

MADISON WATER UTILITY

Unit Well 15 PFAS Treatment Facility

Madison Contract No. 9342

Madison MUNIS No. 14092-86-140

DECEMBER 2023

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June 29, 2023

PROJECT MANUAL
FOR
UW15 PFAS TREATMENT
FOR THE
MADISON WATER UTILITY, MADISON, WISCONSIN



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SPECIFICATIONS

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DIVISION 1
GENERAL REQUIREMENTS

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SECTION 01 11 00

SUMMARY OF WORK

PART 1 GENERAL

1.01 SUMMARY

- A. This project includes Unit Well 15 (UW`15) PFAS treatment equipment. Project includes two GAC vessels, two ion exchange vessels, roof movement to accommodate vessels, treated water reservoir separation to create a filter-to-waste tank, chemical feed location changes, acid feed system changes, general HVAC, electrical, and architectural improvements, and driveway resurfacing, all within the City of Madison, Dane County, Wisconsin.
- B. Measurement and Payment:
 - 1. Comply with Section 01 29 02.

1.02 FORM OF SPECIFICATIONS

- A. These Specifications are written in imperative and abbreviated form. Imperative language of Specification sections is directed at CONTRACTOR, unless specifically noted otherwise. Incomplete sentences in Specifications shall be completed by inserting “shall,” “CONTRACTOR shall,” “shall be,” and similar mandatory phrases by inference in same manner as they are applied to notes on Drawings. Words “shall be” shall be supplied by inference where colon (:) used within sentences or phrases. Except as worded to contrary, fulfill (perform) indicated requirements whether stated imperatively or otherwise.
- B. Items of Work are specified by section. Specifications or requirements of one or more sections may apply or be referenced in other sections.
- C. Provide Work described and comply with requirements stated in each Specification section and Drawings unless specifically assigned to other CONTRACTORS or OWNER.

1.03 CONTRACTS

- A. Perform Work under single lump sum price Contract(s) with OWNER.
- B. Contract “Notice To Proceed” will be provided following:
 - 1. DNR approval of the pump station design has been received.
 - 2. DSPS approval, if required, has been received.
 - 3. PSC approval and OWNER acceptance of terms has been received.
 - 4. City board approval.

1.04 WORK BY OTHERS

- A. Utility Services:

1. Madison Water Utility will operate existing and new valves connecting to the active water system.
2. Wisconsin Public Service will make adjustments to their facilities (generator) should the need arise concurrent with Work under this Contract.

B. Rehabilitation of Well 15 by OTHERS.

C. Materials Provided by OWNER:

1. None

1.05 MILESTONES (WORK SEQUENCE)

A. Construct Work in stages to accommodate use of site during construction period; coordinate Construction Progress Schedule and operations with OWNER and ENGINEER.

1. Work within existing road right of ways or easements indicated on Drawings.
2. Access to all existing driveways shall be maintained to extent possible.

B. Construct Work in stages to provide for vessel installation.

1. Do not remove roof until vessel delivery is confirmed.
2. Do not remove roof when danger of freezing conditions is imminent.

C. Erosion control measures shall be in place prior to the start of construction. Erosion control measures shall be inspected regularly and maintained throughout the project Work in accordance with the notes on the construction plans.

D. The entire project shall be and ready for final payment in accordance with Paragraph 14.07 of the General Conditions on or before dates specified in the agreement.

1.06 CONTRACTOR'S USE OF PREMISES

A. Limit use of premises for Work and storage to allow for following.

1. Work by other CONTRACTORS.
2. OWNER occupancy.

B. Coordinate use of premises with ENGINEER and OWNER.

C. Assume full responsibility for protection and safekeeping of products under this Contract.

D. Obtain and pay for use of additional storage or Work areas needed for operations at no additional cost to OWNER.

E. Confine operations to areas within road right of ways and easements indicated. Do not disturb portions of site beyond areas in which Work is indicated. Work is adjacent to public park and protection from public entering site is required.

F. Keep driveways, roads, and entrances serving premises clear and available to private residents at all times, except when driveway approach, including curb and gutter across, is being poured and cured.

Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on Site.

