.

G The final payment will not be approved until all the requirements for Record Documents have been satisfied.

1.09 WARRANTY

A The Contractor shall warrant the electronic security system for one year from date of Owner’s Acceptance against defects in equipment or workmanship. Failed equipment shall be replaced by the contractor at no cost to the owner. Owner's personnel may perform initial trouble investigation, but replacement of failed equipment and escalated problem support will be handled by the contractor.

B The warranty period shall not start until the Owner has provided a written Letter of Acceptance. It shall be the Contractor’s responsibility to request and obtain the Letter of Acceptance from the Owner.

C Once the Contractor has obtained a Letter of Acceptance from the Owner, the Contractor must provide a Warranty Letter to the Owner. The Warranty Letter must state the start date of the Warranty, instructions that explain how warranty request are to be made and contact name / phone number for service.

1.10 DESCRIPTION

A The work included under this section of the specifications consists of the installation of a complete IDS system for the Tellico Ranger Station Complex. Provide all labor, equipment, materials, and supervision to install, calibrate, adjust, document, and test the total system as required herein and on the drawings.

B The contractor shall provide all documentation and shall perform all duties involved in obtaining permits and inspections as required to complete the project. All permitting shall be within the associated city or jurisdiction.

C The work shall consist of the installation of a complete electronic security system consisting essentially of, but not limited to, the following major components:
1. Installation of Control Panels, control modules and keypads
2. Field Peripheral Devices (i.e., duress switches, keypads, door position switches, card readers and door sounder hardware, etc.)
3. Power supplies, Batteries & Uninterruptible Power Supplies (UPS)
4. Low Voltage Cable and Raceway
5. Programing and configuration/ integration with ACS

PART 2 - PRODUCTS

1.01 OL PANEL

A he Control panel shall be the main point of programming, monitoring, accessing, securing, and troubleshooting the IDS. Refer to American National Standards Institute (ANSI) CP-01 Control Panel Standard-Features for False Alarm Reduction.

B he Control panel shall utilize a Multifunctional Keypad, Input and Output Modules for expansion of alarm zones, interfacing with additional security subsystems, and programming, monitoring, and controlling the IDS.

C he IDS control panel shall be UL listed for commercial security application and shall, at minimum, support the following features:
1. tional telephone Line Module, programmable for signaling and supervision.
2. tegrated IP based Ethernet communications.
3. pport for multiple programmable areas with perimeter and interior partitioning.
4. nimum 99 on-board hardwired or wireless points with expansion capability.
5. nimum 8 on-board configurable form “C” relay outputs with expansion capability.
6. tegrated battery charger with reverse hook up protection, battery supervision, and battery deep discharge protection.
7. pervision of peripheral devices and communications interfaces.

D he IDS system shall be programmable to provide the following type of response in the system based on point activation, keypad operation, or configurable input:
1. ways on / Instant Alarm
2. when system is Master Armed
3. rimeter Armed (Stay Operation)
4. try Delay
5. arm verification
6. lay/Event activation by Point
7. yswitch arming function
8. stem restore on input.
9. tomatic system restore.
10. nt/Zone bypass

E he IDS shall support scheduling capabilities with the following characteristics:
1. m/ disarm based on schedule
2. pass/ un-bypass zones or points
3. tivate/ De-activate relay
4. nd test reports
5. ogrammable holiday schedules
6. tomatic adjustment of system clock for daylight savings time.

F DS system shall support a minimum of 500 User/Passcodes with custom definable authority levels. Assigned to the User. The system shall be capable of assigning authority levels to each user based on zones/areas as well as Master/Supervisor authority levels system wide. A service passcode shall be assigned to the servicing agent allowing limited access to system functions.

G he IDS system shall be capable of reporting system events and supervisory reports including alarm, trouble, system supervisory, system restore, and test functions to primary and secondary off-site monitoring services. The method of communication shall be in accordance with UL requirements and the requirements of the Authority Having Jurisdiction.

H rimary power shall be a 120VAC power circuit routed directly to the IDS system enclosure or power supply cabinet or located in a secure location within 6ft of the IDS control panel. 120VAC power shall be un-switched circuit, clearly identified in the servicing panel. 120VAC power shall be stepped down to power the IDS panel using a class two transformer rated to continuously power the entire system in full alarm with minimum 10% spare capacity. Transformers shall be fixed in place to prevent tampering. System shall produce a Supervisory alarm signal upon loss of primary power and shall automatically fail over to secondary power without loss of operation.

I econdary Power shall be provided by Sealed Lead Acid (SLA) battery or deep cycle battery directly connected to the systems integrated battery charger. Batteries shall be sized to allow a minimum of 24 hours of operation in stand-by mode and 15 minutes of operation in full alarm. System shall provide automatic battery supervision and testing and shall produce a Supervisory alarm signal upon any battery system failure.

J cceptable manufacturers shall be Bosch, Honeywell, DSC, UTC, or approved alternate.

1.02 SION SYSTEM KEYPADS

A eypads shall be a 2-line, 32-character English language display for complete zone identification and system status.

B he keypad shall be wall mounted.

C eypads shall be by the same manufacturer as the Alarm Control panel and shall be fully compatible with all features of the Intrusion Detection System.

1.03 SOUNDERS

A oor Alarm sounders shall be audible signaling device mounted at 80” AFF. Sounders shall be manufacture utilizing high impact ABS plastic and shall be white in color.

B oor sounders shall provide and audible alert tone between 95 and 105 dB.

C cceptable manufacturers shall be Bosch, Honeywell, DSC, UTC, or approved alternate.

1.04 SIENT VOLTAGE SURGE SUPPRESSION

A rotect all equipment against surges induced on all control and power cables. All copper cables and conductors that serve as 120V power and control conductors shall have surge protection circuits installed at each end and locations where conductors enter or exit a building. Fuses shall not be used for surge protection.

B urge suppression devices shall meet the following standards/publications:
1. UL 497B
2. UL 1449 (must meet 330 Volt suppression rating)
3. IEEE Category B impulse and ring wave tests

C cceptable Manufacturers: Northern Technologies, Inc., EDCO, or Dietek

D ll power connections, including 24 VDC and 24 VAC power supplies and direct wired or plug-in 120 VAC power connections, for all systems and components specified herein, shall be equipped with surge suppression devices. Devices shall be bonded to building grounding system in accordance with Article 250 of the National Electric Code.

E rounding: Provide a dedicated, separate No. 6 AWG copper conductor from true earth ground (grounding rod) to all security equipment rooms, security equipment cabinets, and control rooms. Connect all lightning protection devices and security equipment non-current carrying metal parts to grounding conductor in accordance with Article 250 of the National Electric Code. Provide ground bus bar in each equipment room and control room with dedicated ground conductor to each cabinet, enclosure, pull/junction box and all equipment.

F round Resistance Measurement: Each signal ground system D.C. resistance shall be measured between any point on the signal ground bus and the earth ground. An instrument designed specifically to measure the resistance of a point to each earth ground shall be used. The systems subcontractor shall measure ground resistance in accordance with the procedure as outlined by the test equipment manufacturer.

1.05 WINDOW POSITION SWITCHES

A rovide magnetic door position switch contacts where shown on the contract drawing.

B oor contacts for recessed mounted swing or sliding door locations shall be GRI 180-12 or equal.

C verhead Doors - Overhead door contacts shall be provided with armored cable and be surface mounted. The floor mount units shall be constructed with a low-profile heavy cast aluminum housing. The reed switch assembly shall be fully encased in polyurethane potting material to prevent damage due to moisture or humidity. A wide operation gap distance of up to three inches shall be required to prevent false alarms caused by door movement or damaged and loose fitting doors. Door contacts shall be GRI 200 series or equal.

D urface Mount - Door contacts shall be provided with supervised loop and shall have a flexible armored cable with total encapsulation to protect against moisture. Door contact shall have anodized aluminum finish, with stainless steel flexible cable. Door contacts shall be UL Listed

and be warrantied for two years. Door contact for surface mount swing door locations shall be GRI 4400 series or approved equal.

E ll security hardware inputs shall be provided and configured as 'Normally Closed'.

1.06 ON DETECTORS

A otion detection devices shall operate on the Verified Intrusion principle using Passive Infrared (PIR), and shall be listed by Underwriter's Laboratories, Inc. The device shall incorporate a single red LED to indicate alarm condition.

B he detector shall provide the detection, signal processing, alarm relay, and operating power circuitry in the same enclosure; and shall provide an alarm relay actuation upon the detection of an intruder moving into or through its protection pattern. Each detector shall feature a single piece electronics board whose circuitry is specifically designed for the detector and mounted to a housing with the cover being secured. The case shall include wiring knockouts for installation.

C all mounted Motion Detection devices shall contain a front mounted, dual-purpose lens that shall focus received infrared energy onto the sensor. The lens shall be capable of providing a minimum 35FT detection range.

D eiling mounted Motion Detection devices shall contain a spherical lens capable of providing a 360 degree detection area of up to 50 FT when mounted at 12'-0" above finished floor.

E cceptable manufacturers shall be Bosch, Honeywell, DSC, UTC, Takex, Optex, or approved alternate.

1.07 S BREAK SENSORS

A lass break sensors shall utilize an acoustical sensor with integrated pattern recognition for breaking glass up to ¼ inch thickness for plate, tempered, laminated, or wired glass.

B lass break sensor shall support Omni-directional 360° microphone with selectable sensitivity.

C cceptable manufacturers shall be Bosch, Honeywell, DSC, UTC or approved alternate.

1.08 SS ALARM

A uress alarm devices shall be a supervised, latching device, capable of mounting in both vertical and horizontal position. Wall mount, under desk/counter, etc.) Provide duress alarm hardware where indicated on Contract Drawings.

B uress alarm device shall a mechanical hold-up switch designed for silent operation. It is activated by using one finger to press down on the switch. When activated, the switch mechanism locks, insuring an immediate alarm signal. A status window designed on top of the hold-up switch indicates its condition: RED (alarmed) and BLUE (armed). To reset, use the key provided. The housing shall be metal and painted gray.

C uress button shall be AMSECO Husk-20 Panic Switch or equal.

1.09 ER SYSTEM WIRING

A ntrusion detection connection cable shall be of a type specified by the manufacturer of the security System. Cable must meet minimum NEC requirements for Cl.

B ower wiring for electrified door hardware shall not be smaller than No. 18 THWN or XHHW.

C ll wiring systems shall use stranded copper.

D ll wiring systems shall be color-coded so that each conductor for individual lock set is of a distinctive color. All wiring shall be in accordance with the manufacturers written recommendations. All cabling/wiring shall be submitted in a detailed spreadsheet including cut sheets and samples to the Owner prior to any installation.

E ll conductors within junction boxes, pull boxes, and equipment cabinets shall be grouped and laced with nylon tie straps with identification tab, for individual lock sets.

2.10 DATA NETWORK CABLING REQUIREMENTS

A Data cables shall be 100 Ohm, 0.5mm, un-shielded twisted pair (UTP), 23 AWG, plenum rated with solid copper conductors. Cables shall exceed ANSI/TIA/EIA-568-B.2 Category 6 requirements and the spool shall be labeled as such. Cables shall be tested to 350 MHz. Cables

shall be UL or ETL verified to exceed Category 6 requirements and cable jacket shall be labeled to indicate verification. Cable shall be outside plant, wet location, rated.

B Acceptable manufacturers shall include:
1. Seimon
2. Belden
3. Panduit
4. Leviton

C All data cabling required to be certified to TIA/EIA Category 6 standards with all testing performed with a Level 2 tester.

2.11 TRANSIENT VOLTAGE SURGE SUPPRESSION

A Protect all equipment against surges induced on all exterior control, video, and power cables. All copper cables and conductors which serve as 120V power, control, or video conductors shall have surge protection circuits installed at each end and locations where conductors enter or exit a building. Fuses shall not be used for surge protection.

A urge suppression devices shall meet the following standards/publications:
1. UL 497B
2. UL 1449 (must meet 330 Volt suppression rating)
3. IEEE Category B impulse and ring wave tests

B cceptable Manufacturers: Northern Technologies, Inc., EDCO. Product shall be warranted against defect for a period of not less than five (5) years.

C ll power connections, including 24 VDC and 24 VAC power supplies and direct wired or plug-in 120 VAC power connections, for all systems and components specified herein, shall be equipped with surge suppression devices. Devices shall be bonded to building grounding system in accordance with Article 250 of the National Electric Code.

D rounding: Provide a dedicated, separate No. 6 AWG copper conductor from building grounding system to all security equipment rooms, security equipment cabinets, and control rooms. Connect all lightning protection devices and security equipment non-current carrying metal parts to grounding conductor in accordance with Article 250 of the National Electric Code. Provide ground bus bar in each equipment room and control room with dedicated ground conductor to each cabinet, enclosure, pull/junction box and all equipment.

E round Resistance Measurement: Each signal ground system D.C. resistance shall be measured between any point on the signal ground bus and the earth ground. An instrument designed specifically to measure the resistance of a point to each earth ground shall be used. The systems subcontractor shall measure ground resistance in accordance with the procedure as outlined by the test equipment manufacturer. Instrument shall be Biddle earth resistance test instrument, or approved equal.

2.12 D.C. POWER SUPPLY PANEL

A. Provide low voltage power supply units associated with Local Interface Units and Door Control Panels and as required to provide both 12 and 24 volt regulated, filtered D.C. power for locking controls, D.C. locks and signal devices. Output power shall be both 12 and 24 volt D.C. with ampere rating not less than 150% of load imposed on power supply under most severe conditions of load. D.C. output shall be fused. Output voltage shall be regulated within plus or minus 5% from no load to full load. Power supply shall be UL listed. The power supply also shall have the ability to individually select fire alarm disconnect for any of the supplied outputs.

B. Power supplies shall be provided with battery back-up sized for 30 minutes of operation. Contractor to submit battery load calculations in order to confirm 30 minutes of continuous operation.

C. Power supplies shall be connected to the county security network via network interface module. Module will facilitate status monitoring of power status, output current draw, temperature, output voltage and battery status. The module shall have the capability to notify personnel via e-mail should any issues arise with the given power supply.

D. Contractor shall provide the following for each panel:
   1. All cables shall be labeled at each termination.
   2. As-built drawings shall be left inside panel.
   3. Wire molding shall be installed throughout each panel for cable routing.
   4. Panel locks shall be re-keyed per owner requirements.
   5. Enclosure tamper switches must be installed for all enclosures and monitored as an individual alarm point.
   6. Power supplies shall be the LifeSafety Power MClass Unified Power System.

2.13 VIDEO AND COMMUNICATION SYSTEM:

A Basis of design for IP Video Door Station is 2N telecommunication. www.2nusa.com
Model: IP Verso

B Basis of design for IP Video Master Station is Grandstream. www.grandstream.com
Model: GXV3380

2.14 IP AUDIO VIDEO MASTER STATION

A The IP Master Station shall be a desk mounted Smart Video Phone utilizing a native Android operating system and integrated video camera to offer an all-in-one communications solution.

B Master Station shall be a completely functional IP Video Phone capable of providing full telephony features utilizing SIP communications protocol with or without a SIP PBX solution.

C Master station shall support a minimum of 8 SIP accounts without PBX.

D Minimum telephony features shall include: hold, transfer, forward, call park, call pickup, call waiting, auto-answer, and audio conferencing,

E Integrated 10/100/1000 Gigabit auto-sensing Ethernet.

F The IP Master Station shall support 3-way video conference utilizing video resolution of up to 1080p/15fps.

G Integrated camera shall be an integrated 2MP CMOS sensor capable of 1080p/30fps streaming video.

H Master station shall include optional handset for audio communications.

I IP Master Station shall support additional peripheral connection including:
   1. HDMI Video Output
   2. USB
   3. Micro SD storage
   4. Aux headphone jack

J Basis of design shall be Grandstream GXV3380

2.15 IP VIDEO DOOR STATION:

A The IP Video Door Station shall be a weather and vandal resistant network attached appliance with integrated video camera and high quality two-way audio communications utilizing industry IP phone integration and SIP support.

B Door station shall incorporate the features of a remote entry control device including the following:
   1. One-touch button activation.
   2. Automatic dialing/answering
   3. Full duplex audio
   4. Streaming Video Camera capable of 640x480 resolution.
   5. Integrated 10/100 auto-sensing Ethernet.
      a) Integrated relay output with remote activation.
      b) Optional RFID card reader support. (125kHz HID Prox)
   6. Door Station shall be provided with all manufacturer recommended hardware for installation including back box, mounting brackets, enclosures, name plates, extending modules, etc. as required to meet installation requirements.
   7. Basis of design shall be 2N IP Verso.

2.16 IP VIDEO APPLICATION

A

B The IP Video Intercom System shall have an available PC Client application compatible with IP Door Stations and IP Master Stations to allow monitoring of Streaming video and allow remote door control.

C IP Video Application shall be available for the following operating systems:
1. Windows 7, Windows 8, or Windows 10 Standard
2. OS X 10.3 or later

D Application software shall support automatic answering and automatic display of incoming calls.

PART 3 - EXECUTION

3.01 WIRING SYSTEMS

A Protect all communication and data equipment against surge induced on all control, sensor and data cables. All cables and conductors which serve as control, sensor, or data conductors shall have surge protection circuits installed at each end that meet the IEEE 472 surge withstand capability test and the electrical transient tests established in UL365. Fuses shall not be used for surge protection.

3.02 TESTING

A Testing requirements apply to all new construction.

B Materials and documentation to be furnished under this specification are subject to inspections and tests. All components shall be terminated prior to testing. Equipment and systems will not be accepted until the required inspections and tests have been made, demonstrating that the access control system conforms to the specified requirements, and that the required equipment, systems, and documentation have been provided.

3.03 TRAINING

A The Contractor shall include in the base Contract all costs required to train Owner designated operating and maintenance personnel in the use and maintenance of systems provided under this section of the Specifications. Training sessions shall be conducted by instructors certified in writing by the manufacturer of the specific system.

B Sessions shall be conducted for not more than four hour periods during normal working hours, i.e., Monday through Friday, 8:00 AM to 5:00 PM. Training session schedules shall conform to the requirements of the Owner; therefore such schedules shall be submitted to the Owner for approval not less than two weeks prior to the training session. All training sessions shall be video-taped and saved to digital disk as well as the server hard drive for future reference.

C Time to be included in base Contracts for the Intrusion Detection System shall be 4 hours.

END OF SECTION

SECTION 31 1000
SITE CLEARING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

A. Clearing and protection of vegetation.

B. Stripping and stockpiling topsoil.

C. Removing above- and below-grade site improvements.

D. Disconnecting, capping or sealing, and removing site utilities.

E. Retain subparagraph below if erosion and sedimentation control are not included in Section 015000 "Temporary Facilities and Controls."

F. Temporary erosion and sedimentation control.

1.03 RELATED REQUIREMENTS

A. Section 01 1000 - Summary: Limitations on Contractor's use of site and premises.

B. Section 01 5000 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.

C. Section 01 5713 - Temporary Erosion and Sediment Control.

D. Section 01 7000 - Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products.

E. Section 01 7419 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.

F. Section 31 2200 - Grading: Topsoil removal.

G. Section 31 2200 - Grading: Fill material for filling holes, pits, and excavations generated as a result of removal operations.

1.04 DEFINITIONS

A. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.

B. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil," but in disturbed areas such as urban environments, the surface soil can be subsoil.

C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow.

D. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow. Its appearance is generally friable,
   1. 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 larger than 2 inches (50 mm) in diameter; and free of weeds, roots, toxic materials, or other non-soil materials.

E. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction and indicated on Drawings.

F. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and indicated on Drawings.

G. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.05 PRE-INSTALLATION MEETINGS

A. Pre-installation Conference: Conduct conference at Project site.

1.06 MATERIAL OWNERSHIP

A. Except for materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.07 SUBMITTALS

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

B. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.
   1. Use sufficiently detailed photographs or video recordings.
   2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plant designated to remain.

C. Topsoil stripping and stockpiling program.

D. Rock stockpiling program.

E. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.08 QUALITY ASSURANCE

A. Topsoil Stripping and Stockpiling Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work. Include dimensioned diagrams for placement and protection of stockpiles.

B. Rock Stockpiling Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work. Include dimensioned diagrams for placement and protection of stockpiles.

1.09 FIELD 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 trafficways if required by Owner or authorities having jurisdiction.

B. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.

C. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.

D. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.

E. Soil Stripping, Handling, and Stockpiling: Perform only when the soil is dry or slightly moist.

PART 2 PRODUCTS

2.01 MATERIALS

A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 312000 "Earth Moving."
   1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

B. Antirust Coating: Fast-curing, lead- and chromate-free, self-curing, universal modified-alkyd primer complying with MPI #23 (surface-tolerant, anticorrosive metal primer) or SSPC-Paint 20 or SSPC-Paint 29 zinc-rich coating.

C. Fill Material: As specified in Section 31 2323 - Fill

PART 3 EXECUTION

3.01 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Protect existing site improvements to remain from damage during construction.
   1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.02 SITE CLEARING

A. Comply with other requirements specified in Section 01 7000.

B. Minimize production of dust due to clearing operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

3.03 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, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.

B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

D. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.

3.04 EXISTING UTILITIES AND BUILT ELEMENTS

A. Owner will arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing, when requested by Contractor.
   1. Verify that utilities have been disconnected and capped before proceeding with site clearing.

B. Locate, identify, disconnect, and seal or cap 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.

C. Locate, identify, and disconnect utilities indicated to be abandoned in place.

D. Interrupting 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:

E. Notify Architect and Owner not less than 2 days in advance of proposed utility interruptions.
   1. Do not proceed with utility interruptions without Owner and Architect’s written permission.

F. Excavate for and remove underground utilities indicated to be removed.

G. Protect existing structures and other elements that are not to be removed.

3.05 VEGETATION

A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.

B. Protect trees and plants remaining on-site according to Drawings

C. Do not remove or damage vegetation beyond the limits indicated on drawings.

D. In areas where vegetation must be removed but no construction will occur other than pervious paving, remove vegetation with minimum disturbance of the subsoil.

E. Vegetation Removed: Do not burn, bury, landfill, or leave on site, except as indicated.

1. Existing Stumps: Treat as specified for other vegetation removed; remove stumps and roots larger than 2 inches (50 mm) in diameter to depth of 18 inches.
2. Fill holes left by removal of stumps and roots, using suitable fill material, with top surface neat in appearance and smooth enough not to constitute a hazard to pedestrians.
   a. Place fill material in horizontal layers not exceeding a loose depth of 8 inches (200 mm), and compact each layer to a density equal to adjacent original ground.
3. Use only hand methods or air spade for grubbing within protection zones.
4. Chip removed tree branches and stockpile in areas approved by Landscape Architect.

F. Restoration: If vegetation outside removal limits or within specified protective fences is damaged or destroyed due to subsequent construction operations, replace at no cost to Owner.

3.06 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to depth of 6 inches (150 mm) in a manner to prevent intermingling with underlying subsoil or other waste materials.
   1. Remove subsoil and non-soil materials from topsoil, including clay lumps, gravel, and other objects larger than 2 inches (50 mm) in diameter; trash, debris, weeds, roots, and other waste materials.

C. Stockpile topsoil away from edge of excavations without intermixing with subsoil or other materials. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.
   1. Limit height of topsoil stockpiles to 72 inches (1800 mm).
   2. Do not stockpile topsoil within protection zones.
   3. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.
   4. Stockpile surplus topsoil to allow for respreading deeper topsoil.

3.07 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and 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 along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
   2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

3.08 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

B. All burning of tree, shrub, and other vegetation waste is prohibited.

C. Separate recyclable materials produced during site clearing from other non-recyclable materials. Store or stockpile without intermixing with other materials, and transport them to recycling facilities. Do not interfere with other Project work.

D. Leave site in clean condition, ready for subsequent work.

E. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

SECTION 31 2200
GRADING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Removal of topsoil.

B. Rough grading the site for site structures.

C. Finish grading.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete.

B. Section 31 1000 - Site Clearing.

C. Section 31 2316 - Excavation.

D. Section 31 2316.13 - Trenching: Trenching and backfilling for utilities.

E. Section 31 2323 - Fill: Filling and compaction.

F. Section 32 9223 - Sodding.

1.03 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: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Aggregate layer 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 Engineer. Authorized additional excavation and replacement material will be paid for according to Contract provisions.
   2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 1 cu. yd. for bulk excavation or 1/2 cu. yd. for footing, trench, and pit excavation that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:
   1. Trench Excavation: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch-wide, maximum, short-tip-radius rock bucket; rated at not less than 138-hp
      a. flywheel power with bucket-curling force of not less than 28,700 lbf and stick-crowd force of not less than 18,400 lbf with extra-long reach boom; measured according to SAE
      b. J-1179.
   2. Open Excavation: Late-model, track-mounted bulldozer equipped with a single-tooth ripper shank; rated at not less than 230-hp flywheel power and developing a minimum of 56,000-lbf breakout force; measured according to SAE J-732.

3. Blasting is not to be employed for rock removal in this project without written permission of the County.

I. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material 1/2 cu. yd. or more in volume that exceed a standard penetration resistance of 100 blows/2 inches when tested by a geotechnical testing agency, according to ASTM D 1586.

J. 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.

K. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

L. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

M. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.04 SUBMITTALS

A. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

B. Submittals are required for Borrow Soil.

1.05 QUALITY ASSURANCE

A. A. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.

PART 2 PRODUCTS

2.01 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Soil Classification Groups CL, ML, SC, SW, SP, SP-SM, SP-SC and SM according to ASTM D 2487, or a combination of these groups; free of rock or gravel larger than 4 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: Soil Classification Group OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.

1. Unsatisfactory soils materials consist of soil materials not capable of being compacted to density specified; rock material, as defined in this Section, larger than three inches (3”), debris and organic material including muck, which is a wet organic material that cannot support a light crawler tractor type of equipment and requires removal by power shovels or draglines; or material otherwise identified and designated as unsuitable by the Geotechnical Engineer.
2. Soil material which is too wet to permit the specified compaction but is still suitable to be used in a structural capacity (once dried) based on the recommendations of the Geotechnical Engineer, shall be spread as permitted to dry in an area to be designated by the Landscape Architect/Engineer. Contractor shall assist drying by discing, harrowing or pulverizing until the soil moisture content is reduced to the specified value.
3. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a
4. 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.
5. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a
6. 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.

7. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a
8. 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.
9. 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.
10. Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.
11. 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.
12. Sand: ASTM C 33; fine aggregate.
13. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.02 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility; 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.

B. 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

3.01 EXAMINATION

A. Verify that survey bench mark and intended elevations for the Work are as indicated.

B. Verify the absence of standing or ponding water.

3.02 PREPARATION

A. Identify required lines, levels, contours, and datum.

B. Stake and flag locations of known utilities.

C. Locate, identify, and protect from damage above- and below-grade utilities to remain.

D. Provide temporary means and methods to remove all standing or ponding water from areas prior to grading.

E. Protect site features to remain, including but not limited to bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs, from damage by settlement, lateral movement, undermining, washout, and other hazards created by grading equipment and vehicular traffic.

F. Protect and maintain erosion and sedimentation controls during earth moving operations.

G. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.03 ROUGH 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. Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations.
   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. Remove topsoil from areas to be further excavated, re-landscaped, or re-graded, without mixing with foreign materials.

C. Do not remove topsoil when wet.

D. Remove subsoil from areas to be further excavated, re-landscaped, or re-graded.

E. Do not remove wet subsoil, unless it is subsequently processed to obtain optimum moisture content.

F. When excavating through roots, perform work by hand and cut roots with sharp axe.

G. Stability: Replace damaged or displaced subsoil to same requirements as for specified fill.

H. Remove and replace soils deemed unsuitable by classification and which are excessively moist due to lack surface water control.

I. SOIL REMOVAL AND STOCKPILING
   1. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
      a. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.
      b. Store in area as designated by the Owner’s representative on site or remove off site at Owner’s direction.

3.04 FINISH GRADING

A. Before Finish Grading:
   1. Verify building and trench backfilling have been inspected.
   2. Verify subgrade has been contoured and compacted.

B. Remove debris, roots, branches, stones, in excess of 1/2 inch in size. Remove soil contaminated with petroleum products.

C. In areas where vehicles or equipment have compacted soil, scarify surface to depth of 3 inches.

D. Fine grade topsoil to eliminate uneven areas and low spots. Maintain profiles and contour of subgrade.

E. Maintain stability of topsoil during inclement weather. Replace topsoil in areas where surface water has eroded thickness below specifications.

3.05 TOLERANCES

A. Top Surface of Subgrade:
   1. Turf or Unpaved Areas: Plus or minus 1 inch.
   2. Walks: Plus or minus 1 inch.
   3. Pavements: Plus or minus 1/2 inch.

B. Top Surface of Finish Grade: Plus or minus 1/2 inch when tested with a 10-foot straightedge.

3.06 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. 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.
   1. Scarify or remove and replace soil material to depth as directed by Engineer; reshape and recompact.

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.

3.07 REPAIR AND RESTORATION

A. Existing Facilities, Utilities, and Site Features to Remain: If damaged due to this work, repair or replace to original condition.

B. Trees to Remain: If damaged due to this work, trim broken branches and repair bark wounds; if root damage has occurred, obtain instructions from Landscape Architect as to remedy.

C. Other Existing Vegetation to Remain: If damaged due to this work, replace with vegetation of equivalent species and size.

3.08 FIELD QUALITY CONTROL

A. See Section 31 2323 for compaction density testing.

3.09 3.10 CLEANING

A. Leave site clean and raked, ready to receive landscaping.

B. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

C. Stockpile or spread soil as directed by Engineer/Owner’s representative, if applicable/requested.
   1. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION

SECTION 31 2316
EXCAVATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Excavating for building volume below grade, footings, pile caps, slabs-on-grade, paving, site structures, and utilities within the building.

1.02 RELATED REQUIREMENTS

A. Section 31 1000 - Site Clearing.

B. Section 31 2200 - Grading.

C. Section 31 2316.13 - Trenching: Trenching and backfilling for utilities.

D. Section 31 2323 - Fill: Filling and compaction.

1.03 QUALITY ASSURANCE

A. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.

1.04 PROJECT CONDITIONS

A. Verify that survey bench mark and intended elevations for the Work are as indicated.

B. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving 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 Owner or authorities having jurisdiction.

C. Utility Locator Service: Notify "Call Before You Dig" for area where Project is located before beginning earth moving operations or qualified utility locator service for “private”/Owner utilities.

D. The following practices are prohibited within protection zones:
   1. Storage of construction materials, debris, or excavated material.
   2. Parking vehicles or equipment.
   3. Foot traffic.
   4. Erection of sheds or structures.
   5. Impoundment of water.
   6. Excavation or other digging unless otherwise indicated.
   7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

E. Do not direct vehicle or equipment exhaust towards protection zones.

F. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

PART 2 PRODUCTS

2.01 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility; 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.

B. 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

3.01 EXAMINATION

A. Verify that survey bench mark and intended elevations for the work are as indicated.

3.02 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.

3.03 EXCAVATING, 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 unsatisfactory soil materials and rock, replace with satisfactory soil 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, and the greater of 24 inches wider than pipe or 42 inches wide.

3.04 EXCAVATING FOR STRUCTURES

A. Excavations at Edges of Tree- and Plant-Protection Zones:
   1. Excavate by hand to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.

3.05 EXCAVATING FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.06 SUBGRADE INSPECTION

A. Notify Engineer when excavations have reached required subgrade.

B. If Engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Proof-roll subgrade below the building slabs and pavements with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 20 tons to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Engineer, and replace with compacted backfill or fill as directed.

D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Engineer, without additional compensation.

3.07 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 Engineer.
   1. Fill unauthorized excavations under other construction, pipe

3.08 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
   1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.
   2. Store in area as designated by the Owner's representative on site or remove off site at Owner's direction.

3.09 PROTECTION

A. Divert surface flow from rains or water discharges from the excavation.

B. Prevent displacement of banks and keep loose soil from falling into excavation; maintain soil stability.

C. Protect open excavations from rainfall, runoff, freezing groundwater, or excessive drying so as to maintain foundation subgrade in satisfactory, undisturbed condition.

D. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.

E. Keep excavations free of standing water and completely free of water during concrete placement.

END OF SECTION

SECTION 31 2316.13
TRENCHING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Excavating and backfilling trenches for utilities and pits for buried utility structures.

1.02 RELATED REQUIREMENTS

A. Section 31 2200 - Grading: Site grading.

B. Section 31 2316 - Excavation: Building and foundation excavating.

C. Section 31 2323 - Fill: Backfilling at building and foundations.

1.03 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: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Aggregate layer 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 Engineer. Authorized additional excavation and replacement material will be paid for according to Contract provisions.
   2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 1 cu. yd. for bulk excavation or 1/2 cu. yd. for footing, trench, and pit excavation that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:
   1. Trench Excavation: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch-wide, maximum, short-tip-radius rock bucket; rated at not less than 138-hp flywheel power with bucket-curling force of not less than 28,700 lbf and stick-crowd force of not less than 18,400 lbf with extra-long reach boom; measured according to SAE J-1179.
   2. Open Excavation: Late-model, track-mounted bulldozer equipped with a single-tooth ripper shank; rated at not less than 230-hp flywheel power and developing a minimum of 56,000-lbf breakout force; measured according to SAE J-732.
   3. Blasting is not to be employed for rock removal in this project without written permission of the County.

I. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material 1/2 cu. yd. or more in volume that exceed a standard penetration resistance of 100 blows/2 inches when tested by a geotechnical testing agency, according to ASTM D 1586.

J. 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.

K. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

L. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

M. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.04 REFERENCE STANDARDS

A. AASHTO T 180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18 in.) Drop; 2015.

B. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)); 2012.

C. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN m/m3)); 2012.

1.05 SUBMITTALS

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

B. Submittals are required for Borrow Soil.

1.06 QUALITY ASSURANCE

A. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.

1.07 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving 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 Owner or authorities having jurisdiction.

B. Utility Locator Service: Notify "Call Before You Dig" for area where Project is located before beginning earth moving operations or qualified utility locator service for “private”/Owner utilities.

C. The following practices are prohibited within protection zones:
   1. Storage of construction materials, debris, or excavated material.
   2. Parking vehicles or equipment.
   3. Foot traffic.
   4. Erection of sheds or structures.
   5. Impoundment of water.
   6. Excavation or other digging unless otherwise indicated.
   7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

D. Do not direct vehicle or equipment exhaust towards protection zones.

E. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

PART 2 PRODUCTS

2.01 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Soil Classification Groups CL, ML, SC, SW, SP, SP-SM, SP-SC and SM according to ASTM D 2487, or a combination of these groups; free of rock or gravel larger than 4 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: Soil Classification Group OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.
   1. Unsatisfactory soils materials consist of soil materials not capable of being compacted to density specified; rock material, as defined in this Section, larger than three inches (3”), debris and organic material including muck, which is a wet organic material that cannot support a light crawler tractor type of equipment and requires removal by power shovels or draglines; or material otherwise identified and designated as unsuitable by the Geotechnical Engineer.
   2. Soil material which is too wet to permit the specified compaction but is still suitable to be used in a structural capacity (once dried) based on the recommendations of the Geotechnical Engineer, shall be spread as permitted to dry in an area to be designated by the Landscape Architect/Engineer. Contractor shall assist drying by discing, harrowing or pulverizing until the soil moisture content is reduced to the specified value.

D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.

F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

G. 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.

H. Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.

I. 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.

J. Sand: ASTM C 33; fine aggregate.

K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.02 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility; 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.

B. 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

3.01 EXAMINATION

A. Verify that survey bench marks and intended elevations for the work are as indicated.

3.02 PREPARATION

A. Identify required lines, levels, contours, and datum locations.

B. See Section 31 2200 for additional requirements.

C. Grade top perimeter of trenching area to prevent surface water from draining into trench. Provide temporary means and methods, as required, to maintain surface water diversion until no longer needed, or as directed by the Landscape Architect.

3.03 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.

3.04 TRENCHING

A. Provide temporary means and methods, as required, to remove all water from trenching until directed by the Landscape Architect. Remove and replace soils deemed unsuitable by classification and which are excessively moist due to lack of dewatering or surface water control.

B. Determine the prevailing groundwater level prior to trenching. If the proposed trench extends less than 1 foot into the prevailing groundwater, control groundwater intrusion with perimeter drains routed to sump pumps, or as directed by the Landscape Architect.

C. 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.

D. 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.
   1. Clearance: 12 inches each side of pipe or conduit.

E. 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.
   1. For pipes and conduit less than 6 inches in nominal diameter, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
   2. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe or conduit circumference. Fill depressions with tamped sand backfill.
   3. For flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support conduit on an undisturbed subgrade.
   4. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

F. Trench Bottoms: Excavate trenches 4 inches deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.
   1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

G. Trenches in Tree- and Plant-Protection Zones:
   1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
   2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.
   3. Cut and protect roots.

3.05 PREPARATION FOR UTILITY PLACEMENT

A. Cut out soft areas of subgrade not capable of compaction in place. Backfill with general fill.

B. Compact subgrade to density equal to or greater than requirements for subsequent fill material.

C. Until ready to backfill, maintain excavations and prevent loose soil from falling into excavation.

3.06 BACKFILLING

A. Place and compact backfill in excavations promptly, but not before completing the following:
   1. Construction below finish grade including, where applicable, subdrainage, 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.

3.07 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. 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.
   1. Scarify or remove and replace soil material to depth as directed by Engineer; reshape and recompact.

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.

3.08 CLEANING

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

B. Stockpile or spread soil as directed by Engineer/Owner’s representative, if applicable/requested.
   1. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION

SECTION 31 2323
FILL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Filling, backfilling, and compacting for building volume below grade and paving.

B. Backfilling and compacting for utilities outside the building to utility main connections.

C. Filling holes, pits, and excavations generated as a result of removal (demolition) operations.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete.

B. Section 31 2200 - Grading: Site grading.

C. Section 31 2316 - Excavation: Removal and handling of soil to be re-used.

D. Section 31 2316.13 - Trenching: Trenching and backfilling for utilities.

E. Section 32 9223 - Sodding.

1.03 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: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Aggregate layer 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 Engineer. Authorized additional excavation and replacement material will be paid for according to Contract provisions.
   2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 1 cu. yd. for bulk excavation or 1/2 cu. yd. for footing, trench, and pit excavation that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:
   1. Trench Excavation: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch-wide, maximum, short-tip-radius rock bucket; rated at not less than 138-hp flywheel power with bucket-curling force of not less than 28,700 lbf and stick-crowd force of not less than 18,400 lbf with extra-long reach boom; measured according to SAE J-1179.
   2. Open Excavation: Late-model, track-mounted bulldozer equipped with a single-tooth ripper shank; rated at not less than 230-hp flywheel power and developing a minimum of
      a. 56,000-lbf breakout force; measured according to SAE J-732.
   3. Blasting is not to be employed for rock removal in this project without written permission of the County.

I. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material 1/2 cu. yd. or more in volume that exceed a standard penetration resistance of 100 blows/2 inches when tested by a geotechnical testing agency, according to ASTM D 1586.

J. 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.

K. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

L. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

M. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.04 REFERENCE STANDARDS

A. AASHTO T 180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18 in.) Drop; 2015.

B. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)); 2012.

C. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN m/m3)); 2012.

1.05 SUBMITTALS

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

B. Submittals are required for Borrow Soil.

C. Compaction Density Test Reports.

1.06 QUALITY ASSURANCE

A. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.

1.07 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving 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 Owner or authorities having jurisdiction.

B. Utility Locator Service: Notify "Call Before You Dig" for area where Project is located before beginning earth moving operations or qualified utility locator service for “private”/Owner utilities.

C. The following practices are prohibited within protection zones:
   1. Storage of construction materials, debris, or excavated material.
   2. Parking vehicles or equipment.
   3. Foot traffic.
   4. Erection of sheds or structures.
   5. Impoundment of water.
   6. Excavation or other digging unless otherwise indicated.
   7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

D. Do not direct vehicle or equipment exhaust towards protection zones.

E. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

PART 2 PRODUCTS

2.01 FILL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Soil Classification Groups CL, ML, SC, SW, SP, SP-SM, SP-SC and SM according to ASTM D 2487, or a combination of these groups; free of rock or gravel larger than 4 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: Soil Classification Group OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.
   1. Unsatisfactory soils materials consist of soil materials not capable of being compacted to density specified; rock material, as defined in this Section, larger than three inches (3”), debris and organic material including muck, which is a wet organic material that cannot support a light crawler tractor type of equipment and requires removal by power shovels or draglines; or material otherwise identified and designated as unsuitable by the Geotechnical Engineer.
   2. Soil material which is too wet to permit the specified compaction but is still suitable to be used in a structural capacity (once dried) based on the recommendations of the Geotechnical Engineer, shall be spread as permitted to dry in an area to be designated by the Landscape Architect/Engineer. Contractor shall assist drying by discing, harrowing or pulverizing until the soil moisture content is reduced to the specified value.

D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.

F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

G. 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.

H. Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.

I. 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.

J. Sand: ASTM C 33; fine aggregate.

K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.02 GEOTEXTILES

A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications by Mirfi, US Fabrics or equal, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following minimum specifications:
   1. Survivability: Class 2; AASHTO M 288.
   2. Grab Tensile Strength: 120 lbf ASTM D 4632.
   3. Sewn Seam Strength: 142 lbf ASTM D 4632.
   4. Tear Strength: 56 lbf ASTM D 4533.
   5. Puncture Strength: 56 lbf ASTM D 4833.

6. Apparent Opening Size: No. 60 sieve, maximum; ASTM D 4751.
7. Permittivity: 0.2 per second, minimum; ASTM D 4491.
8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
1. Survivability: Class 2; AASHTO M 288.
2. Grab Tensile Strength: 247 lbf ASTM D 4632.
3. Sewn Seam Strength: 222 lbf ASTM D 4632.
4. Tear Strength: 90 lbf ASTM D 4533.
5. Puncture Strength: 90 lbf ASTM D 4833.
6. Apparent Opening Size: No. 60 sieve, maximum; ASTM D 4751.
7. Permittivity: 0.02 per second, minimum; ASTM D 4491.
8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

2.03 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility; 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.

B. 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

3.01 EXAMINATION

A. Identify required lines, levels, contours, and datum locations.

B. See Section 31 2200 for additional requirements.

C. Verify areas to be filled are not compromised with surface or ground water.

3.02 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.

B. Protect and maintain erosion and sedimentation controls during earth moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.03 STORAGE OF SOIL MATERIALS

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

2. Store in area as designated by the Owner's representative on site or remove off site at Owner's direction.

3.04 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:
   1. Construction below finish grade including, where applicable, subdrainage, 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.

3.05 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 satisfactory soil material.
   2. Under walks and pavements, use satisfactory soil material.
   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.

3.06 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 3 percent of optimum moisture content.
   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.

3.07 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

B. 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 12 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 turf or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 95 percent.
   4. For utility trenches, compact each layer of initial and final backfill soil material at 95 percent.

3.08 FILL AT SPECIFIC LOCATIONS

A. Subbase and Base Courses under Pavements and Walks
   1. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.

2. On prepared subgrade, place subbase course and base course under pavements and walks as follows:
    a. Install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
    b. Place base course material over subbase course under hot-mix asphalt pavement.
    c. Shape subbase course and base course to required crown elevations and cross-slope grades.
    d. Place subbase course and base course 6 inches or less in compacted thickness in a single layer.
    e. Place subbase course and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
    f. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

B. Drainage Course under Concrete Slabs-On-Grade
1. Place drainage course on subgrades free of mud, frost, snow, or ice.
2. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:
    a. Install subdrainage geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
    b. Place drainage course 6 inches or less in compacted thickness in a single layer.
    c. Place drainage course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
    d. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.09 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. 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.
1. Scarify or remove and replace soil material to depth as directed by Engineer; reshape and recompact.

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.

3.10 CLEANING

A. See Section 01 7419 - Construction Waste Management and Disposal, for additional requirements.

B. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

C. Stockpile or spread soil as directed by Engineer/Owner’s representative, if applicable/requested.
1. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION

SECTION 32 1123
AGGREGATE BASE COURSES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This section includes providing all materials, labor and equipment necessary for the complete installation of all graded aggregate base course material on a prepared sub- grade. Installation shall be in close conformity with the lines, grades, thickness and typical cross-sections shown on the plans.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03 1000: Earthwork

B. Section 03 3000: Cast-in-Place Concrete

C. Section 32 1216: Asphalt Paving

1.03 REFERENCE DOCUMENTS

A. Construct graded aggregate base course in accordance with the materials, workmanship, and other applicable requirements of the following referenced standard:
   1. Tennessee Department of Transportation "Standard Specifications for Construction of Roads and Bridges", Current edition.

1.04 SUBMITTALS

A. Submittals shall be made in accordance with the requirements of Section 01 3000 - Submittals. In addition, the following specific information shall be provided:
   1. Material Certificates:
   2. For each material, submit manufacturer’s certification of compliance with requirements of the contract documents.

1.05 QUALITY ASSURANCE

A. General:
   1. Work in this section shall be performed in the presence of the Owner's Representative.

B. Testing and Inspection:
   1. Perform testing and inspection in accordance with requirements of the referenced standard.

1.06 SITE CONDITIONS

A. Environmental Requirements:
   1. Comply with environmental requirements specified in the referenced standard for each type of construction and paving material.

PART 2 PRODUCTS

2.01 GENERAL

A. Provide materials as required for graded aggregate base, subbase or shoulder course material.

B. Graded Aggregate Base shall be uniform quality throughout the material retained on the No. 10 sieve shall be composed of Class A or B aggregate.

C. #57 Stone - 100% passing 1 1/2" screen, 95-100% passing 1" screen, 25-60% passing 1/2" screen, 0-10% passing #4 screen, and 0-5% passing #8 screen.

D. All materials shall be in accordance with the referenced standards.

PART 3 EXECUTION

3.01 GENERAL

A. Comply with cross sections, elevations, and grades indicated on the drawings.

B. Examine, prepare, and install base in accordance with the contract documents and with applicable provisions of the referenced standard.

3.02 EXAMINATION

A. Verification of Subbase Conditions:
   1. Verify that subgrade is dry and in suitable condition to support paving and imposed loads.
   2. Notify Owner's Representative in writing of any unsatisfactory conditions. Do not begin installation until these conditions have been satisfactorily corrected.

3.03 PREPARATION

A. The subgrade or subbase shall be prepared in accordance with the referenced standards.

B. No graded aggregate materials shall be placed on a muddy or frozen subgrade or subbase.

3.04 INSTALLATION

A. The material shall be spread uniformly with a mixture spreader to the proper depth to obtain the specified thickness.

B. Graded aggregate materials containing frost or frozen particles shall not be placed.

C. The maximum thickness to be laid in one course shall be 6 inches compacted. If the design thickness of the base subbase or shoulder course is more than 6 inches, it shall be constructed in two or more courses of approximately equal thickness.

D. No graded aggregate shall be shipped to the project when the moisture content of the material exceeds 2 percent of optimum moisture.

E. After the material has been placed, shaped to line, grade, and cross section, it shall be rolled until the course has been uniformly compacted to at least 100 percent of the maximum dry density, when Group 2 aggregate is used, or to at least 98 percent of maximum dry density when Group 1 aggregate is used.

F. The compacted base shall have sufficient stability to support construction equipment without pumping regardless of compaction.

G. If the base material becomes unstable as a result of too much moisture, the base material and the underlying subgrade, if necessary, shall be dried and reworked to a moisture content that will provide stability and compaction.

H. Compaction: The maximum dry density shall be determined from representative samples of the material to be compacted by AASHTO: T180, Method D. Determination of the in- place density shall be made in accordance with GDT: 20 or GDT: 59.

I. The finished surface shall be checked transversely with a template or by a system of ordinates measured from a string line, or with a surveyor level. It shall also be checked with a 15-foot straightedge placed parallel to the lines and grades shown on the drawings. Ordinates measured from the bottom of the template, string line or straightedge to the surface shall not exceed 0.25 inches at any point, nor shall the rod readings deviate more than 0.02 feet from the required readings.

END OF SECTION

SECTION 32 1216
ASPHALT PAVING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Cold milling of existing hot-mix asphalt pavement.

B. Hot-mix asphalt patching.

C. Hot-mix asphalt paving.

D. Hot-mix asphalt paving overlay.

E. Asphalt surface treatments.

F. Pavement-marking paint.

1.02 RELATED REQUIREMENTS

A. Section 32 1123 - Aggregate Base Courses (for aggregate subbase and base courses and for aggregate pavement shoulders.)

1.03 PREINSTALLATION MEETINGS

A. Preinstallation conference: Conduct conference at the Project site to review procedure.

1.04 SUBMITTALS

A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.
   1. Job-Mix Formulas and Designs: For each job mix proposed for the work.

B. Shop Drawings: Indicate pavement markings, lane separations, and defined parking spaces. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.

C. Material Certificates: For each paving material, from manufacturer.

D. Material Test Reports: For each paving material.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by authorities having jurisdiction or the Tennessee DOT.

B. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of Tennessee DOT for asphalt paving work

1.06 DELIVERY, STORAGE, AND HANDLING

A. 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.

B. Store pavement-marking materials in a clean, dry, protected location within temperature range required by manufacturer. Protect stored materials from direct sunlight.

1.07 FIELD CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:
   1. Prime Coat: Minimum surface temperature of 60 deg F.
   2. Tack Coat: Minimum surface temperature of 60 deg F.
   3. Slurry Coat: Comply with weather limitations in ASTM D 3910.
   4. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
   5. 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, 55 deg F for water-based materials, and not exceeding 95 deg F.

PART 2 PRODUCTS

2.01 MATERIALS

A. Aggregates
   1. General: Use materials and gradations that have performed satisfactorily in previous installations.
   2. Coarse Aggregate: ASTM D 692, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.
   3. Fine Aggregate: ASTM D 1073, sharp-edged natural sand or sand prepared from stone, gravel, cured blast-furnace slag, or combinations thereof.
   4. Mineral Filler: ASTM D 242, rock or slag dust, hydraulic cement, or other inert material.
   5. Asphalt Materials
      a. Asphalt Binder: Comply with Tennessee DOT Standard specifications.
      b. Asphalt Cement: ASTM D 3381 for viscosity-graded material.
      c. Prime Coat: Asphalt emulsion prime coat complying with Tennessee DOT requirements.
      d. Tack Coat: Comply with Tennessee DOT Standard specifications.
   6. Auxiliary Materials
      a. Recycled Materials for Hot-Mix Asphalt Mixes: Reclaimed asphalt pavement; reclaimed, unbound-aggregate base material; and recycled tires asphalt shingles or glass from sources and gradations that have performed satisfactorily in previous installations, equal to performance of required hot-mix asphalt paving produced from all new materials.
      b. Herbicide: Commercial chemical for weed control, registered by the EPA, and not classified as "restricted use" for locations and conditions of application. Provide in granular, liquid, or wettable powder form.
      c. Sand: ASTM D 1073, Grade Nos. 2 or 3.
      d. Paving Geotextile: AASHTO M 288, nonwoven polypropylene; resistant to chemical attack, rot, and mildew; and specifically designed for paving applications.
      e. Joint Sealant: ASTM D 6690, hot-applied, single-component, polymer-modified bituminous sealant.
      f. Thermoplastic: All stop bars shall be thermoplastic. All pavement markings shall meet the requirements of Section 6.5.4 of the County Development Regulations.
      g. Pavement-Marking Paint: Alkyd-resin type, lead and chromate free, ready mixed, complying with AASHTO M 248, Type N; colors complying with FS TT-P-1952. All pavement markings shall meet the requirements of MUTCD.
         1) Color: White, Yellow, Blue (HC).
         2) Two (2) coats of paint to be applied.
      h. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952, Type II, with drying time of less than three minutes. All pavement markings shall meet the requirements of MUTCD.
         1) Color: White, Yellow, Blue (HC).
         2) Two (2) coats of paint to be applied.
      i. Glass Beads: AASHTO M 247, Type 1.
      j. Wheel Stops: Wheel stops to be placed at locations indicated on the contract drawings.

2.02 ASPHALT PAVING MIXES AND MIX DESIGN

A. Hot-Mix Asphalt: Dense-graded, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction and complying with the following requirements:
   1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that compacted subgrade is dry and ready to support paving and imposed loads.