- G. Contractor shall maintain the project worksite in an orderly fashion, including stockpiled material, pipe for utilities, equipment, and tools. Contractor will cleanup, remove, or relocate said materials, equipment, pipe, or tools as directed by Engineer or Owner.

1.07 EASEMENTS, LICENSES, AND PERMITS

- A. Easements, construction licenses, and permits obtained for Work shown on Drawings.
 - 1. OWNER has copies of documents on file for review.
 - 2. Comply with provisions of easements, licenses, and permits.
 - 3. Obtain additional construction easements necessary to complete Work.
 - 4. Easements are shown on Drawings.
 - 5. Perform construction within existing rights-of-way or within limits of easements and construction licenses.
 - 6. Obtain written authorization from affected property owners or maintaining authorities if construction is outside these areas.
 - 7. Comply with requirements of owners or maintaining authorities.
 - 8. Obtain written approval of restoration from easement and construction license grantors shown on Drawings.

1.08 STANDARD SPECIFICATIONS

- A. Perform utility Work in accordance with these Specifications and City of Madison Standard Specifications (“City Specifications”) available online:
<https://www.cityofmadison.com/engineering/developers-contractors/standard-specifications>

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

(Not Used)

END OF SECTION

SECTION 01 11 55

ON-SITE HEALTH AND SAFETY REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

- A. Construction/remediation activities may place CONTRACTOR'S personnel, personnel of other Contractors hired by OWNER to perform Work at site, and public in potentially hazardous situations.
- B. CONTRACTOR is responsible for implementation and enforcement of safe Work practices including, but not limited to, personnel exposure; scaffolding; materials handling and cleaning; operation of equipment; and safety of public during progress of Work.
- C. Payment:
 - 1. Work specified in this section is considered incidental and cost shall be included as part of the lump sum price specified in Bid Form.

1.02 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Plan for and ensure personnel comply with basic provisions of OSHA Safety and Health Standards (29 CFR 1910) and General Construction Standards (29 CFR 1926) as appropriate.
 - 2. Comply with applicable laws and regulations of any public body having jurisdiction for safety of persons or property.

1.03 OPERATIONS AND EQUIPMENT SAFETY

- A. CONTRACTOR is responsible for initiating, maintaining, and supervising safety precautions and programs in connection with Work. Take necessary precautions for safety of employees on Project site and other persons and organizations who may be affected by Project.
- B. CONTRACTOR'S duties and responsibilities for safety in connection with Work shall continue until such time as Work is complete and ENGINEER has issued notice to CONTRACTOR that Work is complete.

1.04 HEALTH AND SAFETY

- A. CONTRACTOR is responsible for implementation and enforcement of health and safety requirements and shall take necessary precautions and provide protection for following.
 - 1. Personnel working on or visiting Project site, irrespective of employer.
 - 2. Work and materials or equipment to be incorporated in Work area on- or off-site.
 - 3. Other property at or adjacent to Project site.
 - 4. Public exposed to job related operations or potential release of toxic or hazardous materials.

- B. CONTRACTOR shall prepare site-specific health and safety plan (HASP). If CONTRACTOR does not have capability to prepare HASP, CONTRACTOR shall employ consultants with appropriate capability. CONTRACTOR is solely responsible for adequacy of HASP's preparation, monitoring, management, and enforcement. At minimum, CONTRACTOR'S HASP shall address following.
 - 1. Site description and history.
 - 2. Project activities and coordination with other Contractors.
 - 3. Hazard evaluation.
 - 4. On-site safety responsibilities.
 - 5. Work zones.
 - 6. Personnel training.
 - 7. Atmospheric monitoring.
 - 8. Personal protection, clothing, and equipment.
 - 9. Emergency procedures.
- C. If OWNER contracts with others for Work on-site, CONTRACTOR shall amend HASP to include provisions for Work of others. CONTRACTOR shall also manage, enforce, and monitor health and safety activities of other Contractors during duration of other Contractors' work.