B. Verify gradients and elevations of base are correct.

C. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
   1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
   2. Proof roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
   3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.
   4. Proceed with paving only after unsatisfactory conditions have been corrected.
   5. Verify that utilities, traffic loop detectors, and other items requiring a cut and installation beneath the asphalt surface have been completed and that asphalt surface has been repaired flush with adjacent asphalt prior to beginning installation of imprinted asphalt.

3.02 COLD MILLING

A. Clean existing pavement surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement by cold milling to grades and cross sections indicated.
   1. Mill to a depth of 1-1/2 inches or variable depth as required for the site conditions.
   2. Mill to a uniform finished surface free of excessive gouges, grooves, and ridges.
   3. Control rate of milling to prevent tearing of existing asphalt course.
   4. Repair or replace curbs, manholes, and other construction damaged during cold milling.
   5. Excavate and trim unbound-aggregate base course, if encountered, and keep material separate from milled hot-mix asphalt.
   6. Transport milled hot-mix asphalt to asphalt recycling facility.
   7. Keep milled pavement surface free of loose material and dust.

3.03 PATCHING

A. Hot-Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.

B. Tack Coat: Before placing patch material, apply tack coat uniformly to vertical asphalt surfaces abutting the patch. Apply at a rate in accordance with Tennessee DOT Standard Specifications.
   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.

C. Patching: Fill excavated pavements with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.

3.04 REPAIRS

A. Leveling Course: Install and compact leveling course consisting of hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch in existing pavements.
   1. Install leveling wedges in compacted lifts not exceeding 3 inches thick.

B. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth of 1/4 inch.
   1. Clean cracks and joints in existing hot-mix asphalt pavement.
   2. Use emulsified-asphalt slurry to seal cracks and joints less than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.

3. Use hot-applied joint sealant to seal cracks and joints more than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.

3.05 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.

B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of

C. compacted-aggregate base before applying paving materials.
   1. Mix herbicide with prime coat if formulated by manufacturer for that purpose.

D. Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.15 to 0.50 gal./sq. yd. Apply enough material to penetrate and seal but not flood surface. Allow prime coat to cure.
   1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
   2. Protect primed substrate from damage until ready to receive paving.

E. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate in accordance with Tennessee DOT Standard Specifications.
   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.

3.06 HOT-MIX ASPHALT PLACING

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to 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 number of lifts and thicknesses indicated.
   2. Place hot-mix asphalt surface course in single lift.
   3. Spread mix at minimum temperature of 250 deg F.
   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.

3.07 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 at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."

5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.08 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 with

B. vibratory-plate compactors in areas inaccessible to rollers.
   1. Complete compaction before mix temperature cools to 185 deg F.

C. 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.

D. 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 ASTM D 6927, but not less than 92 percent nor greater than 100 percent.

E. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

F. 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.

G. 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.

H. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

I. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.09 TOLERANCES

A. Pavement 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.
   3. ATTENTION: Total thickness shall be within 3/8” of the thickness specified based on testing provided by the Geotechnical Engineer. Failure to meet this requirement is cause for rejection.

B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straight edge 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.

C. Traffic-Calming Devices: Compact and form asphalt to produce the contour indicated and within a tolerance of plus or minus 1/8 inch of height indicated above pavement surface.

3.10 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 beads uniformly into wet pavement markings at a rate of 6 lb./gal.

3.11 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.

C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

D. Traffic-Calming Devices: Finished height of asphalt speed bumps above pavement will be measured for compliance with tolerances.

E. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D 979.
   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. Replace and compact hot-mix asphalt where core tests were taken.

G. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.12 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 milled materials to accumulate on-site.

END OF SECTION

SECTION 32 1440
STONE PAVING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Paver materials.

B. Mortar materials.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Pavement subbase.

B. Section 04 0100 - Maintenance of Masonry.

C. Section 04 0511 - Mortar and Masonry Grout.

D. Section 31 2200 - Grading: Preparation of subsoil for pavers.

E. Section 31 2200 - Grading: Pavement substrate.

F. Section 31 2323 - Fill: Compacted fill for pavers.

1.03 PRICE AND PAYMENT PROCEDURES

A. See Section 01 2200 - Unit Prices, for additional unit price requirements.

1.04 REFERENCE STANDARDS

A. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2011.

B. ASTM C150/C150M - Standard Specification for Portland Cement; 2016.

1.05 SUBMITTALS

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

B. Product Data: Provide characteristics of paver unit, dimensions, special shapes, and setting materials.

C. Shop Drawings: Indicate layout of pavers, dimensions of paved areas, elevations, and affected adjacent construction.

D. Samples: Submit two samples of each paver size, illustrating style, size, color range and surface texture of units being provided.

E. Maintenance Materials: Provide the following for Owner's use in project maintenance.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Pavers: 30 of each type and size.

1.06 MOCK-UP

A. Provide paver mock-up, 4 feet long by 4 feet wide; include setting bed, pavers, joints, and edging.

B. Locate where directed.

1.07 FIELD CONDITIONS

A. Maintain cementitious materials and substrate surface to a minimum of 50 degrees F prior to, during, and 48 hours after completion of work.

PART 2 PRODUCTS

2.01 PAVER MATERIALS

A. Flagstone Pavers: Irregular cut stone units; size varies, 1-inch minumum to 2-inch maximum thickness; irregular shape, finish and color to match existing flagstone on site

B. Mortar: 1/2-inch joints, staggered. Type S. Color to match existing on site.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate is level, smooth, capable of supporting pavers and imposed loads, and ready to receive work of this section.

B. Verify gradients and elevations of substrate are correct.

3.02 CLEANING

A. The contractor shall clean the jobsite of excess materials.

3.03 PROTECTION

A. Do not permit traffic over unprotected paver surface.

B. Protect paver surface with sheets of plywood.

END OF SECTION

SECTION 32 1500
AGGREGATE SURFACING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. River Rock.

B. #57 Stone.

1.02 RELATED REQUIREMENTS

A. Section 31 2200 - Grading: Preparation of subbase.

B. Section 32 1123 - Aggregate Base Courses.

1.03 REFERENCE STANDARDS

A. ASTM C136/C136M - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates; 2019.

1.04 SUBMITTALS

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

B. Certificates: Certify that products of this section meet or exceed specified requirements.

1.05 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 6000 - Product Requirements for additional requirements.

PART 2 PRODUCTS

2.01 MATERIALS

A. River Rock - Smooth, natural aggregate that has a blended color palette of browns, grays, and neutral tones.
   1. Size 1" to 2".

B. #57 Stone - 100% passing 1 1/2" screen, 95-100% passing 1" screen, 25-60% passing 1/2" screen, 0-10% passing #4 screen, and 0-5% passing #8 screen.

C. Aggregate Base Course: See Section 32 1123.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that subgrade has been prepared correctly, is smooth, and is at proper grade and level.

B. Do not begin work until subgrade is correct.

3.02 CLEANING

A. See Section 01 7419 - Construction Waste Management and Disposal for additional requirements.

B. Remove unused or stockpiled fill, base, and reinforcement.

C. Clean adjacent surfaces of excess sand, gravel, soil, and debris. Sweep broom clean.

END OF SECTION

SECTION 32 3119
DECORATIVE METAL FENCES AND GATES

PART 1 - GENERAL

1.01 WORK INCLUDED

A. The contractor shall provide all labor, materials and appurtenances necessary for installation of the welded ornamental steel fence system defined herein.

1.02 SYSTEM DESCRIPTION

A. The manufacturer shall supply a total fence system of Montage® standard picket space Welded and Rackable (ATF – All Terrain Flexibility) Ornamental Steel, Majestic™ design. The system shall include all components (i.e., panels, posts, gates and hardware) required.
   1. Or equal approved by Architect.

1.03 QUALITY ASSURANCE

A. The contractor shall provide laborers and supervisors who are thoroughly familiar with the type of construction involved and materials and techniques specified.

1.04 REFERENCES

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.

B. ASTM B117 - Practice for Operating Salt-Spray (Fog) Apparatus.

C. ASTM D523 - Test Method for Specular Gloss.

D. ASTM D714 - Test Method for Evaluating Degree of Blistering in Paint.

E. ASTM D822 - Practice for Conducting Tests on Paint and Related Coatings and Materials using Filtered Open-Flame Carbon-Arc Light and Water Exposure Apparatus.

F. ASTM D1654 - Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.

G. ASTM D2244 - Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.

H. ASTM D2794 - Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).

I. ASTM D3359 - Test Method for Measuring Adhesion by Tape Test.

J. ASTM F2408 – Ornamental Fences Employing Galvanized Steel Tubular Pickets.

1.05 COORDINATION

A. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.06 SUBMITTAL

A. The manufacturer’s literature shall be submitted prior to installation.

1.07 PRODUCT HANDLING AND STORAGE

A. Upon receipt at the job site, all materials shall be checked to ensure that no damage occurred during shipping or handling. Materials shall be stored in such a manner to ensure proper ventilation and drainage, and to protect against damage, weather, vandalism and theft.

1.08 PRODUCT WARRANTY

A. All structural fence components (i.e. rails, pickets, and posts) shall be warranted within specified limitations, by the manufacturer as stated in the Montage product warranty. Warranty shall cover any defects in material finish, including cracking, peeling, chipping, blistering or corroding.

B. Reimbursement for labor necessary to restore or replace components that have been found to be defective under the terms of manufactures warranty shall be guaranteed for five (5) years from date of original purchase.

PART 2 - MATERIALS

2.01 MANUFACTURER

A. The fence system shall conform to Montage® standard picket space Welded and Rackable (ATF – All Terrain Flexibility) Ornamental Steel, Majestic™ design, flush bottom rail treatment, 3-Rail style manufactured by Ameristar Perimeter Security USA Inc., in Tulsa, Oklahoma.
   1. Or equal approved by Architect.

2.02 MATERIAL

A. Steel material for fence panels and posts shall conform to the requirements of ASTM A653/A653M, with a minimum yield strength of 45,000 psi (310 MPa) and a minimum zinc (hot-dip galvanized) coating weight of 0.60 oz/ft2 (184 g/m2), Coating Designation G-60.

B. Material for pickets shall be 5/8” square x 18 Ga. tubing. The rails shall be steel channel, 1.25” x 0.92” x 14 Ga. Picket holes in the rail shall be spaced 4.334” o.c. Fence posts shall be a minimum of 2” square x 16 Ga.

2.03 FABRICATION

A. Pickets, rails and posts shall be pre-cut to specified lengths. Rails shall be pre-punched to accept pickets.

B. Pickets shall be inserted into the pre-punched holes in the rails and shall be aligned to standard spacing using a specially calibrated alignment fixture. The aligned pickets and rails shall be joined at each picket-to-rail intersection by Ameristar’s proprietary fusion welding process, thus completing the rigid panel assembly (Note: The process produces a virtually seamless, spatter-free good-neighbor appearance, equally attractive from either side of the panel).

C. The manufactured panels and posts shall be subjected to an inline electrode position coating (E-Coat) process consisting of a multi-stage pretreatment/wash, followed by a duplex application of an epoxy primer and an acrylic topcoat. The minimum cumulative coating thickness of epoxy and acrylic shall be 2 mils (0.058 mm). The color shall be Black. The coated panels and posts shall be capable of meeting the performance requirements for each quality characteristic shown in Table 1 (Note: The requirements in Table 1 meet or exceed the coating performance criteria of ASTM F2408).

D. The manufactured fence system shall be capable of meeting the vertical load, horizontal load, and infill performance requirements for Residential weight fences under ASTM F2408.

PART 3 - EXECUTION

3.01 PREPARATION

A. All new installation shall be laid out by the contractor in accordance with the construction plans.

3.02 FENCE INSTALLATION

A. Fence post shall be spaced according to Table 2, plus or minus ½”. For installations that must be raked to follow sloping grades, the post spacing dimension must be measured along the grade. Fence panels shall be attached to posts with brackets supplied by the manufacturer.

3.03 FENCE INSTALLATION MAINTENANCE

A. When cutting/drilling rails or posts adhere to the following steps to seal the exposed steel surfaces; 1) Remove all metal shavings from cut area. 2) Apply zinc-rich primer to thoroughly cover cut edge and/or drilled hole; let dry. 3) Apply 2 coats of custom finish paint matching fence color. Failure to seal exposed surfaces per steps 1-3 above will negate warranty. Ameristar spray cans or paint pens shall be used to prime and finish exposed surfaces; it is recommended that paint pens be used to prevent overspray. Use of non-Ameristar parts or components will negate the manufactures’ warranty.

3.04 CLEANING

A. The contractor shall clean the jobsite of excess materials.

3.05 TABLE 1 – COATING PERFORMANCE REQUIREMENTS

Quality Characteristics	ASTM Test Method	Performance Requirements
Adhesion	D3359 – Method B	Adhesion (Retention of Coating) over 90% of test area (Tape and knife test).
Corrosion Resistance	B117, D714 & D1654	Corrosion Resistance over 1,000 hours (Scribed per D1654; failure mode is accumulation of 1/8" coating loss from scribe or medium #8 blisters).
Impact Resistance	D2794	Impact Resistance over 60 inch lb. (Forward impact using 0.625" ball).
Weathering Resistance	D822, D2244, D523 (60° Method)	Weathering Resistance over 1,000 hours (Failure mode is 60% loss of gloss or color variance of more than 3 delta-E color units).

3.06 TABLE 2 – MONTAGE - POST SPACING BY BRACKET TYPE

Span	For CLASSIC, GENESIS, MAJESTIC, WARRIOR, CRESCENT, GEMINI 8' Nominal (94" Rail) or equal approved by Architect.			
Post Size	2"	2"	2"	2"
Bracket Type	Montage Universal (BB102)	Montage Line Boulevard (BB104)	Montage Flat Mount (BB105)	Montage Swivel (BB106)
Post Settings ± ½" O.C.	96-3/4"	96-3/4"	96-3/4"	96-3/4"

A. Note: When using BB106 swivel brackets on either or both ends of a panel installation, care must be taken to ensure the spacing between post and adjoining pickets meets applicable codes. This will require trimming one or both ends of the panel.

END OF SECTION

SECTION 32 3129
WOOD FENCE AND GATES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Construction of wood fences and gates.

1.02 QUALITY ASSURANCE

A. The contractor shall provide laborers and supervisors who are thoroughly familiar with the type of construction involved and materials and techniques specified.

1.03 REFERENCES

A. ASTM A 123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

B. ASTM A 500, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

C. ASTM F 1043, Standard Specification for Strength and Protective Coatings on Steel Industrial Chain Link Fence Framework

D. ASTM F 1083, Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures

1.04 SUBMITTALS

A. Shop drawings: Layout of fences and gates with dimensions, details, and finishes of components, accessories and post foundations

B. Product data: Manufacturer’s catalog cuts indicating material compliance and specified options

1.05 PRODUCT HANDLING AND STORAGE

A. Upon receipt at the job site, all materials shall be checked to ensure that no damage occurred during shipping or handling. Materials shall be stored in such a manner to ensure proper ventilation and drainage, and to protect against damage, weather, vandalism and theft.

1.06 WARRANTY

A. Reimbursement for labor necessary to restore or replace components that have been found to be defective shall be guaranteed for five (5) years from date of original purchase.

PART 2 - PRODUCTS

2.01 MATERIALS

A. General
   1. Gate hinges and hardware shall be of steel, painted black.
   2. All wood shall be pressure treated pine, fully kiln dried, painted white.
   3. All hardware to be stainless steel unless otherwise noted.
   4. All hardware to be countersunk, centered on boards, and aligned vertically/horizontally.

B. Horizontal Infill: 2-inch x 6-inch pressure treated pine
   1. Free from all major decay or defects which would weaken or otherwise cause them to be unsuitable for fence slats.

C. Corner, Gate, End, or Line Posts: 6-inch x 6-inch pressure treated pine
   1. Free from all decay, splits, multiple cracks, or any other defect which would weaken the posts or otherwise cause them to be structurally unsuitable for the purpose intended
   2. Setting Materials
      a. Concrete
         1) Minimum 28 day compressive strength of 3,000 psi
         2) Bagged concrete allowed.

D. Vertical Fascia: 1-inch x 6-inch pressure treated pine

1. Free from all major decay or defects which would weaken or otherwise cause them to be unsuitable for vertical fascia.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verification of Conditions
   1. Verify areas to receive fencing are completed to final grades and elevations.
   2. Ensure property lines and legal boundaries of work are clearly established.

3.02 INSTALLATION

A. Wood Fence Framing
   1. Locate terminal post at each fence termination and change in horizontal or vertical direction of 30 degrees or more.
   2. Space line posts uniformly at 8 feet on center, maximum.
   3. Set all posts in concrete.
      a. Drill holes in firm, undisturbed or compacted soil.
      b. Drill hole diameter 4 times greater than outside dimension of post (minimum 12 inches).
      c. Set post bottom 24 inches below surface when in firm, undisturbed soil.
      d. Excavate deeper as required for adequate support in soft and loose soils, and for posts with heavy lateral loads.
      e. Place concrete around posts in a continuous pour.
      f. Trowel finish around post. Slope to direct water away from posts.
   4. Check each post for vertical and top alignment and maintain in position during placement and finishing operations.

B. Horizontal Infill
   1. Place bottom slat approximately 2-1/2 inches above the ground, and on a straight grade between posts.
   2. Fasten slats to posts with 2 screws designed for wood fence construction at both ends.
   3. Additional slats to be vertically evenly spaced with a 1-inch gap between boards.
   4. Additional slats to be aligned horizontally and butted end-to end.

C. Vertical Fascia
   1. Align vertical fascia with posts and conceal ends of horizontal infill.
   2. Fasten with 2 screws designed for wood fence construction at both ends.

3.03 CLEANING

A. The contractor shall clean the jobsite of excess materials.

END OF SECTION

SECTION 32 3300
SITE FURNISHINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Eye Wash Station

B. Pesticide Building

C. Fuel Tank

D. Secondary Containment Vessel

E. Spill Kit

F. Waste Can

1.02 SUBMITTALS

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

B. Product Data: Provide manufacturer's specifications and descriptive literature, installation instructions, and maintenance information.

PART 2 PRODUCTS

2.01 EYE WASH STATION

A. Freeze-Resistant Eyewash Station
   1. EWFR-16* – Pedestal mounted, freeze resistant eyewash with stainless steel bowl, Schedule 40 galvanized pipe and fittings, powder-coated cast aluminum flag handle and floor flange, and ¾” IPS freeze resistant stay-open bury valve with push plates (36” standard bury depth) and a 1/8” NPT bleed outlet. Unit shall have (2) polypropylene GS-Plus™ spray heads with integral “flip-top” dust covers, filters and 1.6 GPM flow control orifices mounted on a chrome-plated brass eyewash assembly. Unit shall include ANSI compliant sign.
   2. Unit shall be hydrostatically tested to meet or exceed ANSI Z358.1 – 2014, and come with a full 2-year warranty.
   3. Products:
      a. Guardian Equipment; GFR1825: www.gesafety.com or equal approved by Architect.
      b. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PESTICIDE BUILDING

A. Chemical Storage Locker
   1. Shape: Rectangular
   2. Depth: 8 feet.
   3. Width: 14 feet.
   4. Height: 8 feet 4 inches.
   5. Mounting: Surface mounted per manufacture'rs recommendations.
   6. Materials:
      a. Exterior Walls: 12 gauge galvannealed steel.
      b. Interior Walls: 20-gauge galvannealed steel (3" air space between walls)
      c. Chemical/corrosive/ultraviolet resistant paint
   7. Insulation: R-11 fiberglass insulation in ceiling and walls
   8. Door: One 60 inch wide x 80 inch high door with UL classified commercial grade keyed lockset and reflective warning tape marking entryway.
   9. Shelving: 3 teirs steel shelving with raised edges
   10. Flooring: Removable galvanized steel safety floor planking
   11. Sump: 12-guage steel liquid tight, continuously welded
   12. Lighting:
      a. Interior: Dust Proof/Fluorescent Interior Light with Weatherproof Switch.
      b. Exterior: Moisture Resistant Exterior Light with Photocell.

13. Forklift Channel: 12 guage galvanized steel
14. Labeling: Moisture Resistant Exterior Light with Photocell
15. Venting: Natural convection vents
16. Products:
    a. Securall; AG2400: www.securallproducts.com or equal approved by Architect.
        1) OP-100A Load Center: 12 Space100A Main Breaker NEMA 3R
        2) OP-BLDG PARTS: Non-Explosion Proof Fan-Forced Heater
        3) OP0015-32: Sump Liner for 32 Drum Kit
        4) OP-EXTENSION BRACKET: Extension Bracket for Shelving
        5) OP0023: Grounding Kit
        6) OP002810 LB TANK: 10 lb. Refillable Portable Fire Extinguisher
        7) OP0041-IC: Adjustable Vents with Insulated Cover
        8) BR60 - Ramp 24 inches x 72 inches
    b. Substitutions: See Section 01 6000 - Product Requirements.

2.03 FUEL TANK

A. 300 Gallon 12 Gauge Double Wall UL142 Skid Tank and Accompanying Accessories
1. Capacity: 300 gallons
2. Shape: Cylindrical
3. Diameter: 39 inches.
4. Length: 60 inches.
5. Mounting: Freestanding.
6. Materials:
    a. 12-guage steel, double wall construction
7. Products:
    a. JME Tanks; NENB00300DWS03812G: www.jmesales.com or equal approved by Architect.
        1) 3/4" Pump; TUFR604
        2) Nozzle; MCN7UOBF:
        3) Hose; AGYFARM075X_MXM
        4) Filter; ACIM34G
        5) Meter; A807KIT
        6) Kit; ANT30038DWVENTGAS
            (a) Female Threaded Fill Cap; TCALF2
            (b) Direct Reading Guage; KSD238
            (c) Type K Leak Guage; KSK236
            (d) Male Threaded Emergency Vents (QTY. 2); MO244OM0050AV
            (e) Pressure Vaccum Vent; MO7490100AV
            (f) Spill Containter; M05170100AC
    b. Substitutions: See Section 01 6000 - Product Requirements.

2.04 SECONDARY CONTAINMENT VESSEL

A. Containment Sump
1. Capacity: 605 Gallons
2. Shape: Rectangular
3. Length: 90 inches.
4. Width: 61 inches.
5. Height: 32.75 iches.
6. Mounting: Freestanding.
7. Materials:100% Polyethylene.
    a. 100% polyethylene.
8. Drainage: 0.75 inch drain fitting.
9. Prodcuts:
    a. UltraTech International; UT2820: www.jmesales.com or equal approved by Architect.
    b. Substitutions: See Section 01 6000 - Product Requirements.

2.05 SPILL KIT

A. Oil-Only Spill Kit
   1. Capacity: 6.5 gallon bucket with 3.7 gallons of absorbency
   2. Shape: Cylindrical
   3. Diameter: 13.375 inches.
   4. Height: 17.625 inches.
   5. Mounting: Install with mounting bracket as indicated in Drawings. See Products.
   6. Materials: Polyethelene bucket with gasketed screw-on lid. UV resistant.
   7. Products:
      a. Spill Kit: New Pig; KIT631: www.newpig.com or equal approved by Architect.
      b. Mounting Bracket: New Pig; bkt1213: www.newpig.com or equal approved by Architect.
      c. Substitutions: See Section 01 6000 - Product Requirements.

2.06 WASTE CAN

A. Oily Waste Can
   1. Capacity: 14 gallons.
   2. Shape: Round.
   3. Diameter: 16.17 inches.
   4. Height: 20.25 inches.
   5. Mounting: Freestanding.
   6. Materials:
      a. Galvanized steel
      b. Factory powder coated red finish.
   7. Operating Machanism: Foot-operated, self-closing lid.
   8. Products:
      a. Justrite; 09500: www.justrite.com or equal approved by Architect.
      b. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify proper installation of mounting surfaces, preinstalled anchor bolts, and other mounting devices; and ready to receive site furnishing items.

B. Do not begin installation until unacceptable conditions are corrected.

3.02 INSTALLATION

A. Install site furnishings in accordance with approved shop drawings, and manufacturer's installation instructions.

B. Unless otherwise indicated, install site furnishings after landscaping and paving have been completed.

C. Install site furnishings level, plumb, true, and securely anchored at locations indicated on Drawings.

END OF SECTION

SECTION 32 9223
SODDING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

A. Fertilizing.

B. Sod installation.

C. Maintenance.

1.03 RELATED REQUIREMENTS

A. Section 32 9300 - Plants: for trees, shrubs, ground covers, and other plants as well as border edgings and mow strips.

1.04 DEFINITIONS

A. Weeds: Includes Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.

B. Finish Grade: Elevation of finished surface of planting soil.

C. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

D. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

E. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

F. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.05 PRE-INSTALLATION MEETINGS

A. Pre-installation Conference: Conduct conference at Project site.

1.06 SUBMITTALS

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

B. Qualification Data: For landscape Installer.
   1. Certification of each seed mixture for turfgrass sod. Include identification of source and name and telephone number of supplier.

C. Product Certificates: For fertilizers, from manufacturer.

D. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

1.07 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful turf establishment.
   1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
   2. Experience: Three years' experience in turf installation in addition to requirements in Section 014000 "Quality Requirements."

3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
4. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the Professional Landcare Network:
   a. Landscape Industry Certified Technician - Exterior.
   b. Landscape Industry Certified Lawncare Manager.
   c. Landscape Industry Certified Lawncare Technician.
5. Pesticide Applicator: State licensed, commercial.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" sections in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod within 24 hours of harvesting and in time for planting promptly. Protect sod from breakage and drying.

B. Bulk Materials:
   1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
   2. Accompany each delivery of bulk materials with appropriate certificates.

1.09 FIELD CONDITIONS

A. Planting Restrictions: General planting, in areas receiving irrigation, shall be installed under favorable weather conditions preferably November 1st to April 15th. General planting, in non-irrigated areas shall take place November 1st through March 1st, under favorable weather conditions. Planting small reforestation trees in non-irrigated areas shall take place between November 15th and January 15th. The contract may be adjusted, if necessary, to meet the proper planting time frame, at no additional cost to the Owner.

B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

PART 2 PRODUCTS

2.01 TURFGRASS SOD

A. Turfgrass Sod: Certified, complying with "Specifications for Turfgrass Sod Materials" in TPI's "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture that is strongly rooted and capable of vigorous growth and development when planted.