1.05 ENGINEER'S RESPONSIBILITIES

- A. When ENGINEER is required to be present on Project site to perform engineering services, ENGINEER will comply with CONTRACTOR'S safety plans, programs, and procedures.
- B. If ENGINEER determines CONTRACTOR'S safety plans, programs, and procedures do not provide adequate protection for ENGINEER, ENGINEER may direct its employees to leave Project site or implement additional safeguards for ENGINEER'S protection. If taken, these actions will be in furtherance of ENGINEER'S responsibility to its employees only, and ENGINEER will not assume responsibility for protection of any other persons affected by Work.
- C. If ENGINEER observes situations which appear to have potential for immediate and serious injury to persons, ENGINEER may warn persons who appear to be affected by such situations. Such warnings, if issued, shall be given based on general humanitarian concerns, and ENGINEER will not, by issuance of any such warning, assume any responsibility to issue future warnings or any general responsibility for protection of persons affected by Work.

1.06 SUBMITTALS

- A. Submit copies of HASP to OWNER and ENGINEER within 10 days after Notice to Proceed. Work on-site shall not proceed until HASP has been submitted to ENGINEER.
 - 1. Submittal of CONTRACTOR'S HASP to ENGINEER is to inform ENGINEER and OWNER so they can comply with HASP during performance of their on-site responsibilities as described in Contract Documents.
 - 2. Submittal of CONTRACTOR'S HASP shall neither impose on ENGINEER responsibility for adequacy of HASP nor relieve CONTRACTOR from full responsibility, therefore.
 - 3. CONTRACTOR shall certify to OWNER weekly by notarized certificate that CONTRACTOR is in compliance with HASP.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

(Not Used)

END OF SECTION

SECTION 01 29 02

MEASUREMENT AND PAYMENT (LUMP SUM)

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Summary:

1. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.

1.02 DEFINITIONS:

- ###### A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.03 SCHEDULE OF VALUES:

- ###### A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.

1. Coordinate line items in the schedule of values with other required administrative forms and schedules, including the following:
 - a. Application for Payment forms with continuation sheets.
 - b. Submittal schedule.
 - c. Items required to be indicated as separate activities in Contractor's construction schedule.
2. Submit the schedule of values to Engineer at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
3. Subschedules for Phased Work: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values coordinated with each phase of payment.
4. Subschedules for Separate Elements of Work: Where the Contractor's construction schedule defines separate elements of the Work, provide subschedules showing values coordinated with each element.
5. Subschedules for Separate Design Contracts: Where the Owner has retained design professionals under separate contracts who will each provide certification of payment requests, provide subschedules showing values coordinated with the

scope of each design services contract as described in Division 01 Section "Summary of Work."

B. Format and Content: Use Contract Documents table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.

1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Name of Engineer.
 - c. Engineer's project number.
 - d. Contractor's name and address.
 - e. Date of submittal.

2. Arrange the schedule of values in tabular form with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or Division.
 - b. Description of the Work.
 - c. Name of subcontractor.
 - d. Name of manufacturer or fabricator.
 - e. Name of supplier.
 - f. Change Orders (numbers) that affect value.
 - g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
 - (1) Labor
 - (2) Materials.
 - (3) Equipment.

3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with Contract Documents table of contents. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
5. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site. If required, include evidence of insurance.

6. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.

7. Purchase Contracts: Provide a separate line item in the schedule of values for each purchase contract. Show line-item value of purchase contract. Indicate owner payments or deposits, if any, and balance to be paid by Contractor.
8. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
 - a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.
 - b. Other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.
9. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.04 MEASUREMENT:

A. General:

1. In determining the quantities of excavation to which unit prices shall apply, the limits of normal width and depth of excavation shall be as described below, unless other limits are indicated on the Drawings or specified.
2. For pipes in trench, the normal width of the trench shall be measured between vertical planes which are a distance apart equal to the sum of 18 inches (450 mm) plus 1-1/3 times the nominal inside diameter of the pipe. If the width so computed is less than 3 feet (0.9 m), a width of 3 feet (0.9 m) shall be taken as the normal width for payment. The normal depth shall be measured to a distance of 0.2 feet (0.06 m) below the bottom of the pipe in earth and 0.7 feet (0.2 m) in rock, unless there be a cradle underneath the pipe, in which case the normal depth shall be measured to the underside of the cradle. The width of trench for the cradle shall be assumed to be that specified above for pipes in trench.
3. For concrete placed directly against undisturbed earth, the normal width and depth of the excavation for such concrete shall be measured to the neat lines of the concrete as indicated on the Drawings or as ordered.
4. For concrete placed against rock surfaces resulting from rock excavation, the normal width and depth of the excavation shall be measured to 4 inches outside the neat lines of the concrete as indicated on the Drawings or as ordered.
5. For other structures, except manholes as noted below, the normal width shall be measured between vertical planes 1 foot (0.3 m) outside the neat lines of the several parts of the structure, except that the width at any elevation shall be measured as not less than the width at a lower elevation. The normal depth shall be measured to the underside of that part of the structure for which the excavation is made.

6. No additional width or depth of trenches excavated in earth or rock shall be allowed at standard circular manholes.
7. Wherever bell holes are required for jointing pipe, they shall be provided without additional compensation over and above that resulting from measurements as above described.

B. Extra Work:

1. Extra work, if any, shall be performed and paid in accordance with the Madison Water Utility Standard Specifications.

1.05 APPLICATIONS FOR PAYMENT:

- A. The following subsections describe the measurement of and payment for the work to be done under the items listed in the BID.
 1. Estimates of lump sum items shall be based on a schedule of values dividing each such item into its appropriate component parts together with a quantity and a unit price for each part so that the sum of the products of prices and quantities will equal the Contract price for the item. This schedule shall be submitted by the Contractor for and must have the acceptance of the Engineer before the first estimate becomes due. Submit the schedule of values in accordance with Articles 2.05 and 2.07 of the General Conditions.
- B. Each unit or lump-sum price stated in the BID shall constitute full compensation as herein specified for each item of work completed in accordance with the drawings and specifications, including cleaning up.
- C. The prices for those items which involve excavation shall include compensation for disposal of surplus excavated material, handling water, and installation of all necessary sheeting and bracing.
- D. In all items involving excavation, the price shall be based on doing the entire excavation in subgrade material indicated on the Contract Drawings. Where rock is required to be excavated in quantities exceeding those indicated on the Contract Drawings, the price therefore shall be in addition to the cost of excavating earth, and no deduction will be made in the amount for earth excavation.
- E. If changes are made in the design based on the drawings and specifications as issued, and should such changes increase or decrease the quantity of work to be done under Item 1, adjustment will be made therefore as stipulated under the contract conditions.
- F. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Engineer and paid for by Owner.

1. Initial Application for Payment, Application for Payment at time of Substantial Completion, Monthly Application for Progress Report, and final Application for Payment involve additional requirements.
- G. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- H. Application for Payment Forms: Use forms acceptable to Engineer and Owner for Applications for Payment. Submit forms for acceptance with initial submittal of schedule of values.
- I. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Engineer will return incomplete applications without action.
1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
 2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
 3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
 4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.
- J. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.
 2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
 3. Provide summary documentation for stored materials indicating the following:
 - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
 - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
 - c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
- K. Transmittal: Submit digitally signed and notarized original copies of each Application for Payment to Engineer by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.

1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
 2. Provide up to three hard copies upon request of Owner or Engineer.
- L. **Waivers of Mechanic's Lien:** With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 2. When an application shows completion of an item, submit conditional final or full waivers.
 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 4. **Waiver Forms:** Submit executed waivers of lien on forms acceptable to Owner.
- M. **Initial Application for Payment:** Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
 2. Schedule of values.
 3. Pre-construction surveys and photographs.
 4. Health and safety and environmental protection plans.
 5. Contractor's construction schedule (preliminary if not final).
 6. Combined Contractor's construction schedule (preliminary if not final) incorporating Work of multiple contracts, with indication of acceptance of schedule by each Contractor.
 7. Products list (preliminary if not final).
 8. Schedule of unit prices.
 9. Submittal schedule (preliminary if not final).
 10. List of Contractor's staff assignments.
 11. List of Contractor's principal consultants.
 12. Copies of building permits.
 13. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 14. Initial progress report.
 15. Report of preconstruction conference.
 16. Certificates of insurance and insurance policies.
 17. Performance and payment bonds.
 18. Data needed to acquire Owner's insurance.
- N. **Application for Monthly Progress Payment:** Administrative actions and submittals that must precede or coincide with submittal of monthly Application for Progress Payment include the following:
1. Schedule of values.