B. Turfgrass Species: contractor to match existing on site.

2.02 FERTILIZERS

A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
   1. Composition: 1 lb/1000 sq. ft. (0.45 kg/92.9 sq. m) of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
   2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

B. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
   1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
   2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

2.03 PESTICIDES

A. General: Pesticide, registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that prepared soil base is ready to receive the work of this section.
   1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
   2. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
   3. Uniformly moisten excessively dry soil that is not workable or which is dusty.

3.02 PREPARATION

A. Protect structures; utilities; sidewalks; pavements; and other facilities, trees, shrubs, and plantings from damage caused by planting operations.
   1. Protect grade stakes set by others until directed to remove them.

3.03 TURF AREA PREPARATION

A. General: Prepare planting area for soil placement and mix planting soil according to Landscape Plans.

B. Placing Planting Soil: Place and mix planting soil in place over exposed subgrade.
   1. Reduce elevation of planting soil to allow for soil thickness of sod.

C. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

D. Before planting, obtain Landscape Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.04 LAYING SOD

A. Lay sod within 24 hours after harvesting unless a suitable preservation method is accepted by Landscape Architect prior to delivery time. Do not lay sod if ground is frozen or muddy. The planting and/or installation of dormant sod is prohibited, unless stated otherwise herein the contract documents and/or amended through a Change Order.

B. Lay sod smooth and tight with no open joints visible, and no overlapping; stagger end joints 12 inches minimum. Do not stretch or overlap sod pieces.A void damage to soil or sod during installation. Tamp and roll lightly to ensure contact with soil, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.
   1. Lay sod across slopes exceeding 1:3.
   2. Anchor sod on slopes exceeding 1:6 with wood pegs or steel staples spaced as recommended by sod manufacturer but not less than two anchors per sod strip to prevent slippage.

C. Saturate sodded areas with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches of soil.

3.05 TURF MAINTENANCE

A. General: All planting shall be protected and maintained by the Contractor until time of final acceptance as defined herein these contract documents and/or amended by a Change Order. Contractor's maintenance shall include but is not limited to watering, weeding, cultivation, removal of dead material, lawn mowing, fertilizing, staking, and other necessary operations. Roll, regrade, and replant bare or eroded areas to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.
   1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
   2. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.

B. Watering: Water necessary for planting and maintenance shall be of satisfactory amounts and quality to sustain the growth of plants and shall not contain harmful, natural or man-made, elements detrimental to plants. Water meeting the above standard shall be furnished by the Contractor and all arrangements for securing water, dispersing, and associated expenses are the responsibility of the Contractor. Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches (100 mm).
   1. Schedule watering to prevent wilting, puddling, and erosion. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
   2. Water turf with fine spray at a minimum rate of 1 inch (25 mm) per week unless rainfall precipitation is adequate.

C. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than one-third of grass height. Remove no more than one-third of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:
   1. Mow bentgrass to a height of 1/2 inch (13 mm) or less.
   2. Mow bermudagrass to a height of 1/2 to 1 inch (13 to 25 mm).
   3. Mow carpetgrass, centipedegrass, perennial ryegrass, and zoysiagrass to a height of 1 to 2 inches (25 to 50 mm).
   4. Mow Kentucky bluegrass, buffalograss, annual ryegrass, and chewings red fescue to a height of 1-1/2 to 2 inches (38 to 50 mm).
   5. Mow bahiagrass, turf-type tall fescue, and St. Augustinegrass to a height of 2 to 3 inches (50 to 75 mm).

D. Turf Post-fertilization: Apply commercial fertilizer after initial mowing and when grass is dry.
   1. Use fertilizer that provides actual nitrogen of at least 1 lb/1000 sq. ft. (0.45 kg/92.9 sq. m) to turf area.
   2. E.

3.06 SATISFACTORY TURF

A. Turf installations shall meet the following criteria as determined by Landscape Architect:
   1. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted,
   2. even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.

B. Use specified materials to reestablish turf that does not comply with requirements, and continue maintenance until turf is satisfactory.

3.07 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents according to requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

B. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.08 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.

C. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.

3.09 MAINTENANCE SERVICE

A. Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in "Turf Maintenance" Article. Begin maintenance immediately after each area is planted and continue until acceptable turf is established, but for not less than the following periods:
   1. Sodded Turf: Until substantial completion and Owner acceptance.

3.10 3.10 LANDSCAPE WARRANTY

A. The Owner’s Representative shall have the final approval for acceptance of all work. All plants, grass, shrubs, and trees shall be warrantied to be alive and healthy one (1) year after the date of final acceptance.
   1. The Owner will not water non-irrigated plant material upon acceptance.
   2. The Owner is not responsible for adverse weather or environmental conditions.
   3. The Owner’s Representative is responsible for notifying the Contractor of any plant material, including grass, shrubs, or tree that is dead, dying, diseased, or not showing satisfactory growth. Following written notification, said plant material shall be replaced, or conditions contributing to unsatisfactory growth shall be corrected by the Contractor in a mutually agreeable and or appropriate season timeframe with the Owner’s Representative.
   4. All replacement plant material shall be of the same contract specified quality and or shall be of a size equal to that attained by adjacent plant material or trees of the same species. If necessary, any replacement plant material substitutions shall be proposed to and accepted by the Owner’s Representative, prior to installation. The Contractor is responsible for protection and maintenance of replacement plant material including, but not limited to, watering, weeding, cultivating, removal of dead material, lawn mowing, fertilizing, staking, and other necessary operations.
   5. The Contractor shall water replacement plant material for a period of ninety (90) days following installation, a minimum of 3” per plant every ten (10) days, if no measurable rain is received during that period. Replacement plant material shall be guaranteed to be alive and healthy at the beginning of the following growing season. The Contractor shall submit written warranty notice detailing replacement plant material, locations, quantity, species, substitutions accepted, date of installation, and scheduled maintenance. The Owner’s Representative shall review, approve, and note the date beginning of the following growing season and end of re-instated warranty period.

END OF SECTION

SECTION 32 9413
LANDSCAPE EDGING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. The scope of work includes all labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for, and incidental to performing all operations in connection with furnishing, delivery, and installation of landscape edging materials (also known as "edging") complete as shown on the drawings and as specified herein.
   1. The scope of work in this section includes, but is not limited to, the following:
      a. Location.
      b. Staking.
      c. Tree Root Conflicts.

1.02 REFERENCE STANDARDS

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

B. Related Specification Sections
   1. Section 01 6500 – Product Delivery Requirements (as applicable)
   2. Section 01 6600 – Product Storage and Handling Requirements (as applicable)
   3. Section 01 7000 – Execution and Closeout Requirements (as applicable)

1.03 MAINTENANCE DATA

A. Submit under provisions of Section 01 7000 (as applicable).

1.04 QUALITY ASSURANCE

A. The Contractor is solely responsible for quality control of the work.

1.05 PRODUCT HANDLING AND STORAGE

A. Upon receipt at the job site, all materials shall be checked to ensure that no damage occurred during shipping or handling. Materials shall be stored in such a manner to ensure proper ventilation and drainage, and to protect against damage, weather, vandalism and theft.

PART 2 - PRODUCTS

2.01 LANDSCAPE EDGING

A. Steel Landscape Edging Size: Comply with ASTM A 569, hot-rolled, standard flexible carbon steel landscape edging, fabricated in sections with stake pockets stamped, punched, or welded to face of sections approximately thirty inches (30") apart to receive stakes. Edging is to be 3/16" thick, 6" wide, by 16' length, with 6 stakes (actual coverage 15'-4").
   1. Steel landscape edging shall be designed to receive tapered steel stakes
   2. Steel Landscape Edging Finish: Unpainted Hot-Dipped Galvanized finish to be applied after steel landscape edging is cut to length and stake pockets are stamped, punched or welded. Galvanization shall comply with ASTM A123/A123M-97A. Zinc coverage shall be to a standard thickness of 3.0 mil (1.7 oz/s.f.)
   3. Steel Landscape Edging Stakes: Steel, tapered, 16" minimum length, and finished to match specified steel landscape edging in place, and shall be made by the manufacturer of the steel landscape edging for which they will be used.
   4. Accessories: Standard start/end sections, 90-degree corners, splicers as required, sectional and one-piece circles.
   5. Acceptable manufacturers: Steel Landscape Edging shall be DuraEdge Heavy Duty, manufactured by the J.D. Russell Company, or approved equal.

PART 3 - EXECUTION

3.01 LOCATION

A. Field mark locations for steel landscape edging as indicated on Contract Drawings.

1. All edging locations shall be laid out in the field with spray paint or flags and approved by Owner prior to installation of any edging.
    a. Horizontal Alignment: Install straight sections true to the alignments as indicated, free of waves or bends, using strings as guides.

3.02 STAKING

A. Anchor with steel stakes spaced approximately 30 inches on-center, driven below top elevation of edging, or at every stake pocket location in landscape edging sections designed and manufactured to receive stakes. Stakes shall be located in solid undisturbed soil unless otherwise directed by contract drawings and specifications.

B. Steel landscape edging shall be double staked at overlap joints.
    1. Vertical Alignment: Install parallel with the finished grade.
    2. Damaged Edging: Replace edging sections damaged by construction operations.

3.03 TREE ROOT CONFLICTS

A. In the event a tree root of one inch diameter or greater conflicts with the installation of the edging, contact Architect for further instruction.

END OF SECTION

SECTION 33 05 23

TRENCHLESS UTILITY INSTALLATION
08/15, CHG 2: 08/16

PART 1 GENERAL

Provide utility installation using microtunneling boring and jacking techniques at locations indicated. The Contractor is responsible for all work related to the provision of utilities installed, including assessing surface, subsurface, and environmental (seasonal) conditions.

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN PETROLEUM INSTITUTE (API)

API Spec 5L	(2018; 46th Ed; ERTA 2018) Line Pipe
API Spec 13A	(2010; Errata 1 2014; Errata 2-3 2015) Specification for Drilling-Fluid Materials

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 27-00	(2000) Standard Practice for Direct Design of Precast Concrete Pipe for Jacking in Trenchless Construction
ASCE 28-00	(2001) Standard Practice for Direct Design of Precast Concrete Box Sections for Jacking in Trenchless Construction
ASCE 36-15	(2015) Standard Design and Construction Guidelines for Microtunneling

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C200	(2012) Steel Water Pipe - 6 In. (150 mm) and Larger
AWWA C203	(2020) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2020; Errata 1 2021) Structural Welding Code - Steel
AWS D1.5M/D1.5	(2020; Errata 1 2022) Bridge Welding Code

ASTM INTERNATIONAL (ASTM)

ASTM A53/A53M	(2020) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A139/A139M	(2016) Standard Specification for Electric-Fusion (ARC)-Welded Steel Pipe (NPS 4 and over)

ASTM A716	(2018) Standard Specification for Ductile Iron Culvert Pipe
ASTM A746	(2018) Standard Specification for Ductile Iron Gravity Sewer Pipe
ASTM C33/C33M	(2018) Standard Specification for Concrete Aggregates
ASTM C76	(2020) Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C150/C150M	(2021) Standard Specification for Portland Cement
ASTM C1091	(2003a; R 2013) Standard Test Method for Hydrostatic Infiltration Testing of Vitrified Clay Pipe Lines

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2014) Safety -- Safety and Health Requirements Manual

1.2 DEFINITIONS

As used herein, the terms "shaft" and "pit" are synonymous.

1.2.1 Microtunneling

Unless otherwise specified or indicated, see ASCE 36-15 for definitions.

1.2.2 Jacking Precast Concrete Pipe

Unless otherwise specified or indicated, see ASCE 27-00 for definitions.

1.2.3 Jacking Precast Concrete Box Sections

Unless otherwise specified or indicated, see ASCE 28-00 for definitions.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Microtunneling Plan; G

Boring and Jacking Plan; G

Statement of Contractor Qualifications; G

SD-03 Product Data

Pipe casing and couplings; G

Lubricating Fluid for pipe exterior; G

Submit manufacturer's standard drawings or catalog cuts, except submit both drawings and cuts for push-on [and rubber-gasketed bell-and-spigot] joints. Include information concerning gaskets with submittal for joints and couplings.

SD-05 Design Data

Design calculations for pipe casing; G

Access Shaft Construction Plan; G

SD-06 Test Reports

Monitoring Survey; G

SD-08 Manufacturer's Instructions

Installation procedures for pipe casing; G

Safety Data Sheets; G

SD-11 Closeout Submittals

Record Drawings; G

Daily Work Logs of installation operations, including records of the volume of materials removed, daily progress and grout volumes used, and as-built drawings of location and alignment of pipeline]; G

1.4 PRE-CONSTRUCTION

No later than 45 days prior to commencement of the work, submit the following to the Contracting Officer for review and approval:

Microtunneling Plan

Boring and Jacking Plan

Access Shaft Construction Plan

Statement of Contractor Qualifications

Submit a complete list of all drilling fluids, additives, and mixtures to be used along with Safety Data Sheets.

1.5 QUALITY CONTROL

1.5.1 STATEMENT OF CONTRACTOR QUALIFICATIONS

Contractors are required to have proven and successful experience in microtunneling boring and jacking. The experience is the successful completion of similar projects to the tolerances indicated for the size of pipe and quantities shown on the plans, in the anticipated soil conditions indicated in the geotechnical report included in the contract documents. Submit a description of at least three such projects which include, at a minimum, a listing of the location(s), date of projects, owner with contact information, pipe type, size installed, length of installation, type, and manufacturer of equipment used, and other information relevant to the successful completion of the project.

1.5.2 RECORDS

1.5.2.1 DAILY WORK LOG

Maintain a work log of construction events and observations. Include the following information for each days' work:

a. Hours worked.

b. Location of boring machine face or shield by station and progress made in advancing pipe.

c. Completed field forms, such as steering control logs, for checking line and grade of boring operation, showing achieved alignment relative to design alignment.

d. Maximum pipe jacking pressures per drive.

e. Ground water control operations and piezometric levels.

f. Descriptions of soil conditions encountered.

g. Any unusual conditions or events, including observed ground movement.

h. Reasons for operational shutdown in event drive is halted.

1.6 DELIVERY, STORAGE, AND HANDLING

Inspect materials delivered to site for damage. Unload and store with minimum handling. Store materials on site in enclosures or under protective covering. Store jointing materials and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes free of dirt and debris.

1.6.1 Handling

Handle pipe in a manner to ensure delivery to the excavation site in sound undamaged condition. Avoid damage to coatings and linings on pipe; make repairs if coatings or linings are damaged. Carry, do not drag pipe to the excavation site. Store jointing materials and rubber gaskets that are not to be installed immediately, under cover out of direct sunlight. Handle steel pipe with coal-tar epoxy coating in accordance with the provisions for handling coal-tar enamel coated pipe in AWWA C203. Handling coal-tar epoxy coated steel is not permitted below 40 degrees F.

1.7 SAFETY

1.7.1 General

Provide procedures for safe conduct of the work in accordance with EM 385-1-1. When and where installations temporarily disrupt pedestrian use of sidewalk areas for periods exceeding two consecutive work days, provide an alternate route that meets current ABA Accessibility Standard for Department of Defense Facilities.

1.7.2 Equipment

Utilize equipment that employs a common grounding system to prevent electrical shock in the event of underground electrical cable strike. Ensure the grounding system connects all pieces of interconnecting machinery; the drill, mud mixing system, drill power unit, drill rod trailer, operators booth, worker grounding mats, and any other interconnected equipment to a common ground. Utilize

equipment having an "electrical strike" audible and visual warning system that notifies the system operators of an electrical strike.

1.7.3 Sheeting, Shoring and Dewatering

Provide sheeting, shoring and dewatering as specified in Section 31 23 00.00 20, EXCAVATION AND FILL, and as specified herein.

1.7.4 Tunnel Bore

Unprotected mining of the tunnel bore is not permitted. Fully support the tunnel face and bore at all times.

1.8 QUALITY ASSURANCE

1.8.1 Microtunneling PlanBoring and Jacking Plan

Provide a plan prepared, signed and sealed by a licensed Professional Engineer and include the following:

1.8.1.1 Operational Layout

1.8.1.1.1 Layout Plan

Provide a plan location of the operation, discussing relationship of equipment, the method of construction and details for the following:

a. Access pits configurations and details, including equipment layout.

b. Location of intermediate jacking stations, if required.

c. Casing pipe with connection details.

1.8.1.1.2 Pedestrian Access Around Site

When and where installations disrupt pedestrian use of sidewalk areas for periods exceeding two consecutive days, provide an alternate route that meets current ADA requirements.

1.8.1.2 Method and Procedures

Provide an outline of the methods and procedures, including drawings, schedule of operations, specifications, and manufacturer's catalog data for products in lieu of specifications, methods of operation for microtunneling boring and jacking operations, and specifically the following:

a. Jacking Equipment and Methods: Provide drawings of the jacking frame, jacking head, reaction blocks, jacking installation, pipe guides, procedures for lubricating exterior of pipe during jacking (if applicable), maximum force that jacking equipment can deliver.

b. Boring Equipment and Methods: Provide a discussion of the methods of operation, design and specifications for boring operation, steerage control, line and grade control methods, proposed procedures for removing or clearing obstructions, and a description of proposed methods for ground stabilization and minimizing overexcavation and loss of ground. Submit safety data sheets for fluids, grout, or chemical products.

c. Casing Annulus and Interior Space Grouting: Identify casing insulators/spacers/centralizers/tiedowns (type, number, spacing and installation instructions,)

grout materials and method of placement, description of equipment used and grout pressure employed.

d. Survey Alignment Control: Identify method and equipment to install pipe within specified tolerances.

e. Ground Stabilization: Discuss dewatering and grouting, identification of measures and methods used to stabilize face at heading (if necessary), narrative of equipment, procedure and grout mix, and identification of subcontractor who will perform any required stabilization grouting.

f. Excavation Support System Plan: Provide a plan and discussion of methods to be employed, including design drawings and calculations, sealed and signed by a licensed Professional Engineer.

g. Monitoring/Survey Plan: Develop and provide a discussion of the monitoring/survey plan to be employed to protect structures and utilities from settlement and/or heave, including the following. Incorporate into the plan any supplemental requirements specified in Part 3, paragraph entitled "Field Quality Control".

(1) Structures Assessment: Provide a discussion of structures and utilities to be protected, and measures to be employed for preconstruction and postconstruction assessment of critical structures, namely those located within the zone of active excavation from proposed pipe centerline. Include photographs or video of existing damage to structures in the vicinity of sewer alignment in assessment reports.

(2) Instrumentation Monitoring Plan: Describe of instrumentation design, layout of instrumentation points, equipment installation details, manufacturer's catalog literature, and monitoring report forms.

(3) Surface Settlement Monitoring Plan: Identify on a plan the location of settlement monitoring points, reference benchmarks, survey frequency and procedures, and reporting formats.

h. Contingency Plan: Provide a plan and discuss protection of pavements, adjacent structures, and utilities affected by adverse movements detected by instrumentation. As a minimum, include the following:

(1) Names, telephone numbers, and locations of persons responsible for implementation of contingency plans.

(2) Materials and equipment required to implement contingency plans. Identify the location of all required materials and equipment.

(3) Step-by-step procedure for performing work involved in implementation of the contingency plans.

(4) Clear identification of the objectives of the contingency plans and methods to measure plan success.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

The work includes providing labor, materials, and specialized equipment for the installation of utility pipelines utilizing the boring and jacking microtunneling methods of installation.

2.1.1 Design Requirements

2.1.1.1 Excavations

Design excavations, including access shaft walls, considering loadings from reaction blocks, traffic loads and any surcharge loads.

2.1.1.2 Design Calculations of Pipe Casing

Submit design calculations for pipe casing demonstrating that the equipment used in installing the pipe will not distort or otherwise damage the pipe. Provide calculations of maximum allowable jacking force to be used based on pipe materials to be used. The calculations are to be sealed by a licensed Professional Engineer using soil properties derived from subsurface investigations performed along the utility route.

2.2 EQUIPMENT

2.2.1 Microtunneling System

2.2.1.1 General Requirements

Utilize a continuously monitored laser guided Microtunneling Boring Machine (MTBM) system matched to the expected subsurface conditions, a hydraulic jacking system to jack the pipeline, a process to remove the slurry from the slurry water, a guidance system to provide installation accuracy to within the indicated tolerances, excavation equipment, material handling equipment, a dewatering system, and sheeting/shoring required to provide the work indicated and meet the following minimum performance requirements:

a. Capable of providing positive face support both during excavation and during shutdown regardless of the MTBM type.

b. Capable of handling and removing materials of high water content from the machine head.

c. All functions are controlled remotely from a surface control unit.

d. Capable of controlling rotation utilizing a bidirectional drive on the cutter head or by using anti-roll fins or grippers.

e. Capable of injecting lubricant around the exterior of the pipe being jacked.

f. Capable of controlling heave and settlement.

g. Minimize overcut during the operation. Do not exceed 1 inch on the radius, unless approved by the Contracting Officer.

2.2.1.2 Control System

The main control system of the MTBM is to provide the following information to the operator, as the minimum, required for successful operation of the MTBM:

a. Deviation of the MTBM from the required line and grade of the pipeline (normally by reference to a laser beam).

b. Grade and roll of the MTBM.

c. Jacking load.

d. Torque and RPM of the cutter head.

e. Instantaneous jacking rate and total distance jacked.

f. Indication of steering direction.

g. Progress of pipe advancement via CCTV at the pipe head.

2.2.2 Boring and Jacking System

Utilize a continuously monitored boring and jacking system matched to the expected subsurface conditions, a hydraulic jacking system to jack the pipeline, an auger to remove boring spoils, a guidance system to provide installation accuracy within the indicated tolerances, excavation equipment, material handling equipment, a dewatering system, and sheeting/shoring required to provide the work indicated.

2.2.3 Pipe Jacking Equipment

Provide main jacking equipment with a capacity greater than the anticipated jacking load. Provide intermediate jacking stations when the total anticipated jacking force needed to complete the installation may exceed the capacity of the main jacks or the designed maximum jacking force for the pipe. The jacking system is to supply a uniform distribution of jacking forces on the end of the pipe by use of thruster rings and cushioning material.

2.3 MATERIALS

2.3.1 Pipe Casing

Provide straight wall pipe casing of type and diameter indicated of steel pipe.

2.3.1.2 Steel Pipe

2.3.1.2.1 Pipe

Provide steel pipe in conformance with [ASTM A139/A139M, Grade B with a minimum yield strength of 35,000 psi] [AWWA C200] [API Spec 5L Grade B] [ASTM A53/A53M] [ASTM A716] [ASTM A746]. [Weld steel pipe seamless, square cut with even lengths that complies with Articles 4.2, 4.3, and 4.4 of the API Spec 5L]. Pipe shall have an inside diameter of [_____] inches and a minimum wall thickness of [____] inches [as indicated].

2.3.1.2.2 Joints

Accomplish the connection of adjacent pieces of microtunneling steel pipe internal weld sleeves, by a certified welder, in compliance with AWS D1.1/D1.1M as long as loading and installation design criteria are met.

Utilize casing pipe having beveled ends with a single V-groove for field welding. Butt weld joints using a full-penetration weld on the outside circumference of the pipe prior to jacking. The welds are to conform to the latest AWS Welding Code by a certified welder. Unless otherwise specified, inspect and test welds using a non-destructive testing method consisting of magnetic particle examination (MT), in compliance with the AWS code. Visually inspect in compliance with AWS D1.1/D1.1M visual inspection criteria by a certified welder and by the QC manager welds on casing pipe that is sacrificial (fully grouted internally). Non-destructive testing is not required on welds on casing pipe that is sacrificial.

Grouting Plugs: On large pipe, (24-inch diameter or greater), provide pipe with 2-inch diameter tapped holes with threaded plugs for exterior grouting.

2.3.1.2.3 Roundness

The maximum difference between the major and minor outside diameters cannot exceed one percent of the specified nominal outside diameter or 0.25 inch, whichever is less.

2.3.1.2.4 Circumference

Ensure that the outside circumference is within plus one percent of the nominal circumference or within plus 0.50 inches, whichever is less.

2.3.1.2.5 Straightness

The maximum allowable straightness deviation in any 10 foot length cannot exceed 1/8 inch. For lengths over 10 feet, the maximum allowable deviation of the entire pipe length is computed by the following formula, but not to exceed 3/8 inch in any length exceeding 30 foot length: Maximum Allowable Deviation in inches equals (1/8) times (total length in feet) divided by 10.

2.3.1.2.6 Pipe Ends

Ensure that the end of the pipe is perpendicular to the longitudinal axis of the pipe and within 1/16 inch per foot of diameter, with a maximum allowable deviation of 1/4 inch measured with a square and straightedge across the end of the pipe.

2.3.2 Grout

Provide cement grout for pressure grouting to fill the voids around the casing and for filling the interior annular space between carrier pipe and the casing composed of Portland cement conforming to ASTM C150/C150M, Type II, and sand meeting requirements of ASTM C33/C33M for fine aggregate, sufficiently fluid to inject through the casing and fill voids, with prompt setting to control grout flow. Utilize a grout with a minimum compressive strength of 100 psi attained within 24 hours. Admixtures are to be free of chlorides, corrosive or other material detrimental to the materials the grout contacts.

2.3.3 CONCRETE

Provide 3000 psi concrete in accordance with Section 03 30 00 CAST-IN-PLACE CONCRETE.

2.3.4 Lubricating Fluid (Bentonite or Polymer)

Provide material for lubricating the exterior of pipe. Provide bentonite machine requirements of API Spec 13A and having the capacity of mixing with water to form a stable and homogeneous suspension.

2.3.5 SOIL MATERIALS

Provide soil materials in accordance with the requirements specified in Section 31 00 00 EARTHWORK, 31 23 00.00 20 EXCAVATION AND FILL.

2.4 INCIDENTAL MATERIALS

2.4.1 Casing Insulators/Bore Spacers

Provide carbon steel with polyvinyl chloride coating or stainless steel casing insulators/bore spacers 8 inches in length for pipe 12 inches and less in diameter, and 12 inches in length for pipe 14 inches and

greater in diameter, having a 2 inch minimum runner width. Orient spacers to allow for grout to flow easily to completely fill the casing pipe with grout throughout its length.

2.4.2 End Closures/Bulkheads

Provide Temporary End Closures to contain grout used for filling the annular space between conduits and the casing. Provide Permanent End Closures of [_____] feet length as indicated consisting of brick and mortar (one part cement/two parts sand/water) to completely encapsulate the conduits transition into the casing. Center the closure on the casing pipe end.

PART 3 EXECUTION

1.1 PREPARATION

1.1.1 Access Shaft and Pit Construction Plan

No later than 45 days prior to start of construction submit an Access Shaft Construction Plan. Include in the plan a discussion of the method of construction of access shafts used for microtunneling boring and jacking. Address the excavation methods, dewatering system, sheeting/shoring and bracing systems proposed for use, and any ground stabilization to be employed for the shaft work area or thrust block. Acceptable construction methods include the use of interlocked steel sheetpiling or precast circular concrete segments lowered in place during excavation.

1.1.1.1 Design Requirements

a. Construct shafts of a size commensurate with safe working practices. Coordinate shaft locations with the Contracting Officer. The Contractor may propose to relocate shafts to better suit the capabilities of the equipment/methods proposed, but may not alter either the indicated pipeline alignment or structures associated with the installed pipeline, nor result in additional claims for compensation.

b. To the extent possible, keep shaft locations clear of pavements, in order to minimize disruption to the flow of traffic. Locate support equipment, spoil piles, and materials to minimize disruption to traffic.

c. Support all excavations and prevent movement of the soil, pavement, utilities or structures outside of the excavation. Furnish, place, and maintain sheeting, bracing, and lining required to support the sides of all shafts and to provide adequate protection of the work, personnel, and the general public. Provide a concrete floor in the jacking access shaft. Design loads on the sides of the jacking and receiving pit walls are dependent on the construction method and flexibility of the wall systems.

d. Consider the loading from boring or pipe jacking when preparing the design of the jacking and receiving pit supports as well as special provisions and reinforcement around the breakout location. Design the base of the pits to withstand uplift forces from the full design head of water, unless approved dewatering or other ground modification methods are employed.

e. Construct a thrust block to transfer jacking loads into the soil. Ensure that the backstop and the proposed pipe alignment are square to each other and are designed to withstand the maximum jacking pressure to be used with a factor of safety of at least 2.5. Also, design the thrust block to minimize excessive deflections in such a manner as to avoid disturbance of adjacent structures or utilities or excessive ground movement. Begin jacking operations only after concrete thrust block or treated soil has attained the required strength.

1.2 CONSTRUCTION

1.2.1 Access Shafts

1.2.1.1 Construction Requirements

a. Provide ground stabilization in the work area and the thrust block as required to accomplish the work.

b. Construct a jacking access shaft to accommodate the installation of pipe casings, equipment and piping jacking device. Install thrust blocks(s) as required and consolidate the ground (grout) where the casings exit the shaft. Provide a dry jacking work area having a stable concrete floor that drains to a recessed sump pump to handle nuisance inflow. Groundwater inflows into the jacking shaft are not to exceed 5 gallons/minute; soil inflows are not to exceed a total volume of 2 cubic feet.

c. Construct a receiver shaft to accommodate the installation of pipe casings and the equipment used in the work. Consolidate the ground (grout) where the casings enter the shaft.

d. Furnish, install, and maintain equipment to keep the jacking shaft free of excess water. Provide surface protection during the period of construction to ensure that surface runoff does not enter shafts. Adhere to the dewatering plan and do not affect surrounding soils or structures beyond the tolerances stated in paragraph entitled "Tolerances."

e. Provide security fence around all access shaft areas and provide shaft cover(s) when the shaft area is not in use.

f. Pit Backfill and Compaction: Upon completion of the pipe jacking and all tests or inspections are complete remove all equipment, debris, and unacceptable materials from the pits and commence backfilling operation. Complete backfilling, compaction, and pavement repairs in accordance with Section 31 00 00 EARTHWORK, 31 23 00.00 20 EXCAVATION AND FILL.

1.3 INSTALLATION

1.3.1 Installation of Tracer Wire

Install a continuous length of tracer wire for the full length of each run of nonmetallic pipe in accordance with the American Public Works Association Uniform Color Code. Attach wire to top of pipe in such a manner that will not be displaced during construction operations.

1.3.2 Connections to Existing Lines

Schedule connections to existing lines with the Contracting Officer to cause a minimum interruption of service on the existing line.

1.3.3 Advancing the Pipe

Jack each pipe casing section forward as the excavation progresses in such a way to provide complete and adequate, ground support at all times. Utilize a bentonite slurry applied to the external surface of the pipe to reduce skin friction. Provide a jacking frame for developing a uniform distribution of jacking forces around the periphery of the pipe. Place a plywood spacer on the outer shoulder of the pipe casing joint. Design and construct the thrust reaction backstop to withstand the jacking forces. Continuously maintain a square alignment between the backstop and pipe casing and support the maximum obtainable jacking pressure with a safety factor at least 2.0. Continuously monitor the jacking pressure and rate of cutter head advancement. Exercise special care when setting the pipe guard rails in the jacking pit to ensure correctness of the alignment, grade and stability.

1.3.3.1 Installation Requirements

a. Utilize boring equipment capable of fully supporting the face of the tunnel.

b. Maintain face pressure exerted at the heading by the MTBM as required to prevent loss of ground, groundwater inflows, and settlement or heave of the ground surface by balancing soils and groundwater pressures present.

c. Dewatering for groundwater control is allowed at the jacking and receiving pits only.

d. Do not jack pipe casing until the concrete thrust block and tremie seal (if selected), and grouted soil zone in jacking and receiving shafts have attained the required strength.

e. Jack the pipe into place without causing damage to the coatings, joints or completed pipe section.

f. After completion of the jacking operation between jacking and receiving shafts, displace the lubricate material from between the pipe casing exterior and the surrounding ground with a cement grout. Control pressure and the amount of grout to avoid pipe damage and displacement of the pipe and soil beyond the tolerances specified in paragraph "Tolerances." Grout within 48 hours after pipe installation has been completed to prevent any surface settlement due to movement of soil material into the void space or loosened zone around the pipe casing.

g. Replace pipe casings damaged during installation.

h. Ensure that the welds of steel pipe attain the full strength of the pipe and are watertight before jacking of the pipe section. Ensure that the inner face of the internal weld seam is flush with the pipe to facilitate the installation of the carrier pipe in the pipe casing.

i. Perform all welding in accordance with requirements for shielded metal arc welding of AWS D1.5M/D1.5 for bridges and AWS D1.1/D1.1M for buildings and other structures.

j. Provide a pipeline that has a consistent diameter across assembled joints.

k. Once the tunneling process has begun, continue with that process uninterrupted until the pipe reaches the receiving shaft. Continue to push any damaged pipe until that damaged pipe section is pushed into the receiving shaft and is removed. Notify the Contracting Officer immediately if any pipe is known to be or believed to be damaged.

1.3.4 Conduit Installation

1.3.4.1 Cleaning

Clean the inside of the casing of all foreign matter by using a pipe cleaning plug.

1.3.4.2 Conduit Joints

Bond all metallic conduit joints within the casing pipe. Inspect with the Contracting Officer, prior to backfilling trenches, the transition of conduit within the casing to non-cased trenching.

1.3.4.3 Casing Insulators/Spacers

Install casing insulators/spacers in accordance with approved submittals and the drawings. On center spacing is not to exceed 4 feet.

1.3.4.4 End Closures/Bulkheads and Grouting of Casing Pipe

a. Closures: Seal ends of casing with brick and mortar

b. After installing, inspecting and acceptance of the carrier pipe][conduit] and spacers within the casing pipe, pressure fill the annular space between the [carrier pipe][conduit] and the casing pipe, with cement grout specified herein. Regulate pump pressures to refusal or in accordance with the approved grouting plan. Place grout in a sequence and manner that will preclude voids or pockets of entrapped air or water. Use a refusal pressure equal to 0.5 psf per foot of overburden.

1.3.5 Ventilation

Provide adequate ventilation for all tunnels and shafts, following confined space entry procedures. Include such factors as the volume required to furnish fresh air in the shafts, and the volume to remove dust that may be caused by the cutting of the face and other operations which may impact the laser guidance system. In the design of the ventilation system, the minimum amount of fresh air to be supplied is [_____] CFM.

1.3.6 Lighting

Provide adequate lighting for the nature of the activity being conducted by workers. Separate and insulate with ground fault interrupters power and lighting circuits. Comply with requirements with regards to shatter resistance and illumination requirements.

1.3.7 Spoil Transportation

Match the excavation rate with rate of spoil removal. Utilize a system capable of balancing groundwater pressures and adjustment to maintain face stability for the particular soil conditions of the project.

1.4 TOLERANCES

1.4.1 Tolerances

Maximum allowable lateral deviation is 5 inches; maximum allowable vertical deviation is [_____] inches in the position of every completed 300 foot section of jacked pipe casings. Water must be free draining between any two points at the pipe invert. Reverse grades are not permitted.

1.5 FIELD QUALITY CONTROL

Employ the monitoring/survey plan. Maintain daily records in accordance with the paragraph titled RECORDS.

1.5.1 Instrumentation/Survey

1.5.1.1 Mandatory Requirements

a. Monitor ground movements associated with the project using established survey points and make changes in the construction methods that control ground movements and prevent damage or detrimental movement to the work and adjacent structures and pavements.

b. Record in the daily work log a summary of monitoring survey results. Clearly identify work not meeting specified requirements, out-of-tolerance results, and impacts on new or existing work from settlement or heave.

c. Install instrumentation and perform monitoring to determine ground settlement surrounding each jacking and receiving pit.

d. Prior to any excavation activities, perform a pre-construction survey of the areas in and surrounding excavations and along the proposed utility alignment to identify any structures, facilities, underground or above ground utilities to be protected within a radius of five times either the depth of any excavation or the depth of trenchless excavation.

1.5.1.2 Supplemental Requirements

a. Prior to the start of advancing the pipe or any dewatering operation, install surface settlement markers along the trenchless excavation centerline using the following guidelines:

(1) Locate surface settlement markers in a grid, spaced 10 feet by 10 feet extending not less than 30 feet on either side of the trenchless excavation centerline. Use wooden hubs in unpaved areas with the hubs driven flush with the surface and a tack driven in the top for level rod placement. Use temporary paint or other approved materials in pavement areas. Minimize the size of temporary markings to the greatest extent practical. Remove all markers and markings prior to completion of work.

b. Prior to the start of advancing the pipe or dewatering operations, survey all monitoring points a minimum of three times to establish baseline readings. Perform all surveys to an accuracy of 0.01 foot. Survey daily feet of casing pipe advancement. In addition, if settlement exceeds Limit Level 2 survey all monitoring points within 20 feet of the heading hourly when the heading is approaching or passing beneath the monitoring points.

c. Evaluate all monitoring survey data immediately to determine corrective or mitigation action should be taken using the following evaluation criteria:

Carbon Monoxide	<0.005 percent
Methane	<0.25 percent
Hydrogen Sulfide	<0.001 percent
Oxygen	>20.0 percent

d. If the survey readings indicate settlement or heave is greater than Limit Level 1 in the above table, provide notification to the Contracting Officer immediately and increase the monitoring frequency of the instruments as directed. Proceed with advancing the pipe after providing mitigating measures to limit additional movements.

e. If the survey readings indicate settlement or heave is greater than Limit Level 2 in the above table, cease work and provide notification to the Contracting Officer immediately and implement the Contingency Plan.

f. Perform all repairs and/or rebuilding of the pavement or adjacent structures to their condition existing prior to settlement/lifting.

g. Continue to monitor by the survey at two week intervals for a period of six weeks after tunneling. When the survey identifies that heave or settlement has occurred that is greater than Limit Level 2 values, make repairs to new or existing work that is affected. Discontinue topographic surveys when settlement is no longer detected.

1.5.2 Field Tests

Perform field tests, and provide labor, equipment, and incidentals required for testing Section. Submit test results, identifying any results that do not meet specified requirements, to the Contracting Officer within four days of test completion. Provide corrective action and retest pipe not meeting specified requirements. Provide corrective action as recommended by the pipe manufacturer and subject to approval by the Contracting Officer.

1.5.2.1 Pipe Casing

Inspect and verify that pipe material meets the dimensional tolerances specified prior to use. Record each days inspection results in the daily work log.

1.5.2.1.1 Testing Requirements for Gravity Mains

Perform low pressure air test of all gravity mains (structure to structure) in accordance with ASTM C1091 Standard Test method for Hydrostatic Infiltration testing of Vitrified Clay Pipe Lines.

1.5.2.1.2 Non-Standard Pipe Lengths

Cut non-standard joint lengths from full length pipe having satisfactorily passed the hydrostatic test.

1.5.2.1.3 Elevations

Prior to removal of MTBM equipment, sheeting, and backfilling of access shafts, collect invert information on pipeline installed. Confirm that the elevations meet stated tolerances.

1.5.3 Inspections

Prior to the removal of MTBM equipment, sheeting, and backfilling of access shafts, conduct CCTV inspection of the mains installed in accordance with Section 33 01 30.16 TV INSPECTION OF SEWER LINES.

1.6 CLEANUP AND FINAL CLOSEOUT

1.6.1 Site Cleanup

Immediately clean "blow holes" or "breakouts" of drilling fluid to the surface and fill depressions with satisfactory fill material. Dispose of all drilling fluids, soils, and separated materials in compliance with Federal, State, and local environmental regulations.

1.6.2 Drilling Fluid

Immediately upon completion of work of this section, remove all rubbish and debris from the job site. Remove all construction equipment and materials leaving the entire area involved in a neat condition equal to existing conditions prior to construction, unless indicated otherwise.

1.6.3 Record Drawings and Daily Work Logs

Submit an electronic copy and three hard copies of the record drawings to the Contracting Officer within five days after completing the work. Include in the record drawings a plan, profile, and all information recorded during the progress of the work. Clearly tie the record drawings to the project's survey control. Maintain and submit upon completion final Daily Work Logs of installation operations, signed by the superintendent.

1.7 DISPOSITION OF MATERIAL

Dispose of waste in Government disposal area as indicated on the drawings. Remove from Government property surplus or other soil material not required or suitable for fill or backfilling.

Store or legally dispose of excavated material and fluids used in the boring process and shaft construction away from the construction site and in compliance with all permits and applicable Federal, State, and local regulations.

END OF SECTION

SECTION 33 31 23.00 10

SANITARY SEWER FORCE MAIN PIPING
08/18

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO HB-17	(2002; Errata 2003; Errata 2005, 17th Edition) Standard Specifications for Highway Bridges

AMERICAN PETROLEUM INSTITUTE (API)

API Spec 6D	(June 2018, 4th Ed; Errata 1 July 2018; Errata 2 August 2018) Specification for Pipeline and Piping Valves

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.1	(2020) Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250
ASME B16.3	(2021) Malleable Iron Threaded Fittings, Classes 150 and 300

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C105/A21.5	(2018) Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C110/A21.10	(2012) Ductile-Iron and Gray-Iron Fittings for Water
AWWA C111/A21.11	(2017) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115/A21.15	(2020) Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges
AWWA C151/A21.51	(2017) Ductile-Iron Pipe, Centrifugally Cast
AWWA C200	(2012) Steel Water Pipe - 6 In. (150 mm) and Larger
AWWA C203	(2020) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied
AWWA C207	(2018) Standard for Steel Pipe Flanges for Waterworks Service, Sizes 4 in. through 144 in. (100 mm through 3600 mm)

AWWA C208	(2017) Dimensions for Fabricated Steel Water Pipe Fittings
AWWA C210	(2015) Standard for Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
AWWA C300	(2016) Reinforced Concrete Pressure Pipe, Steel-Cylinder Type
AWWA C301	(2014; R 2019) Prestressed Concrete Pressure Pipe, Steel-Cylinder Type
AWWA C303	(2017) Concrete Pressure Pipe, Bar-Wrapped, Steel-Cylinder Type
AWWA C500	(2019) Metal-Seated Gate Valves for Water Supply Service
AWWA C508	(2017) Swing-Check Valves for Waterworks Service, 2 In. Through 48-In. (50-mm Through 1,200-mm) NPS
AWWA C600	(2017) Installation of Ductile-Iron Mains and Their Appurtenances
AWWA C900	(2016) Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 In. Through 60 In. (100 mm Through 1,500 mm)
AWWA C909	(2016) Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 In. (100 mm) and Larger

ASTM INTERNATIONAL (ASTM)

ASTM A53/A53M	(2020) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM D1784	(2020) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D1785	(2015; E 2018) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
ASTM D2122	(2016) Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
ASTM D2241	(2015) Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D2464	(2015) Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D2564	(2020) Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D2657	(2007; R 2015) Heat Fusion Joining Polyolefin Pipe and Fittings

ASTM D2774	(2021) Underground Installation of Thermoplastic Pressure Piping
ASTM D2996	(2017) Standard Specification for Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
ASTM D3035	(2015) Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter
ASTM D3139	(2019) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D3308	(2012; R 2017) Standard Specification for PTFE Resin Skived Tape
ASTM D3350	(2021) Polyethylene Plastics Pipe and Fittings Materials
ASTM D3754	(2019) "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer and Industrial Pressure Pipe
ASTM D4101	(2017) Standard Classification System and Basis for Specification for Polypropylene Injection and Extrusion Materials
ASTM D4161	(2014) "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Joints Using Flexible Elastomeric Seals
ASTM F477	(2014; R 2021) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F1483	(2017) Standard Specification for Oriented Poly(Vinyl Chloride), PVCO, Pressure Pipe

DUCTILE IRON PIPE RESEARCH ASSOCIATION (DIPRA)

DIPRA TRD	(2016) Thrust Restraint Design for Ductile Iron Pipe

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-78	(2011) Cast Iron Plug Valves, Flanged and Threaded Ends

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-06 Test Reports

Disposal of Waste Water

Final Test Report

1.3 DELIVERY, STORAGE, AND HANDLING

Do not damage pipe, fittings and accessories, and pipe coatings during delivery, handling, and storage.

PART 2 PRODUCTS

2.1 PIPE AND FITTINGS

Provide piping in locations and sizes as specified in the following table. Also conform to the respective specifications and other requirements specified below

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USACE / NAVFAC / AFCEC / NASA          UFGS-33 31 23.00 10 (August 2018)

                                       ------------------------------------------------
Preparing Activity:  USACE             SupersedingUFGS-33 34 00 (April 2008)
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2.1.2 Plastic Pipe

2.1.2.1 PE Pipe

ASTM D3350 and ASTM D3035, minimum pressure rating of 100 psi at 73.4 degrees F.

2.1.2.2 Polypropylene Pipe

ASTM D2122 and ASTM D4101.

2.1.2.3 PVC Pressure Pipe

a. PVC Pressure Pipe and Fittings Less Than 4 inches Diameter: ASTM D1785, Schedule 80, or ASTM D2241, SDR [21][26][32.5], with screw joints, push-on joints, or solvent weld joints.

b. PVC Pressure Pipe and Fittings 4 inches Diameter and Larger: ASTM D2241, SDR [21][26][32.5], or AWWA C900, Class [100][150][200], with push-on joints.

2.1.2.4 Oriented Polyvinyl Chloride (PVCO) Plastic Pipe

Provide pipe, couplings, and fittings manufactured of material conforming to ASTM D1784, Class 12454-B. Provide pipe conforming to AWWA C909, Class 150, and to ASTM F1483 with an outside diameter equal to cast iron outside diameter.

2.1.3 RPMP Pipe

Provide RPMP in accordance with ASTM D3754 produced by centrifugal casting and with an outside diameter equal to ductile iron pipe dimensions from 18 inch to 48 inch. Provide a smooth uniform continuous resin-rich surface liner coating the entire inner surface of the pipe. Ensure the minimum pipe stiffness provided is 36 psi.

2.1.4 RTRP Lines

ASTM D2996, 350 psi rated, cast iron pipe dimensions only, with elastomeric gasket joints. Fittings: AWWA C110/A21.10, rated 150 psi. Use inside sleeves provided by the manufacturer when mechanical joint fittings are used.

2.1.5 Ductile Iron Pipe

2.1.5.1 Ductile Iron Pipe

AWWA C151/A21.51, working pressure not less than 150 psi, unless otherwise shown or specified.

2.1.5.2 River Crossing Pipe

AWWA C151/A21.51, minimum thickness Class 54 with joints in compliance with applicable requirements of AWWA C110/A21.10.

2.1.5.3 Fittings, Mechanical

AWWA C110/A21.10, rated for 150 psi.

2.1.5.4 Fittings, Push-On

AWWA C110/A21.10 and AWWA C111/A21.11, rated for 150 psi.

2.2 JOINTS

2.2.1 PE Piping

2.2.1.1 Heat Fusion Joints

ASTM D2657.

2.2.1.2 Flanged Joints

ASME B16.1 or AWWA C207.

2.2.1.3 Mechanical Joints

ASME B16.1.

2.2.2 Polypropylene Piping

Heat Fusion Joints: ASTM D2657.

2.2.3 PVC Piping

Provide centering rings or stops to ensure couplings used with plain end pipe are centered on the joint.

2.2.3.1 Screw Joint Fittings

ASTM D2464, Schedule 80

2.2.3.2 Push-On Joint Fittings

ASTM D3139, with ASTM F477gaskets

2.2.3.3 Solvent Cement

ASTM D2564

2.2.4 PVCO Pipe

Provide joints conforming to ASTM D3139 and elastomeric gaskets conforming to ASTM F477.

2.2.5 Ductile Iron Piping

2.2.5.1 Push-on Joints

AWWA C111/A21.11.

2.2.5.2 Mechanical Joints

AWWA C111/A21.11 as modified by AWWA C151/A21.51.

2.2.5.3 Flanged Joints

AWWA C115/A21.15.

2.2.7 RPMP Piping

Provide bell and spigot gasket coupling joints utilizing an elastomeric gasket in accordance with ASTM D4161 and ASTM F477.

2.3 VALVES

2.3.1 Gate Valves

Provide gate valves 3 inches and larger in compliance with AWWA C500. Provide non-rising stem (NRS) valves for buried service, 2 inch square nut operated with joints applicable to the pipe or installation. Furnish buried valves with extension stems comprising socket, extension stem and operating nut, and of an appropriate length to bring operating nut to within 6 inches of grade. Provide one 4 foot "T" handle valve wrench for each quantity of 6 buried valves. Provide outside screw and yoke (OS&Y), handwheel operated with flange ends for gate valves that are exposed or installed inside unless otherwise indicated. Cast an arrow and the word "OPEN" on all gate valve operating nuts and handwheels in raised letters to indicate the direction of opening. Equip gate valves 14 inches and larger with gearing to reduce operating effort. Equip gate valves 14 inches and larger, installed in horizontal lines in horizontal position with stems horizontal, with bronze track, roller and scrapers to support the weight of the gate for its full length of travel. Fit gate valves 14 inches and larger installed in vertical pipe lines with stems horizontal with slides to assist the travel of the gate assembly.

2.3.2 Check Valves

Provide iron-bodied check valves that permit free flow of sewage forward and provide a positive check against backflow. Design check valves for a minimum working pressure of 150 psi or as indicated. Directly cast the manufacturer's name, initials, or trademark and also the size of the valve, working pressure, and direction of flow on the body.

2.3.2.1 Ball Check Valves

Provide iron-bodied ball check valves, with flanged ends, that are of the non-slam type. Provide 125 pound type flanges complying with ASME B16.1 with stainless steel ball unless otherwise specified.

2.3.2.2 Swing Check Valves

Comply with AWWA C508. Provide with iron body, bronze mounted, and flanged ends. Provide 125 pound type flanges, complying with ASME B16.1.

2.3.3 Plug Valves

Provide cast iron valves complying with MSS SP-78 or steel plug valves in compliance with API Spec 6D.

2.3.4 Pinch Valves

Provide double acting, jam-proof type pinch valves with unobstructed streamlined flows and built-in operator. Provide iron bodied valves with a non-rising handwheel. Provide a sleeve of pure gum rubber, neoprene, Buna N or hypalon as required for service. Provide a valve with flanged ends of 125 pound type in compliances with ASME B16.1.

2.3.5 Air Release Valves

Provide air release valves designed to permit release of air from an empty pipe during filling and capable of discharging accumulated air in the line while the line is in operation and under pressure. Attach valves by means of threaded pipe connections. Vent valves to the atmosphere.

2.3.5.1 Manual Air Release Valves

Consisting of an 3 inch gate valve and 3 inch ductile iron pipe and fittings. Install the valve with its line of flow in the horizontal position.

2.3.5.2 Automatic Air Release Valve

Compound lever type capable of withstanding operating pressures of 150 psi, with a 1/2 inch outlet. Provide with iron body and cover of the valve and a stainless steel float. Provide internal parts made entirely of stainless steel or bronze. Provide valve specifically adapted for use with sewage and complete with hose and blow-off valves to permit backflushing without dismantling the valve.

2.4 VALVE VAULTS

Cast iron or concrete, except design concrete vaults installed in locations subject to vehicular traffic to withstand the following HS-20 AASHTO load designation as outlined in AASHTO HB-17. Provide extension type cast iron vaults with slide type adjustment and flared base. Provide 3/16 inch minimum metal. Ensure that the vault length is adaptable, without full extension, to the depth of cover over the pipe at the valve locations. Manufacture concrete vaults accordance with Section 03 42 13.00 10 PLANT-PRECAST CONCRETE PRODUCTS FOR BELOW GRADE CONSTRUCTION. Cast the word "SEWER" in the cover. Provide secure latch/lock mechanism to prevent unauthorized entry or tampering with the components within.

2.5 MISCELLANEOUS MATERIALS

Provide miscellaneous materials in compliance with the following requirements:

2.5.1 Pipe Coatings and Linings

a. Steel, interior: AWWA C203 or AWWA C210.

b. Steel, exterior, buried: AWWA C203.

c. Steel, exterior, exposed: AWWA C210.

2.5.2 Joint Lubricants

Provide joint lubricants as recommended by the pipe manufacturer.

2.5.3 Bolts, Nuts and Glands

AWWA C111/A21.11.

2.5.4 Joint Compound

A stiff mixture of graphite and oil or inert filler and oil.

2.5.5 Joint Tape

ASTM D3308.

2.5.6 Bond Wire

Bond wire type RHW or USE, Size 1/0 AWG, neoprene jacketed copper conductor shaped to stand clear of the joint.