2. Schedule of unit prices.
 3. Construction photographs.
 4. Contractor's updated construction progress schedule and specified reports.
 5. Combined Contractor's construction progress schedule and specified reports, incorporating Work of multiple contracts, with indication of acceptance of schedule by each Contractor.
 6. Documented proof that it has recorded information on the Contract Drawings to reflect "As Built" information.
- O. Application for Payment at Substantial Completion: After Engineer issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum. Documentation include, evidence of all the following:
 - a. Each item of mechanical, electrical, instrumentation, piping and HVAC equipment installed or modified under this Contract have been tested to demonstrate compliance with the performance requirements of this Contract, including successful functional testing, water testing, performance testing and facility commissioning.
 - b. All operating, maintenance manuals and as-built drawings have been provided to the Owner.
 - c. All spare parts and materials have been provided to the Owner.
 - d. All warranty certificates and test results have been provided to the Owner.
 - e. The Contractor has provided instructions and training to the Owner's staff to enable the Owner to operate the Works.
 2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- P. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
 2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 3. Updated final statement, accounting for final changes to the Contract Sum.
 4. Evidence that claims have been settled.
 5. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
 6. Final liquidated damages settlement statement.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

(Not Used)

END OF SECTION

Measurement and Payment (Lump Sum)
Section No. 01 29 02-8

SECTION 01 31 19
PROJECT MEETINGS

PART 1 - GENERAL

1.01 SUMMARY:

- A. Contractor shall schedule and administer progress meetings, construction foremen's meetings, and specially called meetings throughout progress of Work. Contractor shall:
 - 1. Schedule meetings weekly or as otherwise deemed appropriate by Contractor and Owner.
 - 2. Prepare agenda for meetings.
 - 3. Distribute written notice of specially called meetings minimum of one working day(s) in advance of meeting date.
 - 4. Make physical arrangements for meetings.
 - 5. Preside at meetings.
 - 6. Record minutes; include significant proceedings and decisions.
 - 7. Prepare formal minutes and distribute within three working days after each meeting to the following:
 - a. Meeting participants.
 - b. Parties affected by decisions made at meeting.
 - c. Engineer and Owner - furnish both with electronic copies of minutes.
- B. Representatives of Contractor, Subcontractors, and Suppliers attending meetings shall be qualified and authorized to act on behalf of entity each represents.
- C. Owner and Engineer may attend meetings.

1.02 PRECONSTRUCTION CONFERENCE:

- A. Engineer will schedule and conduct preconstruction conference in accordance with General Conditions and Supplementary Conditions.
- B. Attendance and suggested format in accordance with General Conditions and Supplementary Conditions.

1.03 PROGRESS MEETINGS WITH ENGINEER:

- A. In addition to other regular project meetings for other purposes (as indicated elsewhere in the Contract Documents), hold general progress meetings with times coordinated with preparation of payment requests. Meeting dates shall be established by the Engineer. Require every entity then involved in the planning, coordination or performance of work to be properly represented at each meeting. Include (when applicable):
 - 1. Principal subcontractors
 - 2. Suppliers/manufacturers/fabricators
 - 3. Governing authorities

4. Special supervisory personnel and others with an interest or expertise in the progress of the work.
- B. Suggested format includes, but not limited to following:
1. Review each entity's present and future needs including interface requirements
 2. Time, sequence
 3. Deliveries
 4. Access
 5. Site utilization
 6. Temporary facilities and services
 7. Hours of work
 8. Hazards and risks
 9. Housekeeping
 10. Submittals
 11. Change orders
 12. Documentation of information for payment requests
- C. Discuss whether each element of current work is ahead of schedule. Determine how behind-time work will be expedited and secure commitments from the entities involved in doing so. Discuss whether schedule revisions are required to ensure that current work and subsequent work will be completed within the Contract Time. Review everything of significance which could affect the progress of the work.
- D. Immediately following each progress meeting where revisions to the Progress Schedule/Critical Path Schedule have been made or recognized (regardless of whether agreed to by each entity represented), revise the Schedule. Reissue revised Schedule within 10 days after meeting.
- E. At intervals matching the preparation of payment requests, revise and reissue the Schedule to show actual progress of the work in relation to the latest revision of the Schedule.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