PART 3 EXECUTION

3.1 INSTALLATION

Install pipe, pipe fittings, and appurtenances at the locations indicated. Perform excavation, trenching, and backfilling as specified in Section 31 00 00 EARTHWORK 31 23 00.00 20 EXCAVATION AND FILL.

3.1.1 Cutting

Cut pipe in a neat manner with mechanical cutters. Use wheel cutters where practicable. Grind sharp and rough edges smooth and remove loose material from the pipe before laying.

3.1.2 Laying

Except where otherwise authorized, lay pipe with bells facing the direction of laying. Before lowering and while suspended, inspect the pipe for defects. Reject defective material. Lay pipe in compliance with the following:

Nominal inside diameter of pipe	6 inches	8 inches
Nominal lining thickness	1/4 inch	1/4 inch
Nominal coating thickness	1 inch	1 inch
Class 150		
Total steel area per foot	0.94 square inch	0.94 square inch
Gauge cylinder number	16	16

3.1.3 Jointing

3.1.3.1 Concrete Pressure Pipe

Follow the manufacturer's instructions when lubricating and installing rubber gaskets. Provide joints that comply with the manufacturer's instructions. Fill the external annular space with cement mortar or with a portland cement-filled polyurethane loop. For pipe 24 inch diameter and larger, fill the internal annular space with cement mortar and struck off to ensure a smooth and continuous surface between pipe sections. Pipe less than 24 inch diameter must have a rope or trowelable mastic affixed to the concrete face of the bell socket before joining the sections of pipe. Ensure the mastic provided causes no problems with the rubber gasket and ensure the gasket fills the interior annular space when the pipe sections are pushed together.

3.1.3.2 Joints for PE Pipe

Provide heat fusion joints that comply with the manufacturer's instructions concerning equipment, temperature, melt time, heat coat, and joining time. Make flanged and mechanical joints in compliance with the manufacturer's instructions.

3.1.3.3 Joints for Polypropylene Pipe

Ensure heat fusion joints comply with the manufacturer's instructions concerning equipment, temperature, melt time, heat coat, and joining time.

3.1.3.4 Joints for PVC Pipe

a. Make threaded joints by wrapping the male threads with joint tape or by applying an approved thread lubricant, then threading the joining members together. Tighten the joint with strap wrenches taking care not to damage the pipe and fittings. Tighten the joint no more than 2 threads past hand-tight.

b. Bevel the ends of pipe for push-on joints to facilitate assembly. Mark pipe to indicate when the pipe is fully seated. Lubricate the gasket to prevent displacement. Ensure the gasket remains in proper position in the bell or coupling while the joint is made.

c. Ensure solvent-weld joints comply with the manufacturer's instructions.

3.1.3.5 Joints for RPMP Pipe

Use an elastomeric gasket in accordance with ASTM D4161.

3.1.3.6 Joints for RTRP Lines

Provide elastomeric gasket joints in compliance with the manufacturer's instructions.

3.1.3.7 Joints for Ductile Iron Pipe

Install mechanical and push-on type joints in compliance with AWWA C600 and the manufacturer's instructions. Install flanged joints in compliance with manufacturer's instructions.

3.1.3.8 Joints for Steel Pipe

Make screw joints tight with joint tape or joint compound applied with a brush to the male threads only. Install mechanical joints, push-on joints, and flanged joints in compliance with the manufacturer's instructions.

3.1.4 Coating and Lining

Field coat non-galvanized steel pipe in compliance with AWWA C203. Test the applied materials by means of a spark-type electrical device in compliance with AWWA C203. Repair flaws and holidays in the coating or lining of the pipe and the pipe joints; with the repaired areas at least equal in thickness to the minimum required for the pipe.

3.1.5 PE Pipe Encasement

[When installed underground, encase pipe with [_____] mil thick polyethylene in accordance with AWWA C105/A21.5.] [Encase in accordance with AWWA C105/A21.5.]

3.1.6 Installation of Valves

Prior to installation, clean valves of all foreign matter and inspect for damage and then fully open and close valves to ensure that all parts are properly operating. Install valves with the stem in the vertical position. [Install valves in valve vaults as indicated] [_____].

3.1.7 Installation of Valve Boxes

Install valve boxes over each outside gate valve, unless otherwise indicated. Center valve boxes over the valve. Carefully tamp fill around each valve box to a distance of 4 feet on all sides or to undisturbed trench face, if less than 4 feet.

3.1.8 Installation of Valve Vaults

Install valve vaults as indicated.

3.1.9 Drain Lines

Install drain lines where indicated. The drain line consists of a tee in the main line with a 4 inch diameter branch, a 4 inch diameter elbow, and a 4 inch gate valve.

3.1.10 Thrust Restraint

Provide thrust restraint as specified in Section 33 11 00 WATER UTILITY DISTRIBUTION PIPING. Provide plugs, caps, tees and bends deflecting 11-1/4 degrees or more, either vertically or horizontally, with thrust restraint. Securely anchor valves or provide with thrust restraints to prevent movement. Install thrust restraints made from either thrust blocks or, for ductile-iron pipes, restrained joints.

3.1.10.1 Thrust Blocks

Provide concrete thrust blocking of a mix not leaner than: 1 cement, 2-1/2 sand, 5 gravel; and having a compressive strength of not less than 2000 psi after 28 days. Place blocking between solid ground and the fitting to be anchored. Unless otherwise indicated or directed, place the base and thrust bearing sides of thrust blocks directly against undisturbed earth. Place the side of thrust blocks not subject to thrust against forms, if applicable. Provide the area of bearing as shown or as directed. Place blocking so that the fitting joints are accessible for repair. Use steel rods and clamps, protected by galvanizing or by coating with bituminous paint, to anchor vertical down bends into gravity thrust blocks.

3.1.10.2 Restrained Joints

For ductile iron pipe, design restrained joints in accordance with DIPRA TRD.

3.1.11 Grout

Provide grout mix for exterior joint protection on concrete pipes of 1 part portland cement, 2 parts sand, and of sufficient liquid consistency to flow into the joint recess beneath the diaper. Provide grout mix for interior joint protection of 1 part portland cement and 1 part sand. Substitute a polyurethane foam loop, impregnated with portland cement, in lieu of grout for exterior joints, if directed.

3.1.12 Bonded Joints

Where indicated, provide a thermally welded metallic bond at each joint, including joints made with flexible couplings or rubber gaskets, of ferrous-metallic piping to effect continuous conductivity.

3.2 FIELD QUALITY CONTROL

Perform both a pressure test and a leakage test on all pipelines. Obtain the Contracting Officer's approval of the method proposed for disposal of waste water from hydrostatic tests. The Contractor is responsible for all testing. Contractor will coordinate all tests to ensure they are witnessed by the Contracting Officer. Notify the Contracting Officer at least 7 days in advance of equipment tests. Submit the final test report to the Contracting Officer within 30 days after the test.

3.2.1 Pressure Test

After installing the pipe, joints, and thrust blocks, wait at least five days before pressure testing. For the pressure test, partially backfill the trench but leave the joints exposed for examination, then fill the pipe with water to expel all air. Subject the pipeline to a test pressure of 100 psi or 150 percent of the working pressure, whichever is greater, for a period of at least one hour. Open and close each valve several times during the test. Examine the exposed pipe, joints, fitting, and valves for leaks. Stop visible leaks or replace defective pipe, fittings, joints, or valves.

3.2.2 Leakage Test

Conduct the leakage test subsequent to or concurrently with the pressure test. Place the amount of water permitted as leakage for the line in a sealed container attached to the supply side of the test pump. Apply no other source of supply to the pump or line under test. Pump the water into the line by the test pump as required to maintain the specified test pressure as described for a 2 hour period. The test will be considered a failure upon exhaustion of the supply or the inability to maintain the required pressure. PE pipe experiences diametric expansion and pressure elongation during initial testing. Consult the manufacturer prior to testing for special testing considerations. Determine allowable leakage by the following I-P formula:

L = NDP/K Where:

L = Allowable leakage in gallons per hour.

N = Number of joints in length of pipeline tested.

D = Nominal diameter of the pipe in inches.

P = Square root of the test pressure in psig.

K = 7400 for pipe materials.

At the conclusion of the test, measure the amount of water remaining in the container and record the results in the test report.

[Test ductile iron pressure lines in accordance with the requirements of AWWA C600.]

[Test concrete pressure lines in accordance with the recommendations of AWWA M9.]

[Test plastic pressure lines in accordance with the recommendations of AWWA C605.]

3.2.3 Retesting

If any deficiencies are revealed during any test, correct such deficiencies, and repeat the tests until the results of the tests are within specified allowances, without additional cost to the Government.

END OF SECTION

SECTION 33 32 16

PACKAGED UTILITY WASTEWATER PUMPING STATIONS
11/19

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.20.1	(2013; R 2018) Pipe Threads, General Purpose (Inch)
ASME B16.1	(2020) Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250
ASME B16.3	(2021) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.11	(2016) Forged Fittings, Socket-Welding and Threaded

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C104/A21.4	(2016) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C110/A21.10	(2012) Ductile-Iron and Gray-Iron Fittings for Water
AWWA C111/A21.11	(2017) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115/A21.15	(2020) Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges
AWWA C151/A21.51	(2017) Ductile-Iron Pipe, Centrifugally Cast
AWWA C500	(2019) Metal-Seated Gate Valves for Water Supply Service
AWWA C509	(2015) Resilient-Seated Gate Valves for Water Supply Service
AWWA C515	(2020) Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service
AWWA C517	(2009) Resilent-Seated Cast-Iron Eccentric Plug Valves
AWWA C600	(2017) Installation of Ductile-Iron Mains and Their Appurtenances
AWWA C605	(2021) Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings

AWWA M23	(2020) Manual: PVC Pipe - Design and Installation - Third Edition

ASTM INTERNATIONAL (ASTM)

ASTM A48/A48M	(2003; R 2021) Standard Specification for Gray Iron Castings
ASTM A53/A53M	(2020) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A126	(2004; R 2019) Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A536	(1984; R 2019; E 2019) Standard Specification for Ductile Iron Castings
ASTM A615/A615M	(2020) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM C443	(2021) Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C478	(2018) Standard Specification for Circular Precast Reinforced Concrete Manhole Sections
ASTM C618	(2019) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C989/C989M	(2018a) Standard Specification for Slag Cement for Use in Concrete and Mortars
ASTM D883	(2020a) Standard Terminology Relating to Plastics
ASTM D1784	(2020) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D1785	(2015; E 2018) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
ASTM D2241	(2015) Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D2464	(2015) Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D2466	(2017) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D2467	(2015) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D3139	(2019) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals

ASTM D3753	(2019) Glass-Fiber-Reinforced Polyester Manholes and Wetwells
ASTM F477	(2014; R 2021) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 1940-1	(2003; R 2008) Mechanical Vibration - Balance Quality Requirements for Rotors in a Constant (Rigid) State - Part 1: Specification and Verification of Balance Tolerances

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-80	(2019) Bronze Gate, Globe, Angle and Check Valves

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(2016) Motors and Generators - Revision 1: 2018; Includes 2021 Updates to Parts 0, 1, 7, 12, 30, and 31

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code
NFPA 820	(2016) Standard for Fire Protection in Wastewater Treatment and Collection Facilities

UNDERWRITERS LABORATORIES (UL)

UL 67	(2018; Reprint Jul 2020) UL Standard for Safety Panelboards
UL 489	(2016; Rev 2019) UL Standard for Safety Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government . .] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fabrication Drawings

Erection/Installation Drawings

SD-03 Product Data

Submersible Sewage Grindernonclog Pumps; G

Pump Performance Curve; G

Pump Motor; G

Pump Control System; G

Wet Well and Valve Vault; G

Flexible Flanged Coupling; G

Station Piping and fittings; G

Valves; G

Spare Parts Data; G

Access Hatch Covers

SD-05 Design Data

Buoyancy Calculations; G

SD-06 Test Reports

Pump Test G

Pressure Sensor Test[; G]

Float Test[; G]

]SD-07 Certificates

Submersible Sewage Grindernonclog Pumps; G

Recycled Material Content[; G]

Manhole Chamber[; G]

Access Hatch Covers

Gate Valves[; G]

Check Valves[; G]

Blowers[; G]

Dehumidifier[; G]

Pump Motor[; G]

SD-08 Manufacturer's Instructions

Manhole Chamber[; G]

Access Hatch Covers

Pump Control System[; G]

Gate Valves[; G]

Check Valves[; G]

Blowers[; G]

Dehumidifier[; G]

Pump Motor[; G]

Special Tools[; G]

Posted Instructions[; G]

SD-10 Operation and Maintenance Data

Operation And Maintenance Manuals

SD-11 Closeout Submittals

Warranty[; G]

1.3 QUALITY CONTROL

1.3.1 Installer Qualifications

Provide manufacturer's authorized pump representative who is trained and approved for installation of pumps and packaged pump station required for this project.

1.4 DELIVERY, STORAGE, AND HANDLING OF MATERIALS

1.4.1 Delivery and Storage

Inspect materials delivered to site for damage. Unload and store with minimum handling. Store materials in enclosures or under protective covering. Rubber gaskets which are not to be installed immediately must be stored under cover, out of direct sunlight. Do not store materials directly on the ground. Keep interior of pipes, valves and fittings free of dirt and debris.

1.4.2 Handling

Handle pipe, fittings, valves, and other accessories in such manner as to ensure delivery to the trench in sound, undamaged condition. Avoid injury to coatings and linings on pipe and fittings; make repairs if coatings or linings are damaged. Carry pipe to the trench; do not drag it. Do not use any device or fitting inserted into (such as loader forks) or attached to (such as chain hooks) the bell or spigot ends of the pipe to transport pipe. Handle ductile iron pipe, fittings, and accessories in accordance with AWWA C600. Handle PVC pipe, fittings, and accessories in accordance with AWWA C605.

1.5 WARRANTY

Provide manufacturer's standard warranty for a minimum of one year for package pump station including pumps, valves, controls, wet well basin and accessories.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Provide a complete packaged sewage pump station with submersible grindernonclog pumps including equipment and materials, installed and ready for operation. The pump supplier furnishes the controls, pumps and rail system to ensure unit integrity.

Submit fabrication drawings before installation. Submit drawings covering necessary or recommended changes to accommodate the equipment offered. Show on the drawings the design of the chamber, with dimensions, types, and thicknesses of materials, and elevation levels with reference to those elevations indicated.

Submit erection/installation drawings for the manhole chamber with the required equipment and accessories. Provide precast reinforced concrete manhole sections conforming to ASTM C478. Show the design of the chamber, with dimensions, types, and thicknesses of materials, and elevation levels with reference to those elevations indicated.

2.2 SUBMERSIBLE SEWAGE GRINDER NONCLOG PUMPS

Provide submersible sewage nonclog pumps with grinder units as indicated. Provide UL listed pumps for explosion proof Class 1, Division 1, Groups C and D hazardous locations. Provide submersible, centrifugal sewage pumps and grinder units capable of grinding the materials found in normal domestic sewage, including plastics, rubber, sanitary napkins, disposable diapers, animal hair and wooden articles into a finely ground slurry with particle dimensions no greater than 1/4 inch of the nonclogging type with passageways designed to pass 3 inch diameter spheres without clogging. Provide pump capacity, number of pumps and motor characteristics as indicated on the drawings. Select pumps to continuously operate in a submerged or partially submerged condition.

2.2.1 Pump Construction

2.2.1.1 Casing

Provide hard, close-grained cast iron casing or steel that is free from blow holes, porosity, hard spots, shrinkage defects, cracks, and other injurious defects. Provide casings permitting replacement of wearing parts. Ensure all joints are gasketed to prevent leakage. Ensure passageways permit smooth flow of sewage and are free of sharp turns and projections. Use free standing pump support legs of cast-iron providing enough clearance for the solids to get into the grinder.

2.2.1.2 Impeller

Provide a stainless steel impeller for the grinder pump with stainless steel cutter, grinder, or slicer assembly. Provide nonclogging type cast-iron impeller, conforming to ASTM A48/A48M, Class 30, for a submersible nonclog pump. Ensure the impeller has a smooth surface and allows free flowing with the clearance to permit objects in the sewage to pass. Fit and key, spline, or thread impeller on shaft, and lock in such manner that lateral movement is prevented and reverse rotation will not cause loosening.

2.2.1.3 Bearings

Provide heavy duty ball thrust bearing or roller type bearing sized to withstand imposed loads. Oil lubricate bearings.

2.2.1.4 Lubrication

Provide the pump manufacturer's standard type grease fittings.

2.2.1.5 Balance

Balance rotating parts of the equipment mechanically and hydraulically to operate throughout the required range without excessive end thrust, vibration, and noise. Conform allowable vibration limits with ISO 1940-1, Table 1. Existence of defects that cannot be eliminated by adjustment will be sufficient cause for rejection of the equipment.

2.3 PUMP MOTOR

Provide hermetically sealed electric motors with moisture and temperature-sensing probes in the wet well NEMA MG 1, [_____] RPM, 115 volt, [_____] phase, and [_____] Hz cycle for submersible pumps. Motor horsepower must not be less than pump horsepower at any point on the pump performance curve. Fit motors with lifting "eyes" capable of supporting entire weight of pump and motor. Seal the power cable inside the motor end bell. Provide a waterproof power cable for its full length. Motors shall be UL listed for explosion proof Class 1, Division 1, Groups C and D. Air filled motors are not acceptable. Oil used must be able to be disposed as non-hazardous waste.

2.4 PUMP CONTROL SYSTEM

2.4.1 General

Provide an automatic type pump operating control including all necessary components to function reliably. Mount controls in a NEMA [3R][_____] rated stainless steel control panel. Ensure equipment subject to contact with sewage or sewage gases is corrosion-resistant metal. Provide an electronic controller that automatically activates and alternates the pump operation. If the liquid level continues to rise to the plans-specified level, the controller engages both pumps to operate simultaneously until both shut off at the specified low level. Provide hand-off-auto switches to choose the mode of operation for each pump. Provide controls with a 12 VDC powered float switch connected to the alarm contact of the battery charger to activate high-level alarms.

Protect pumping stations from lightning and transient voltage surges and equip with phase protection.

Provide the station with a three-wire, 4-pole (grounding) receptacle for a portable generator in case there is an external power outage.

Design the control system to operate pumps at the power characteristics as shown on the plans. Ensure all controls and wiring meet or exceed the requirements of NFPA 70.

For pumps specified as explosion proof, have pump power and control installation meets NEC requirements for Class 1, Division 1, Group D Hazardous Location, including intrinsically safe controls. Provide components that are UL listed or FM approved.

Require the control function to provide for the operation of the pumps under normal conditions and alternates the pumps on each pump down cycle.

In the event the incoming flow exceeds the pumping capacity of the lead pump, the offline pumps automatically start to handle the increased flow. As the flow decreases, the pumps cut off at the elevations set on the controller.

2.4.2 Enclosure

Provide a NEMA 3R rated enclosure manufactured from stainless steel. The enclosure is a wall mount type suitable for mounting on strut or channel with a minimum depth sized to adequately house all the components. Provide a rubber composition door gasket and assures a positive weatherproof seal. Provide a door that opens a minimum of 180 degrees and is equipped with a 3-point latch and padlockable handle.

Provide a dead front mounted in the panel to provide protection of personnel from live internal wiring. Install cutouts for breaker handles to allow operation of breakers without entering the compartment.

Mount all control switches, indicator pilot lights, elapsed time meters, duplex receptacle and other operational devices on the external surface of the dead front.

Ensure the dead front opens a minimum of 150 degrees to allow access to equipment for maintenance.

Mount all hardware to the subpanel with machine thread tapped holes. Sheet metal screws are not acceptable. Permanently identify all devices to match the schematic diagram.

Provide an enclosure ventilator located near the top of the enclosure on the opposite side of the generator receptacle. Provide a rain and vermin proof ventilator and made of fire retardant thermoplastic material.

2.4.3 Level Control System

Provide the pump station with a submersible pressure type level sensor and an electronic pump controller. Sense levels by a 24 DVC, 1 percent submersible pressure transmitter provided by controller manufacturer. Construct the system as follows:

a. The pressure type level sensor is a submersible type, suspended on its cable.

b. Install the sensor per manufacturer's instructions for wet well installations, including any recommended mounting accessories.

c. The level sensor is as follows:

(1) Select the sensor range based on the wet well depth.

(2) The sensor output is 4-20mA proportional to water level, 2-wire type.

(3) Construct all exposed parts of 316 Stainless Steel.

(4) Fill the sensor with Silicon Oil.

(5) Power the Sensor by 24 VDC output from electronic pump controller.

d. Mount the electronic pump controller in the starter panel enclosure, and be visible from the front of the swing-out panel, with the enclosure door opened. The electronic pump controller is as follows:

(1) Accept a 4-20 mA, 2 wire level signal, and indicate the wet well level digitally in direct engineering units (feet).

(2) Provide pump control outputs, with independent adjustment for each pump starting and stopping setpoint. Indicate each level setpoint digitally in direct engineering units.

(3) Power to the unit is 120 VAC.

(4) Equip controller with hand/off/auto (H.O.A.) switches and pump on indicating lights (one each per pump).

Provide an intrinsically safe barrier relay between the wet well and the control panel.

2.4.4 Alternator

Provide an alternator control switch to operate in connection with each float. Use an alternator control switch to alternate the operation of the pumps and operate both pumps if the water level rises above the second high water level. Incorporate time delay function and devices in the alternator controls such that both sewage pumps cannot be started simultaneously for an adjustable period of 10 to 120 seconds after shutdown. Use the delay function designed to operate in any condition of start-up in either normal or emergency operational mode.

2.4.5 Sewage Pump Alarm and Control Panel

Enclose alarm panel in NEMA [4X] [3R] enclosure and with a flashing red light that is visible from 50 feet away, with long life bulb in guarded enclosure and 6 inch diameter horn. Use horns capable of emitting 120 DB at 10 feet. Power alarm horn and light from 12V DC power supply with battery backup. Provide a rechargeable battery rated to power both the horn and light for a minimum of two hours upon loss of main power. Provide circuitry to automatically recharge the battery after main power is restored. Use batteries capable of being fully recharged in no more than 20 hours. Use panel with power on light, push to test button for horn and light and push to silence button for horn and light with automatic reset for next alarm.

2.4.5.1 Alarms

Provide a test function ability for the alarm system. Provide alarms to activate under the following conditions:

a. High liquid level as sensed by the level control system.

b. Loss of main power.

c. No flow light as sensed by limit switch on the check valve or as sensed by current sensors.

d. Pump failure via temperature overload or motor heat sensor trip; provide motor high temperature light.

e. Seal failure with indication light.

2.4.5.2 Circuit Breakers

a. Provide an individual circuit breaker for each pump.

b. Include a control circuit breaker and an alarm circuit breaker in the control panel.

c. Allow for two additional spare 115V single phase 20A circuit breakers for local pole lighting and future spare.

d. Provide circuit breakers in accordance with UL 489

e. Conform to UL 67 for circuit breaker mounting.

2.4.5.3 Motor Starter and Overload Protection

Provide an International Electrotechnical Commission (IEC) rated motor starter and thermal overload protection located in the control panel for each pump. Include undervoltage release, manual reset buttons and hand-automatic selector switches.

2.4.5.4 Power Lugs

a. Size the incoming power lugs for the proper voltage, amperage, and horsepower for each pump station.

b. Include grounding lugs for the incoming power. Provide a dedicated grounding lug in the control panel for each pump.

c. Size ground lug and rod according to local and base electrical codes and install by a licensed electrician.

d. Use UL listed power lugs.

e. Conform to UL 67 for required power lug mounting.

2.4.5.5 Anti-Condensation Heater

a. Provide an anti-condensation heater in the control panel that is sized based upon the size of the particular pump station's control panel size.

b. Power the heater from the control voltage transformer for three phase pump motor units and from the incoming power for single phase pump motor units.

c. Control the heater by a thermostat, coming on at 50 degree F and going off at 65 degree F.

d. Clearly label panel directory for breakers.

2.4.5.6 Trouble Light

Provide a fluorescent trouble shooting light in the panel that is hard-wired into an appropriately sized circuit breaker. It is acceptable for the light and one of the convenience outlets to share the same circuit breaker.

2.4.5.7 Convenience Outlets

a. Place two duplex convenience outlets in the control panel; utilize one for the battery charger. The battery receives power from the control voltage transformer via the alarm fuse.

b. Upsize the alarm fuse to 1 to 1.5 amps for the battery charger.

c. Provide each outlet with its own 20 amp 115/1/60 circuit breaker.

2.4.5.9 Additional Requirements

a. Provide elapsed time meter for each pump that measures run time in hours to 9999.9.

b. Do not place junction boxes between pumps, control systems and control panels; provide conduit seals at all wet well penetrations. If this is unavoidable, use NEMA 7 construction.

2.4.6 Electrical Requirements

Install labels to identify switches and controls. Provide internal wiring for components of packaged equipment as an integral part of the equipment. Provide power wiring and conduit for field installed equipment.

2.5 WET WELL AND VALVE VAULT

2.5.1 Wet Well and Valve Vault

Provide a fiberglass reinforced polyester resin basin with integral valve vault precast concrete wet well; include a separate precast concrete valve vault. Provide a wet well and valve vault with inside diameters [as indicated and to the depths indicated on the drawings.[

Precast structures may be provided in lieu of cast-in-place structures.]

2.5.1.1 Fiberglass Basins

a. Buoyancy Calculations: Submit buoyancy calculations sealed by a licensed professional engineer assuming seasonal high groundwater elevation at proposed finished grade. Prevent flotation in accordance with manufacturer's written instructions. Include manufacturer's written instructions with submitted calculations.

b. Select Fiberglass Reinforced Polyester (FRP) wet well in accordance with ASTM D883 relating to plastics and ASTM D3753.

(1) Use commercial grade polyester resins evaluated as a laminate by test or determined by previous service to be acceptable for use in the wastewater environment.

(2) Use a commercial grade continuous strand fiberglass reinforcement material.

(3) Design FRP based on the following assumed conditions. Provide independent third party testing.

(a) Hydrostatic pressure of 62.4 pounds/square foot with water at ground surface.

(b) Saturated soil weight of 120 pounds/cubic foot.