(Not Used)

END OF SECTION

SECTION 01 33 00

SUBMITTALS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Procedural requirements for Work-related submittals including Construction Progress Schedules, Shop Drawings, product data, samples, operation and maintenance (O&M) data, schedule of values and other miscellaneous Work-related submittals.

1.02 DEFINITIONS

A. Submittal for Review:

1. Submittal for ENGINEER's review in accordance with requirements of Contract Documents.

B. Submittal for Record:

1. Submittal for inclusion into OWNER's records prior to Substantial Completion. Submittal will not be reviewed by ENGINEER.

1.03 CONSTRUCTION PROGRESS SCHEDULES

A. Prepare and submit Construction Progress Schedule to ENGINEER for review, within 5 days after effective date of Contract.

B. No Work shall be done between 6:00 p.m. and 7:00 a.m., nor on Saturdays, Sundays or legal holidays without written permission of OWNER. Emergency Work may be done without prior permission. Saturday Work may be allowed with written permission of OWNER, with no equipment start up prior to 7:30 a.m.

C. Night Work may be established by CONTRACTOR as regular procedure with written permission of OWNER. Such permission may be revoked at any time by OWNER.

D. Prepare schedules in form of horizontal bar chart.

1. Provide separate horizontal bar for each operation.
2. Horizontal Time Scale: Identify first work day of each week.
3. Scale and spacing to allow space for notations and future revisions.
4. Arrange listings in order of start of each item of Work.

E. Construction Progress Schedule:

1. Show complete sequence of construction by activity.

2. Show dates for beginning and completion of each major element of construction and installation dates for major items. Elements shall include, but not be limited to, following.
 - a. Material and equipment order, manufacturer, delivery.
 - b. Performance tests and supervisory services activity.
 - c. Water main, sanitary sewer and other utility installation.
 - d. Asphalt pavement removal.
 - e. Excavation, backfilling.
 - f. Site grading.
 - g. Concrete work.
 - h. Dewatering.
 - i. Connections to existing water main and sanitary sewer.
 - j. Subcontractor's items of Work.
 - k. Paving asphaltic surface.
 - l. Restoration and landscaping.
 - m. Final cleanup.
 - n. Allowance for inclement weather.
 - o. Miscellaneous items.
3. Show projected percentage of completion for each item as of first day of each month.

F. Schedule Revisions:

1. Every 30 days to reflect changes in progress of Work.
2. Indicate progress of each activity at date of submittal.
3. Show changes occurring since previous submittal of schedule.
 - a. Major changes in scope.
 - b. Activities modified since previous submittal.
 - c. Revised projections of progress and completion.
 - d. Other identifiable changes.
4. Provide narrative report as needed to define following.
 - a. Problem areas, anticipated delays, and impact on schedule.
 - b. Corrective action recommended and its effect.
 - c. Effect of changes on schedules of other CONTRACTORS.

1.04 SHOP DRAWINGS AND PRODUCT DATA

A. Scheduling:

1. CONTRACTOR is not required to submit preliminary or final schedule of Shop Drawing submissions as required in Subparagraph 2.05.A.2 and Paragraph 2.07 of General Conditions.

B. CONTRACTOR's Responsibilities:

1. Review Shop Drawings and product data prior to submittal.
2. Determine and verify following.
 - a. Field measurements.

- b. Field construction criteria.
 - c. Catalog numbers and similar data.
 - d. Conformance with Specifications.
3. Coordinate each submittal with requirements of Work and Contract Documents.
 4. Notify ENGINEER in writing, at time of submittal, of deviations in submittals from requirements of Contract Documents.
 5. Begin no fabrication or Work requiring submittals until return of submittals with ENGINEER approval.
 6. Designate in Construction Progress Schedule, dates for submittal and receipt of reviewed shop drawings and samples.
 7. Submittals received but not requested in Specifications shall be returned without review.