(c) Soil modulus of 700 pounds/square foot.

(d) Pipe stiffness values as specified in ASTM D3753.

(e) Provide FRP laminate with a surface hardness of 90 percent Barcol.

2.5.1.2 Precast Concrete Structures

Submit manufacturer's data indicating percentage of recycled material content in packaged sewage lift stations to verify affirmative procurement compliance.

Fly ash is required as an admixture and is to conform to ASTM C618, Class [F][C]. Fly ash replacement of cement is not to exceed 20 percent (maximum one part fly ash to four parts cement) by weight.

Ground granulated blast furnace slag [is required] [used] as an admixture [and] is to conform to ASTM C989/C989M, Grade [120] with between 25 to 50 percent maximum cement replacement by weight. Submit certificate to verify EPA-CPG compliance.

a. Buoyancy Calculations: Submit buoyancy calculations sealed by a licensed professional engineer assuming seasonal high groundwater elevation at proposed finished grade.

b. Construct precast concrete structures in accordance with ASTM C478, except as specified herein. Provide precast concrete structures with a compressive strength of 4000 psi at 28 days and an air entrainment of 6 percent, plus or minus 2 percent, and a minimum wall thickness of 5 inches. ASTM A615/A615M reinforcing bars. ASTM C443, Type B gaskets for joint connections. Use monolithic base and first riser.

2.5.2 Access Hatch Covers

Provide aluminum access hatch covers as indicated. Include lifting mechanism, automatic hold open arm, slam lock with handle, and flush lift handle with vinyl grip. Use automatic hold open arm that locks in the 90 degree position. Use cover that is 1/4 inch diamond plate with 1/4 inch channel frame and continuous anchor flange. Use access hatch cover capable of withstanding a live load of 300 lb/sq. ft. Provide stainless steel cylinder lock with two keys per lock. Key all the locks the same.

2.5.3 Wet Well Base Material

Provide crushed stone as indicated and specified in Section 31 00 00 EARTHWORK.. Provide a polyethylene vapor barrier as indicated and specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

2.5.3.1 Ventilating Blower

Ensure blowers maintain air changes in accordance with NFPA 820 every 5minutes. Mount a manual and automatic switch on the side of the entrance tube for operation of the blower. Provide vent to atmosphere with covers and screens to prevent the entrance of rain, insects, and rodents. Automatically actuate blower upon opening the entrance tube cover, unless overridden by the manual control.

2.5.3.2 Dehumidifier

Furnish and install a packaged dehumidifier in accordance with lift station manufacturer's recommendations. Include in controls a humidistat and low-temperature cutout/discharge condensate to the wet well.

2.6 STATION PIPING

Provide pressure piping, emergency pump connection, air release valves, and related accessories for force main piping outside the sewage wet well and valve vault in accordance with Section 33 30 00 SANITARY SEWERAGE.

2.6.1 Ductile-Iron Pressure Pipe and Associated Fittings

Conform to AWWA C151/A21.51, Pressure Class 350.

2.6.1.1 Flanged Pipe

Conform to AWWA C115/A21.15, ductile iron.

2.6.1.2 Fittings

AWWA C110/A21.10, flanged. Provide flanged joint fittings within wet well and valve vault as indicated. Provide mechanical joint fittings outside valve vault enclosure as indicated. Use fittings with pressure rating at least equivalent to that of the pipe.

2.6.1.3 Joints

AWWA C115/A21.15 for flanged joints. Use bolts, nuts, and gaskets for flanged connections recommended in the Appendix to AWWA C115/A21.15. Provide ductile iron flange for setscrewed flanges in accordance with ASTM A536, Grade 70-50-05 or 60-42-10, and meeting the applicable requirements of ASME B16.1, Class 125. Use 190,000 psi tensile strength, heat treated, and zinc-coated steel setscrews for setscrewed flanges. Conform to the applicable requirements for mechanical-joint gaskets specified in AWWA C111/A21.11 for setscrewed flange gaskets. Use setscrewed gasket designed to provide for confinement and compression of gasket when joint to adjoining flange is made.

2.6.2 PVC Plastic Pressure Pipe and Associated Fittings

2.6.2.1 Pipe and Fittings Less Than 4 inch Diameter

Use pipe, couplings and fittings manufactured of materials conforming to ASTM D1784, Class 12454-B.

a. Screw-Joint: Follow dimensional requirements of ASTM D1785 Schedule 80 pipe, with joints meeting requirements of 150 psi working pressure, 200 psi hydrostatic test pressure, unless otherwise shown or specified. Follow ASTM D2464 and ASME B1.20.1 for use with Schedule 80 threaded pipe and fittings. Test pipe couplings when used, as required by ASTM D2464.

b. Push-On Joint: ASTM D3139, with ASTM F477 gaskets. Fittings for push-on joints: AWWA C110/A21.10 or AWWA C111/A21.11. Iron fittings and specials: cement-mortar lined (standard thickness) in accordance with AWWA C104/A21.4.

c. Solvent Cement Joint: Use pipe that matches the dimensional requirements of ASTM D1785 or ASTM D2241 with joints meeting the requirements of 150 psi working pressure and 200 psi hydrostatic test pressure. Use fittings for solvent cement jointing that match the requirements of ASTM D2466 or ASTM D2467.

2.6.3 Insulating Joints

Provide between pipes of dissimilar metals a rubber gasket or other approved type of insulating joint or dielectric coupling to effectively prevent metal-to-metal contact between adjacent sections of piping.

2.6.4 Accessories

Provide flanges, connecting pieces, transition glands, transition sleeves, and other adapters as required.

2.6.5 Flexible Flanged Coupling

Provide flexible flanged couplings applicable for sewage as indicated. Use flexible flanged coupling designed for a working pressure of 350 psi.

2.7 VALVES AND OTHER PIPING ACCESSORIES

2.7.1 Isolation Gate Valves in Valve Vault

Conform to AWWA C500 for gate valves with outside-screw-and-yoke rising-stem type with double disc gates and flanged ends. Conform to AWWA C509 for valves with outside-screw-and-yoke rising-stem type with flanged ends. Provide valves that open by counterclockwise rotation of the valve stem. [Bolt

and construct stuffing boxes to permit easy removal of parts for repair of gate valves.] Use valves from one manufacturer.

2.7.1.1 Valves Larger Than 2 Inches

Resilient seat gate valves conforming to AWWA C509 with non-rising stems and flanged ends.

2.7.1.2 Valves 2 Inches and Smaller

Gate valves conforming to MSS SP-80 with non-rising stems and threaded ends.

2.7.2 Check Valves Less Than 4 inch Diameter

Neoprene ball check valve with integral hydraulic sealing flange, designed for a hydraulic working pressure of 175 psi.

2.7.3 Check Valves 4 inch and Larger Diameter

Provide nonclogging swing check valve rated for not less than 175 psig working pressure capable of passing 3-inch diameter solids. Match cast iron to ASTM A126 and flanged ends to AWWA C110/A21.10 Buna-N disc and integral seat.

Provide a positive horizontal, swing check type check valves. Provide valves that permit a free flow of sewage forward and a positive check against backflow. Provide iron body valves with a removable cover for inspection and removal of the gate assembly. Provide bronze gate, gate seats, shaft, studs, and nuts.

2.7.4 Identification Tags and Plates

Provide the manufacturer's name or trademark on a corrosion-resistant identification plate or cast integrally, stamped, or otherwise permanently marked in a conspicuous place on each item of equipment. Include on the pump identification plate the pump capacity in gpm, pump head in feet and speed of rotation. Cast on the body of the pump the direction of rotation.

2.7.5 Pipe Support

Use pipe support schedule 40 galvanized steel piping matching ASTM A53/A53M. Provide either ASME B16.3 or ASME B16.11 galvanized threaded fittings.

2.7.6 Miscellaneous Metals

Use stainless steel bolts, nuts, washers, anchors, and supports for installation of equipment.

2.7.7 Quick Disconnect System with Hydraulic Sealing Flange and Rail System

Use quick disconnect system consisting of a steel base plate for supporting the pumps, a hydraulic sealing flange, pump guide rails and the discharge pipe supports. Provide stainless steel guide rails, brackets and lifting chain for raising and lowering the pump in the basin. Build guides onto pump housing to fit the guide post to assure perfect alignment between pump and guide rails.

2.7.8 Wet Well Vent

Provide a [flanged ductile iron pipe and bend, conforming to AWWA C115/A21.15] [galvanized steel pipe and bend, conforming to ASTM A53/A53M] with insect screening.

2.8 EXCAVATION, TRENCHING, AND BACKFILLING

Provide in accordance with Section 31 00 00 EARTHWORK, 31 23 00.00 20 EXCAVATION AND FILL, except as specified herein.

PART 3 EXECUTION

3.1 INSTALLATION

Provide pump station in accordance with drawings and requirements of the respective equipment manufacturers. Dampen and isolate equipment vibration.

3.1.1 Equipment Installation

Install equipment in accordance with these specifications and the manufacturer's installation instructions. Grout equipment mounted on concrete foundations before installing piping. Install piping to avoid imposing stress on equipment. Match flanges before securing bolts.

3.1.2 Installation of Ductile-Iron Pressure Pipe and Fittings

Unless otherwise specified, install pipe and fittings in accordance with the paragraph GENERAL REQUIREMENTS FOR INSTALLATION OF PIPELINES of Section 33 30 00 SANITARY SEWERAGE, and with the requirements of AWWA C600 for pipe installation, joint assembly, and valve-and-fitting installation.

Make flanged joint with gaskets, bolts, and nuts specified for this type joint. Make flanged joints tight, avoid strain on flanges, fittings, and other accessories. Align bolt holes for each flanged joint. Use bolts sized for the bolt holes; use of undersized bolts is not permitted. Do not allow adjoining flange faces to be out of parallel to such degree that the flanged joint cannot be made watertight without overstraining the flange.

3.1.3 Installation of PVC Plastic Pressure Pipe and Fittings

Unless otherwise specified, install pipe and fittings in accordance with the paragraph GENERAL REQUIREMENTS FOR INSTALLATION OF PIPELINES of Section 33 30 00 SANITARY SEWERAGE, with the recommendations for pipe joint assembly and appurtenance installation in AWWA M23, "Installation."

3.1.3.1 Pipe Less than 4 Inch Diameter:

a. Make threaded joints by wrapping the male threads with joint tape or by applying an approved thread lubricant, then threading the joining members together. Tighten joints with strap wrenches that will not damage the pipe and fittings. Do not tighten joint more than 2 threads past hand-tight.

b. Push-On Joints: Bevel ends of pipe for push-on joints to facilitate assembly. Mark pipe to indicate when the pipe is fully seated. Lubricate gasket to prevent displacement. Ensure that the gasket remains in position in the bell or coupling while making the joint.

c. Solvent-weld joints: Comply with the manufacturer's instructions.

3.1.4 Valves

Make and assemble joints to gate valves and check valves as specified for making and assembling the same type joints between pipe and fittings.

Install valves in accordance with manufacturer's installation instructions. Install gate valves as described in AWWA C500, AWWA C509, and AWWA C515 and with AWWA C600 for valve-and-fitting installation and with the recommendations of the Appendix ("Installation, Operation, and Maintenance of Gate Valves") to AWWA C500.

3.2 FIELD QUALITY CONTROL

Provide appliances, materials, water, and equipment for testing, [except that water and electric power needed for field tests will be provided as set forth in Division 01] [and bear full expenses in connection with the testing]. Conduct testing after equipment, electrical services, and piping are installed, and the pump station is ready for operation. Correct defects discovered to the satisfaction of the Contracting Officer, and tests repeated, at no expense to the Government, until the equipment functions as intended and designed.

3.2.1 Testing Procedure

Perform a pump test, pressure sensor test, float test. Submit the test results to the Contracting Officer.

Test all panels to the power requirements as shown on the plans to assure proper component operation. Activate each control function to check for proper operation and indication.

3.2.2 Field Representative

A representative of the pump manufacturer is to direct the startup of the station and instruct representatives of the Government in startup and operation procedures.

3.3 CLOSEOUT ACTIVITIES

3.3.1 Operation and Maintenance

Submit operation and maintenance manuals in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA for package lift stations, including Equipment Description, Assembly and Installation Procedures, Adjustment and Alignment, Checkout Procedures, Procedures of Operation and Troubleshooting. Include preventative maintenance and inspection procedures for package lift stations. Include in procedures the frequency of preventative maintenance, inspection, adjustment, lubrication, and cleaning necessary to minimize corrective maintenance and repair.

Supply special tools that are required for maintenance and testing of the package lift stations.

Submit spare parts data, including a complete list of parts and supplies with current unit prices and source of supply. List parts and supplies that are either normally furnished at no extra cost with the purchase of equipment, or specified to be furnished as a part of the contract, and list additional items recommended by the manufacturer to ensure an efficient operation for a period of one year.

Install on or near the package lift stations, a complete package of posted instructions, consisting of labels, signs, and templates of operating instructions.

Provide a list or reference all specific operation and maintenance procedures that are required to keep the warranty valid.

END OF SECTION

SECTION 33 40 00

STORMWATER UTILITIES
11/21

PART 1 GENERAL

1.1 UNIT PRICES

1.1.1 Pipe Culverts and Storm Drains

The length of pipe installed will be measured along the centerlines of the pipe from end to end of pipe without deductions for diameter of manholes. Pipe will be paid for at the contract unit price for the number of linear feet of culverts or storm drains placed in the accepted work.

1.1.3 Storm Drainage Structures

The quantity of manholes and inlets will be measured as the total number of manholes and inlets of the various types of construction, complete with frames and gratings or covers and, where indicated, with fixed side-rail ladders, constructed to the depth of 4 feet in the accepted work. The depth of manholes and inlets will be measured from the top of grating or cover to invert of outlet pipe. Manholes and inlets constructed to depths greater than the depth specified above will be paid for as units at the contract unit price for manholes and inlets, plus an additional amount per linear foot for the measured depth beyond a depth of 4 feet.

1.1.4 Walls and Headwalls

Walls and headwalls will be measured by the number of cubic yards of reinforced concrete, plain concrete, or masonry used in the construction of the walls and headwalls. Wall and headwalls will be paid for at the contract unit price for the number of walls and headwalls constructed in the completed work.

1.1.5 Flared End Sections

Flared end sections will be measured by the unit. Flared end sections will be paid for at the contract unit price for the various sizes in the accepted work.

1.1.6 Sheeting and Bracing

Payment will be made for that sheeting and bracing ordered to be left in place, based on the number of square feet of sheeting and bracing remaining below the surface of the ground.

1.1.7 Rock Excavation

Payment will be made for the number of cubic yards of material acceptably excavated, as specified and defined as rock excavation in Section 31 00 00 EARTHWORK , measured in the original position, and computed by allowing actual width of rock excavation with the following limitations: maximum rock excavation width, 30 inches for pipe of 12 inch or less nominal diameter; maximum rock excavation width, 16 inches greater than outside diameter of pipe of more than 12 inch nominal diameter. Measurement will include authorized overdepth excavation. Payment will also include all necessary drilling and blasting, and all incidentals necessary for satisfactory excavation and disposal of authorized rock excavation. No separate payment will be made for backfill material required to replace rock excavation; include this cost in the unit price bid per cubic yard for rock excavation. In rock excavation for manholes and other appurtenances, 1 foot will be allowed outside the wall lines of the structures.

1.1.8 Backfill Replacing Unstable Material

Payment will be made for the number of cubic yards of select granular material required to replace unstable material for foundations under pipes or drainage structures, which will constitute full compensation for this backfill material, including removal and disposal of unstable material and all excavating, hauling, placing, compacting, and all incidentals necessary to complete the construction of the foundation satisfactorily.

1.1.9 Concrete Ditch Lining

Payment will be made for the number of linear feet of concrete ditch lining including any steel reinforcing accepted in the completed work measured along the centerline of the ditch.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO HB-17	(2002; Errata 2003; Errata 2005, 17th Edition) Standard Specifications for Highway Bridges
AASHTO M 43	(2005; R 2018) Standard Specification for Sizes of Aggregate for Road and Bridge Construction
AASHTO M 288	(2021) Standard Specification for Geosynthetic Specification for Highway Applications
AASHTO M 294	(2021) Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm (12- to 60-in.) Diameter

ASTM INTERNATIONAL (ASTM)

ASTM A48/A48M	(2003; R 2021) Standard Specification for Gray Iron Castings
ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A536	(1984; R 2019; E 2019) Standard Specification for Ductile Iron Castings
ASTM A716	(2018) Standard Specification for Ductile Iron Culvert Pipe
ASTM B26/B26M	(2018; E 2018) Standard Specification for Aluminum-Alloy Sand Castings
ASTM C32	(2013; R 2017) Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale)
ASTM C55	(2017) Standard Specification for Concrete Building Brick

ASTM C62	(2017) Standard Specification for Building Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C76	(2020) Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C139	(2017) Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes
ASTM C231/C231M	(2017a) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C270	(2019a; E 2019) Standard Specification for Mortar for Unit Masonry
ASTM C425	(2021) Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings
ASTM C443	(2021) Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C478/C478M	(2020) Standard Specification for Circular Precast Reinforced Concrete Manhole Sections
ASTM C506	(2020) Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe
ASTM C655	(2019a) Standard Specification for Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe
ASTM C923/C923M	(2020) Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
ASTM C990	(2009; R 2019) Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
ASTM C1103	(2019) Standard Practice for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
ASTM D1056	(2020) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D1171	(2018) Standard Test Method for Rubber Deterioration - Surface Ozone Cracking Outdoors (Triangular Specimens)
ASTM D1751	(2018) Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D1752	(2018) Standard Specification for Preformed Sponge Rubber, Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction

ASTM D2321	(2020) Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D2487	(2017; E 2020) Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D2564	(2020) Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D3034	(2016) Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D3212	(2020) Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM F477	(2014; R 2021) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F679	(2016) Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
ASTM F794	(2021) Standard Specification for Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
ASTM F894	(2019) Standard Specification for Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
ASTM F949	(2020) Standard Specification for Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings
ASTM F1417	(2011a; E 2020) Standard Practice for Installation Acceptance of Plastic Non-pressure Sewer Lines Using Low-Pressure Air
ASTM F2418	(2019) Standard Specification for Polypropylene (PP) Corrugated Wall Stormwater Collection Chambers
ASTM F2562/F2562M	(2015; R 2019) Specification for Steel Reinforced Thermoplastic Ribbed Pipe and Fittings for Non-Pressure Drainage and Sewerage
ASTM F2764/F2764M	(2019) Standard Specification for 6 to 60 in. Polypropylene (PP) Corrugated Double and Triple Wall Pipe and Fittings for Non-Pressure Sanitary Sewer Applications
ASTM F2881/F2881M	(2021; E 2021) Standard Specification for 12 to 60 in. (300 to 1500 mm) Polypropylene (PP) Dual Wall Pipe and Fittings for Non-Pressure Storm Sewer Applications
ASTM F2922	(2013; R 2018) Standard Specification for Polyethylene (PE) Corrugated Wall Stormwater Collection Chambers
ASTM F3219	(2019) Standard Specification for 3 to 30 in. (75 to 750 mm) Polypropylene (PP) Corrugated Single Wall Pipe and Fittings

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-06 Test Reports

Leakage Test; G

SD-07 Certificates

Hydrostatic Test on Watertight Joints; G

Frame and Cover or Gratings; G

SD-08 Manufacturer's Instructions

Placing Pipe and Box Culvert; G

SD-11 Closeout Submittals

Post-Installation Inspection Report; G

LID Verification Report; G

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Delivery and Storage

Inspect materials delivered to site for damage and unload and store materials with minimal handling. Do not store materials directly on the ground. Keep the inside of pipes and fittings free of dirt and debris. Before, during, and after installation, protect plastic pipe and fittings from any environment that would result in damage or deterioration to the material. Keep a copy of the manufacturer's instructions available at the construction site at all times and follow these instructions unless directed otherwise by the Contracting Officer. Store solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install plastic pipe in accordance with the manufacturer's recommendations and discard if the storage period exceeds the recommended shelf life. Discard solvents in use when the recommended pot life is exceeded.

1.4.2 Handling

Handle materials in a manner that ensures delivery to the trench in sound, undamaged condition. Carry pipe to the trench.

PART 2 PRODUCTS

2.1 PIPE FOR CULVERTS AND STORM DRAINS

Pipe sizes for culverts and storm drains are indicated on the drawings.

2.1.7 Ductile Iron Culvert Pipe

Provide ductile iron culvert pipe conforming to ASTM A716.

2.1.8 Poly Vinyl Chloride (PVC) Pipe

2.1.8.1 Type PSM PVC Pipe

ASTM D3034, maximum SDR 35.

2.1.8.2 Profile PVC Pipe

ASTM F794, Series 46.

2.1.8.3 Smooth Wall PVC Pipe

ASTM F679.

2.1.8.4 Corrugated PVC Pipe

ASTM F949.

2.1.9 Polyethylene (PE) Pipe

2.1.9.1 Corrugated PE Pipe

AASHTO M 294, Type S. Provide pipe walls having the following properties:

USACE / NAVFAC / AFCEC / NASA UFGS-33 40 00 (February 2021)

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Preparing Activity: USACE SupersedingUFGS-33 40 00 (February 2010)

2.1.9.2 Profile Wall PE Pipe

ASTM F894, RSC 160. Provide pipe walls having the following properties:

Nominal Size (inch)	Minimum Wall Area (square in/ft)	Minimum Moment of Inertia of Wall Section (in. to the 4th/in.)
12	1.5	0.024
15	1.91	0.053
18	2.34	0.062
24	3.14	0.116
30	3.92	0.163
36	4.50	0.222

Nominal Size (inch)	Minimum Wall Area (square in/ft)	Minimum Moment of Inertia of Wall Section (in. to the 4th/in.)
42	4.69	0.543
48	5.15	0.543
54	5.67	0.800
60	6.45	0.800

2.1.11 Polypropylene(PP) Pipe

Provide double wall and triple wall pipe meeting the requirements of ASTM F2764/F2764M or ASTM F2881/F2881M, Class [I] [II].

2.2 PIPE JOINTS

[Provide joints that have been tested for and meet the requirements of paragraph HYDROSTATIC TEST ON WATERTIGHT JOINTS.]

2.2.4 Ductile Iron Pipe

Provide push-on type joints with rubber gaskets.

2.2.5 PVC Plastic Pipe

Provide solvent cement or elastomeric gasket type joints in accordance with the specification for the pipe and as recommended by the pipe manufacturer. Use solvent cement conforming to ASTM D2564. Provide gaskets for elastomeric joints conforming to ASTM F477.

2.2.6 Corrugated PE Plastic Pipe

Provide soil tight joints conforming to the requirements in AASHTO M 294. Make water tight joints using a PE coupling and rubber gaskets as recommended by the pipe manufacturer. Provide rubber gaskets conforming to ASTM F477.

2.2.7 Profile Wall PE Pipe

Provide gasketed or thermal weld type with integral bell joints in accordance with ASTM F894.

2.6 MISCELLANEOUS MATERIALS

2.6.1 Concrete

Unless otherwise specified, provide concrete and reinforced concrete conforming to the requirements for 3000 psi concrete under Section 03 30 00 CAST-IN-PLACE CONCRETE. Provide air content by volume of concrete mixture, based on measurements made immediately after discharge from the mixer, of 5 to 7 percent when maximum size of coarse aggregate exceeds 1-1/2 inches. Determine air

content in accordance with ASTM C231/C231M. Provide a minimum concrete covering over steel reinforcing of not less than 1 inch thick for covers and not less than 1-1/2 inches thick for walls and flooring. For concrete deposited directly against the ground, provide a covering thickness of at least 3 inches between steel and ground. Provide expansion-joint filler material conforming to ASTM D1751, or ASTM D1752, or provide be resin-impregnated fiberboard conforming to the physical requirements of ASTM D1752.

2.6.2 Mortar

Mortar is not allowed for pipe joints. Provide mortar for pipe connections to drainage structures conforming to ASTM C270, Type M, except that the maximum placement time will be 1 hour. Provide a sufficient quantity of water in the mixture to produce a stiff workable mortar but in no case may the quantity exceed 5 gallons of water per sack of cement. Use water that is clean and free of harmful acids, alkalis, and organic impurities. Use the mortar within 30 minutes after the ingredients are mixed with water.

2.6.3 Precast Concrete Segmental Blocks

Provide precast concrete segmental block conforming to ASTM C139, not more than 8 inches thick, not less than 8 inches long, and of such shape that joints can be sealed effectively and bonded with cement mortar.

2.6.4 Brick

Provide brick conforming to ASTM C62, Grade SW; ASTM C55, Grade S-I or S-II; or ASTM C32, Grade MS. Provide mortar for jointing and plastering consisting of one part portland cement and two parts fine sand. Lime may be added to the mortar in a quantity not more than 25 percent of the volume of cement. Provide joints that are completely filled and that are smooth and free from surplus mortar on the inside of the structure. Plaster brick structures with 1/2 inch of mortar over the entire outside surface of the walls. Lay brick in stretcher courses with a header course every sixth course for square or rectangular structures. Lay brick radially with every sixth course a stretcher course for round structures.

2.6.5 Precast Reinforced Concrete Manholes

Provide precast reinforced concrete manholes conforming to ASTM C478/C478M . Provide joints between precast concrete risers and tops that are made with flexible watertight, rubber-type gaskets meeting the requirements of paragraph PIPE JOINTS.

2.6.6 Frame and Cover or Gratings

Provide frame and cover or gratings made of cast gray iron, ASTM A48/A48M, Class 35B; cast ductile iron, ASTM A536, Grade 65-45-12; or cast aluminum, ASTM B26/B26M, Alloy 356.0-T6. Provide curb inlet grates conforming to the weight, shape, size, and waterway openings indicated on the plans. Stamp or cast the word "Storm Sewer" into covers so that it is plainly visible.

2.6.7 Steel Ladder

Provide a steel ladder where the depth of the storm drainage structure exceeds 12 feet. Provide ladders not less than 16 inches in width, with 3/4 inch diameter rungs spaced 12 inches apart. Provide two stringers that are a minimum 3/8 inch thick and 2-1/2 inches wide. Galvanize ladders and inserts after fabrication in conformance with ASTM A123/A123M.

2.6.8 Resilient Connectors

Provide flexible, watertight connectors conforming to ASTM C923/C923M for connecting pipe to manholes and inlets.

2.6.9 Flared End Sections

2.6.9.1 Metal Flared End Sections

Provide sections of a standard design fabricated from zinc or aluminum (Type 2) coated steel sheets meeting requirements of ASTM A929/A929M.

2.6.9.2 Concrete Flared End Sections

Provide sections of a standard design fabricated with reinforced concrete.

2.6.10.1 Plastic Sections

Provide polyethylene, polypropylene, polyester, PVC or HDPE sections with UV inhibitors and interlocking tongue and groove joints. Provide channels with ductile iron frames.

2.6.10.2 Precast Concrete Sections

Provide concrete sections made of fiber reinforced concrete or polyester polymer concrete with male/female connections between channel sections. Provide channels with ductile iron edge rails.

2.6.10.3 Grates

Utilize cast iron trench grates. Attach trench grates to sections as recommended by the manufacturer.

2.7 TESTS, INSPECTIONS, AND VERIFICATIONS

2.7.1 Hydrostatic Test on Watertight Joints

Perform a hydrostatic test on the watertight joint types as proposed. This test will be conducted at the plant or by an independent laboratory. Only one sample joint of each type needs testing; however, if the sample joint fails because of faulty design or workmanship, an additional sample joint may be tested.

2.7.1.1 Concrete, Clay, PVC, PE, SRPE and PP Pipe

Provide joints in reinforced and nonreinforced concrete pipe meeting the performance requirements in ASTM C990M ASTM C990 or ASTM C443M ASTM C443. Provide joints in clay pipe meeting the test requirements in ASTM C425. Provide joints in PVC, PE, SRPE, and PP plastic pipe meeting the test requirements in ASTM D3212.

PART 3 EXECUTION

3.1 EXCAVATION FOR PIPE CULVERTS, BOX CULVERTS, STORM DRAINS, AND DRAINAGE STRUCTURES

Excavate trenches, excavate for appurtenances and backfill for culverts and storm drains, in accordance with the applicable portions of Section 31 00 00 EARTHWORK and the requirements specified below.

3.1.1 Trenching

Excavate trenches to the width indicated on the drawings or as specified herein. Trench width should permit satisfactory jointing and thorough tamping of the bedding material under and around the pipe. Place sheeting and bracing, where required, within the trench width as specified, without any over excavation.

3.1.2 Removal of Rock

Replace rock in either ledge or boulder formation with suitable materials to provide a compacted earth cushion. Provide a compacted earth cushion between unremoved rock and the pipe with a thickness of at least 8 inches or 1/2 inch for each foot of fill over the top of the pipe, whichever is greater, but not more than three-fourths the nominal diameter of the pipe. Maintain the cushion under the bell as well as under the straight portion of the pipe where bell-and-spigot pipe is used. Provide a compacted earth cushion between unremoved rock and the box culvert of at least 8 inches in thickness for concrete box culverts. Excavate rock as specified and defined in Section 31 00 00 EARTHWORK .

3.1.3 Removal of Unstable Material

Where wet or otherwise unstable soil incapable of properly supporting the pipe or box culvert, as determined by the Contracting Officer, is unexpectedly encountered in the bottom of a trench, remove such material to the depth required and replace with select granular material to the proper grade. Compact select granular material as specified in paragraph FINAL BACKFILL. When removal of unstable material is due to the fault or neglect of the Contractor while performing shoring and sheeting, water removal, or other specified requirements, perform such removal and replacement at no additional cost to the Government.

3.2 BEDDING AND INITIAL BACKFILL

Provide a firm bedding foundation of uniform density throughout the entire length of the pipe or box culvert.

3.2.1 Concrete Pipe

Use select granular material conforming to Section 31 00 00 EARTHWORK for haunch and bedding material. Compact haunch and outer bedding to at least 90 percent laboratory maximum density and place in layers not exceeding 6 inch loose thickness for compaction by hand-operated compactors and 200 mm 8 inches for other than hand-operated machines. Loosely place middle bedding and do not compact. After the pipe has been properly bedded, place haunch material, at a moisture content that will facilitate compaction, evenly along both sides of the pipe and thoroughly compact each layer with mechanical tampers or rammers to the springline of the pipe. Thoroughly compact the haunch material under the haunches of the pipe. For bell and spigot pipe, form a depression in bedding material for bells so entire barrel of pipe is uniformly supported. Minimize the length, depth, and width of bell depressions to that required for properly making the particular type of joint.

3.2.1.1 Trenches

After the pipe has been properly bedded and haunch material placed to the midpoint (springline) of the pipe, backfill and compact the remainder of the trench by spreading and rolling or compacting by mechanical rammers or tampers in layers not exceeding 6 inches. Test for density as necessary to ensure conformance to the compaction requirements specified below. Where it is necessary, in the opinion of the Contracting Officer, that sheeting or portions of bracing used be left in place, the contract will be adjusted accordingly. Leave untreated sheeting in place beneath structures or pavements.

3.2.1.2 Fill Sections

For pipe placed in fill sections, uniformly spread fill material longitudinally on both sides of the pipe in layers not exceeding 6 inches in compacted depth, and compact by rolling parallel with pipe or by

mechanical tamping or ramming. Prior to commencing normal filling operations, the crown width of the fill at a height of 12 inches above the top of the pipe must extend a distance of not less than twice the outside pipe diameter on each side of the pipe or 12 feet, whichever is less. After the backfill has reached at least 12 inches above the top of the pipe, place and thoroughly compact the remainder of the fill in layers not exceeding 8 inches.

3.2.4 Ductile Iron Pipe

Provide bedding for ductile iron pipe as shown on the drawings.

3.2.5 Plastic Pipe

Provide bedding for PVC, PE, SRPE and PP pipe meeting the requirements of ASTM D2321. Use Class IB or II material for PVC, PE, SRPE pipe bedding, haunching, and initial backfill. Use Class I, II, or III material for PP pipe bedding, haunching and initial backfill.

3.3.1 Concrete, Clay, PVC, Ribbed PVC, Ductile Iron Pipe

Lay pipe proceeding upgrade with spigot ends of bell-and-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of the flow.

3.3.3 PE, SRPE, and Dual Wall and Triple Wall PP Pipe

Lay on a bed shaped to line and grade and joint sections together in accordance with manufacturer's guidelines.

3.3.5 Structural-Plate Steel

Install structural plate in accordance with ASTM A807/A807M. Assemble structural plate in accordance with instructions furnished by the manufacturer. Instructions must show the position of each plate and the order of assembly. Tighten bolts progressively and uniformly, starting at one end of the structure after all plates are in place. Repeat the operation to ensure that all bolts are tightened to meet the torque requirements of 200 foot-pounds plus or minus 50 foot-pounds. Check power wrenches used by the use of hand torque wrenches or long-handled socket or structural wrenches for amount of torque produced. Check and adjust power wrenches frequently as needed, according to type or condition, to ensure proper adjustment to supply the required torque.

3.3.6 Structural-Plate Aluminum

Assemble structural plate in accordance with instructions furnished by the manufacturer. Instructions must show the position of each plate and the order of assembly. Tighten bolts progressively and uniformly, starting at one end of the structure after all plates are in place. Repeat the operation to ensure that all bolts are torqued to a minimum of 100 foot-pounds on aluminum alloy bolts and a minimum of 150 foot-pounds on galvanized steel bolts. Check power wrenches used by the use of hand torque wrenches or long-handled socket or structural wrenches for the amount of torque produced. Check and adjust power wrenches as frequently as needed, according to type or condition, to ensure that they are in proper adjustment to supply the required torque.

3.5 DRAINAGE STRUCTURES

3.5.1 Manholes and Inlets

Construct manholes of precast reinforced concrete. Construct inlets of precast or cast in place reinforced concrete. Provide manholes and inlets complete with frames and covers or gratings; and

with fixed galvanized steel ladders as indicated. [The wall along the line where steel ladders are installed must be vertical for its entire length. Adequately anchor ladders to the wall by means of steel inserts spaced not more than 6 feet vertically, and install to provide at least 6 inches of space between the wall and the rungs. Make pipe connections to concrete manholes and inlets with flexible, watertight connectors.

3.5.2 Walls and Headwalls

Construct headwalls as indicated.

3.6 INSTALLATION OF TRACER WIRE AND WARNING TAPE

Install a continuous length of tracer wire for the full length of each run of nonmetallic pipe in accordance with Section . Attach wire to top of pipe in such a manner that it will not be displaced during construction operations.

3.8 FINAL BACKFILL

Backfill trenches with satisfactory material deposited in layers of a maximum of 8 inches loose thickness and compacted to 90 percent of maximum density for cohesive soils and 95 percent of maximum density for cohesionless soils in accordance with Section 31 00 00 EARTHWORK . Testing is the responsibility of the Contractor and will be performed at no additional cost to the Government. Unless otherwise specified, determine field in-place density of final backfill at a frequency of one test per 50 linear feet, or fraction thereof, of each lift of backfill. Submit test results in accordance with Section 31 00 00 EARTHWORK . Do not displace or damage pipe or box when compacting final backfill by rolling or operating heavy equipment parallel with the pipe or box. Movement of construction machinery over a culvert or storm drain at any stage of construction will be at the Contractor's risk. Repair or replace any damaged pipe. Protect concrete pipes with a minimum of 3 feet of cover prior to permitting heavy construction equipment to pass over them during construction. Provide the minimum cover for construction loads over corrugated steel pipes as specified in Section 26, Division II of AASHTO HB-17. Provide minimum cover for construction loads over plastic pipes as specified in ASTM D2321.

3.9 FIELD QUALITY CONTROL

3.9.1 Tests

Testing is the responsibility of the Contractor. Perform all testing and retesting at no additional cost to the Government.

3.9.1.1 Leakage Test

Test pipe lines for leakage prior to completing backfill by performing either an exfiltration test, low pressure air pipeline test or by individual pipe joint testing. Submit leakage test results to the Contracting Officer.

3.9.1.1.1 Exfiltration Test

Prior to exfiltration tests, backfill the trench up to at least the lower half of the pipe. If required, place sufficient additional backfill to prevent pipe movement during testing, leaving the joints uncovered to permit inspection. When the water table is 2 feet or more above the top of the pipe at the upper end of the pipeline section to be tested, measure infiltration using a suitable weir or other device acceptable to the Contracting Officer. Perform exfiltration test by filling the line to be tested with water so that a head of at least 2 feet is provided above both the water table and the top of the pipe at the upper end of the pipeline to be tested. Allow the filled line to stand until the pipe has reached its maximum absorption,

but not less than 4 hours. After absorption, reestablish the head. Measure the amount of water required to maintain this water level during a 2-hour test period. Leakage as measured by the exfiltration test must not exceed 0.2 gallons per inch in diameter per 100 feet of pipeline per hour. Correct visible leaks encountered regardless of leakage test results.

3.9.1.1.2 Low Pressure Air Pipeline Tests

Perform low pressure air testing for vitrified clay pipes in accordance with ASTM C828. Perform low pressure air testing for plastic pipe in accordance with ASTM F1417. Perform low pressure air testing procedures for other pipe materials using the pressures and testing times prescribed in ASTM C828, after consultation with the pipe manufacturer.

3.9.1.1.3 Individual Pipe Joint Testing

Testing of individual joints for leakage by low pressure air or water must conform to ASTM C1103M ASTM C1103.

3.9.1.3 Tracer Wire Continuity

Test tracer wire for continuity after initial and final backfilling of pipes. Verify that tracer wire is locatable with electronic utility location equipment. Repair breaks or separations and re-test for continuity.

3.9.2 Inspection

3.9.2.1.2 Flexible Pipe

Check each flexible pipe (PE, PVC, PP, corrugated steel and aluminum) for rips, tears, joint separations, soil migration throughout the joint, cracks, localized buckling, bulges, settlement and alignment.

3.9.2.1.3 Post-Installation Inspection Report

The deflection results and final post installation inspection report must include: pipe location identification, equipment used for inspection, inspector name, deviation from design, grade, deviation from line, deflection and deformation of flexible pipe, inspector notes, condition of joints, condition of pipe wall (e.g. distress, cracking, wall damage dents, bulges, creases, tears, holes, etc.).

3.9.2.2 Low Impact Development Inspection

Inspect Low Impact Development (LID) features indicated on the design portion of the LID Verification Report. Certify LID features were constructed according to plans and specifications or by submitting as-built drawings in accordance with UFGS 01 78 00 Closeout Submittals. When as-built drawings show deviations to the LID features, document the deviations on the LID Verification Report.

3.9.3 Repair of Defects

3.9.3.1 Leakage Test

When leakage exceeds the maximum amount specified, correct source of excess leakage by replacing damaged pipe and gaskets and retest.

3.9.3.2 Deflection Testing

When deflection readings are in excess of the allowable deflection of average inside diameter of pipe are obtained, remove pipe which has excessive deflection and replace with new pipe. Retest 30 days after completing backfill, leakage testing and compaction testing.

3.9.3.3 Inspection

Replace pipe or repair defects indicated in the Post-Installation Inspection Report.

3.9.3.3.2 Flexible Pipe

Replace pipes having cracks or splits.

3.10 PROTECTION

Protect storm drainage piping and adjacent areas from superimposed and external loads during construction.

3.11 WARRANTY PERIOD

Pipe segments found to have defects during the warranty period must be replaced with new pipe and retested.

END OF SECTION

SECTION 33 46 16

SUBDRAINAGE PIPING
05/18

PART 1 GENERAL

1.1 UNIT PRICES

1.1.1 Pipe Subdrains

Measure the length of pipe installed from end to end along the centerlines without any deduction for the diameter of the manholes. Pipe will be paid for according to the number of linear feet of subdrains placed in the accepted work. Payment for bedding and [drainage layer materials, except geotextiles, will be included in the payment for the pipe subdrain system.

1.1.2 Blind or French Drains

Blind or french drains will be paid for by the linear foot and measured from end to end along the centerlines of the completed drains.

1.1.3 Manholes

Manholes to be paid for will be the number of manholes completed with base, rungs or ladders, frames, and covers or gratings (where specified) constructed in the accepted work.

1.1.4 Flushing and Observation Risers

Flushing and observation risers to be paid for will be the number of flushing and observation risers completed with frames and covers (where specified) constructed in the accepted work.

1.1.5 Geotextile

Measure geotextile for payment by the square yard in place. Measure overlapped joints and seams as a single layer of cloth.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 190	(2004; R 2019) Standard Specification for Asphalt-Coated Corrugated Metal Culvert Pipe and Pipe Arches
AASHTO M 252	(2009; R 2017) Standard Specification for Corrugated Polyethylene Drainage Pipe
AASHTO M 288	(2021) Standard Specification for Geosynthetic Specification for Highway Applications

ASTM INTERNATIONAL (ASTM)

ASTM A27/A27M	(2020) Standard Specification for Steel Castings, Carbon, for General Application
ASTM A47/A47M	(1999; R 2018; E 2018) Standard Specification for Ferritic Malleable Iron Castings
ASTM A48/A48M	(2003; R 2021) Standard Specification for Gray Iron Castings
ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A760/A760M	(2015, R 2020) Standard Specification for Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains
ASTM A762/A762M	(2019) Standard Specification for Corrugated Steel Pipe, Polymer Precoated for Sewers and Drains
ASTM A798/A798M	(2017) Standard Practice for Installing Factory-Made Corrugated Steel Pipe for Sewers and Other Applications
ASTM B745/B745M	(2015; R 2021) Standard Specification for Corrugated Aluminum Pipe for Sewers and Drains
ASTM C33/C33M	(2018) Standard Specification for Concrete Aggregates
ASTM C136/C136M	(2019) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C478	(2018) Standard Specification for Circular Precast Reinforced Concrete Manhole Sections
ASTM D2321	(2020) Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D2487	(2017; E 2020) Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D3034	(2016) Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D3753	(2019) Glass-Fiber-Reinforced Polyester Manholes and Wetwells
ASTM D4632/D4632M	(2015a) Grab Breaking Load and Elongation of Geotextiles
ASTM F758	(2014) Smooth-Wall Poly(Vinyl Chloride) (PVC) Plastic Underdrain Systems for Highway, Airport, and Similar Drainage
ASTM F949	(2020) Standard Specification for Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-04 Samples

Geotextile

Pipe and Pipe Fittings

SD-06 Test Reports

Geotextile JP-8 Fuel Resistance Test

SD-07 Certificates

Geotextile

Pipe and Pipe Fittings

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Delivery and Storage

Inspect materials delivered to site for damage; unload, and store with minimum handling. Do not store materials directly on the ground. Keep the inside of pipes and fittings free of dirt and debris. Keep, during shipment and storage, geotextile wrapped in burlap or similar heavy duty protective covering. Protect the geotextile from mud, soil, dust, and debris. Do not store geotextile materials in direct sunlight. Install plastic pipe within 6 months from the date of manufacture unless otherwise approved.

1.4.2 Handling

Handle materials in such a manner as to ensure delivery to the trench in sound undamaged condition. Carry pipe to the trench.

PART 2 PRODUCTS

2.1 PIPE FOR SUBDRAINS

Submit samples of pipe and pipe fittings, before starting the work. Provide type and sizes of subdrain pipe indicated. Submit certifications from the manufacturers attesting that materials meet specification requirements. Certificates are required for drain pipe and fittings.

2.1.1 Plastic

Provide plastic pipe containing ultraviolet inhibitor to provide protection from exposure to direct sunlight. Provide pipe with bell and spigot or solvent cement joints. Provide manufacturer's standard type fittings conforming to the indicated specification.

2.1.1.1 Polyvinyl Chloride (PVC) and Fittings

ASTM D3034, ASTM F949 or ASTM F758, Type PS 46.

2.1.1.2 Corrugated Polyethylene (PE) and Fittings

AASHTO M 252, Type S or SP as indicated.

2.1.2 Corrugated Steel

ASTM A760/A760M, Type I or III, as indicated [with a coating conforming to AASHTO M 190, Type A]. Provide Class 1 perforations in Type III pipe. Pipe sheet thickness 0.064 inch.

2.1.3 Corrugated Aluminum Alloy

ASTM B745/B745M, Type I or III, as indicated [with a bituminous coating conforming to AASHTO M 190, Type A]. Provide Class 1 perforations in Type III pipe. Pipe sheet thickness 0.064 inch.

2.1.4 Precoated Corrugated Steel

ASTM A762/A762M, Type I or III, as indicated. Provide Class 1 perforations in Type III pipe.

2.2 GEOTEXTILE

Provide geotextile conforming to AASHTO M 288 and meeting the subsurface drainage requirements. The minimum grab strength will be 160 pounds in accordance with ASTM D4632/D4632M. Provide geotextile with filaments constructed so as to retain their relative position with respect to each other.

Submit samples of geotextile and certifications from the manufacturers attesting that geotextile meets specification requirements.

2.3 SUBDRAIN FILTER AND BEDDING **MATERIAL**

Provide subdrain filter and bedding material composed of washed sand, sand and gravel, crushed stone, crushed stone screenings, or slag composed of hard, tough, durable particles free from adherent coatings. Filter material may not contain corrosive agents, organic matter, or soft, friable, thin, or elongated particles. Provide filter material that is evenly graded between the limits specified in TABLE I. Gradation curves will exhibit no abrupt changes in slope denoting skip or gap grading. Provide filter materials that are clean and free from soil and foreign materials. Remove and replace filter blankets found to be dirty or otherwise contaminated with material meeting the specific requirements, at no additional cost to the Government.

Type	Minimum	Test
Tensile	100 lbs	ASTM D4632/D4632M grab test 1 inch square and 12 inches per minute constant rate at traverse.
Elongation	15 percent	ASTM D4632/D4632M determine apparent breaking elongation.
Puncture	40 lbs.	ASTM D3787 except polished steel ball replaced with a 5/16 inch diameter solid steel cylinder with a hemispherical tip centered within the ring clamp.

Type	Minimum	Test
Tear	40 lbs.	ASTM D4533 trapezoidal tear strength.

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2.4 DRAINAGE STRUCTURES

2.4.1 Concrete

Provide concrete and reinforced concrete conforming to the requirements for 3,000 psi concrete in Section 03 30 00 CAST-IN-PLACE CONCRETE.

2.4.2 Mortar

Provide mortar for connections to drainage structures that is composed of one part by volume of portland cement and two parts of sand. Provide sufficient quantity of water in the mixture to produce a stiff workable mortar. Use water that is clean and free of injurious acids, alkalies, and organic impurities. Use the mortar within 30 minutes from the time the ingredients are mixed with water.

2.4.3 Manholes and Appurtenances

2.4.3.1 Precast Reinforced Concrete Manhole Risers and Tops

ASTM C478.

2.4.3.2 Precast Concrete Manhole Bases

ASTM C478. Provide bases that allow suitable connection with influent and effluent lines and to provide a suitable base structure for riser sections.

2.4.3.3 Glass Fiber-Reinforced Polyester (FRP)

ASTM D3753.

2.4.3.4 Frames and Covers or Gratings

Except as otherwise permitted, provide frames and gratings, or frames and covers of either cast iron with tensile strength test not less than ASTM A48/A48M Class 25 or steel conforming to ASTM A27/A27M, Class 65-35. Required weight, shape, and size are indicated on the drawings. Frames and covers not subjected to vehicular traffic or storage may be of malleable iron where indicated. Provide malleable-iron frames and covers conforming to ASTM A47/A47M and of the weight, shape, and size indicated.

2.4.3.5 Steel Ladder

Provide a steel ladder where the depth of a manhole exceeds 12 feet. The ladder will be not less than 16 inches in width, with 3/4 inch diameter rungs spaced 12 inches apart. Provide two stringers that are a minimum 3/8 inch thick and 2 inches wide. Adequately anchor ladder to the wall by means of steel inserts spaced not more than 6 feet apart vertically, and install so as to provide at least 6 inches of space between the wall and the rungs. Galvanize ladders and inserts after fabrication in conformance with ASTM A123/A123M.

2.5 TESTS, INSPECTIONS, AND VERIFICATIONS

2.5.1 Geotextile JP-8 Fuel Resistance Test

Immerse five unaged geotextile samples, 4 (plus or minus 0.2) by 6 (plus or minus 0.2) inches in JP-8 fuel at room temperature for a period of 7 days. Test each sample for tensile strength and elongation in accordance with ASTM D4632/D4632M. Provide geotextile with a strength in any direction of not less than 85 percent of the strength specified in paragraph GEOTEXTILE.

PART 3 EXECUTION

3.1 EXCAVATION AND BEDDING FOR SUBDRAIN SYSTEMS

Excavate trenches, including the removal of rock and unstable material, in accordance with Section 31 00 00 EARTHWORK 31 23 00.00 20 EXCAVATION AND FILL. Bedding material shall be placed in the trench as indicated or as required as replacement materials used in those areas where unstable materials were removed. Compaction of the bedding material shall be as specified for cohesionless material in Section 31 00 00 EARTHWORK.

3.2 MANHOLES AND FLUSHING AND OBSERVATION RISERS

3.2.1 Manholes

Install manholes complete with frames and covers or gratings at the locations and within the limits and sizes indicated. Construct manholes of one of the materials specified for manholes in paragraph DRAINAGE STRUCTURES. Completely fill precast concrete manhole joints so that they are smooth and free of surplus mortar or mastic on the inside of the structure. Use either precast or cast-in-place concrete manhole bases.

3.2.2 Flushing and Observation Risers

Install flushing and observation riser pipes with frames and covers at the locations indicated. Construct risers of non-perforated plastic or galvanized pipe. Join riser pipes to the subdrain system as indicated.

3.3 INSTALLATION OF GEOTEXTILE AND PIPE FOR SUBDRAINS

3.3.1 Installation of Geotextile

3.3.1.1 Trench Lining and Overlaps

Grade trenches to be lined with geotextile to obtain smooth side and bottom surfaces so that the geotextile will not bridge cavities in the soil or be damaged by projecting rock. Lay the geotextile flat but not stretched on the soil, and secure it with anchor pins in accordance with manufacturer's instructions. Overlap at least 6 to 12 inches, and secure with anchor pins along the overlaps.

3.3.2 Installation of Pipe for Subdrains

3.3.2.1 Pipelaying

Install pipe in accordance with the manufacturer's recommendations. Thoroughly examine each section of pipe before being laid; do not use defective or damaged pipe. Do not lay pipe when the trench conditions or weather is unsuitable for such work. Remove water from trenches by sump pumping or other approved methods. Lay the pipe to the grades and alignment as indicated. Bed the pipe to the established gradeline. Center perforations on the bottom of the pipe. Lay bell-and-spigot

type with the bell ends upstream. Approval of all in-place pipes by the Contracting Officer is required prior to backfilling.

3.3.2.2 Jointings

3.3.2.2.1 Perforated Corrugated Metal Pipe or Bituminous Coated, Perforated Corrugated Metal Pipe

Securely fasten together the sections of perforated corrugated metal pipe or bituminous coated, perforated corrugated metal pipe standard connecting bands furnished by the manufacturer of the pipe.

3.3.2.2.2 Bituminous Coated or Uncoated Corrugated Aluminum Pipe

If aluminum pipe is to be connected to dissimilar metal, insulate the connection by bituminous coating or other nonconductive material. Securely fasten standard joints between corrugated aluminum pipe with standard connecting bands furnished by the manufacturer of the pipe.

3.5 INSTALLATION OF BEDDING AND BACKFILL FOR NON-PERFORATED SUBRAIN OUTFALL PIPE

3.5.1 Plastic Pipe

Place and compact pipe embedment for plastic pipe in accordance with ASTM D2321. Use Class IB or II embedment materials.

3.5.2 Corrugated Metal Pipe

Place and compact bedding ans structural backfill for corrugated metal pipe in accordance with ASTM A798/A798M. Use structural backfill materials classified by ASTM D2487 as either GW, GM, GP-GM, GW-GM, GC, GP-GC or SW.

3.6 INSTALLATION OF AND BACKFILLING FOR BLIND OR FRENCH DRAINS

Place filter material as indicated and compact as specified for cohesionless materials in Section [31 00 00 EARTHWORK] [31 23 00.00 20 EXCAVATION AND FILL]. Extend filter material to a suitable outlet or to an outlet through a pipeline as indicated. Place and compact overlying backfill material as specified in Section [31 00 00 EARTHWORK] [31 23 00.00 20 EXCAVATION AND FILL].

END OF SECTION