C. Submittals shall contain:

1. Date of submittal and dates of previous submittals.
2. Project title and number.
3. Contract identification.
4. Names of:
 - a. CONTRACTOR.
 - b. Supplier.
 - c. Manufacturer.
5. Identification of product, with identification numbers, and Drawing and Specification section numbers.
6. Field dimensions, clearly identified.
7. Identify details required on Drawings and in Specifications.
8. Show manufacturer and model number, give dimensions, and provide clearances.
9. Relation to adjacent or critical features of Work or materials.
10. Applicable standards, such as ASTM or Federal Specification numbers. Identification of deviations from Contract Documents.
11. Identification of revisions on resubmittals.
12. 8 in. by 3 in. blank space for CONTRACTOR and ENGINEER stamps.
13. CONTRACTOR's stamp, signed, certifying to review of submittal, verification of products, field measurement, field construction criteria, and coordination of information within submittal with requirements of Work and Contract Documents.

D. Resubmittal Requirements:

1. Comply with submittal requirements.
2. Make corrections or changes in submittals required by ENGINEER. Resubmittals required until approved.
3. Identify on transmittal form submittal is resubmission.
4. Shop Drawings and Product Data:
 - a. Revise initial drawings or data and resubmit as specified for initial submittal.
 - b. Indicate changes made other than those requested by ENGINEER.
 - c. ENGINEER's responsibility for variation or revisions from previously reviewed submittal is established in Article 6.17.D.3 of General Conditions.

- E. Distribute reproductions of Shop Drawings and copies of product data which carry ENGINEER's stamp approval to following.
 - 1. Jobsite file.
 - 2. Record documents file.
 - 3. Subcontractors.
 - 4. Supplier or fabricator.

- F. ENGINEER's Duties:
 - 1. Review submittals in accordance with schedule.
 - 2. Affix stamp and signature, and indicate requirements for resubmittal or approval of submittal.
 - 3. Return submittals to CONTRACTOR for distribution or for resubmittal.

1.05 TEST RESULTS AND CERTIFICATIONS

- A. Submit test results and certifications required in Specification sections.
- B. Submit test results upon completion of test or submittal of results from testing laboratory.
- C. Test results and certifications are to be submitted for review of conformance with specified requirements and information.

1.06 DELAYS AND RECOVERY

- A. If, at any time during Project, CONTRACTOR fails to complete activity by its latest scheduled completion date, CONTRACTOR shall, within three working days, submit to ENGINEER written statement as to how and when Work force will be reorganized to return Contract to current construction schedule.
- B. When it becomes apparent from progress evaluation and updated schedule data that milestone completion or Contract completion dates will not be met, CONTRACTOR shall take some or all of the following actions:
 - 1. Increase construction staffing in such quantities and crafts as shall substantially eliminate backlog of Work.
 - 2. Increase number of working hours per shift, shifts per work day, work days per week, or amount of construction equipment, or combination of foregoing sufficient to substantially eliminate backlog of Work.
 - 3. Reschedule Work items to achieve concurrency of accomplishment.
- C. Addition of equipment or construction forces, increasing working hours or other method, manner, or procedure to return to current Construction Progress Schedule will not be considered justification for amending Contract Documents or treated as acceleration.

1.07 GUARANTEE, WARRANTIES, MAINTENANCE AGREEMENTS, AND WORKMANSHIP BONDS

- A. Refer to Specification sections for requirements. Submittal considered final when submittal is returned by ENGINEER, marked "No Exception Taken" or "Make Corrections Noted."

- B. In addition to copies desired for CONTRACTOR's use, furnish 2 executed copies. Provide 2 additional copies where required for maintenance data.
- 1.08 OPERATION AND MAINTENANCE (O&M) DATA
- A. Compile product data and related information appropriate for OWNER's maintenance and operation of products furnished under Contract. Prepare O&M data as specified in this section and as referenced in other pertinent sections of Specifications.
 - B. Manual Format: Prepare data in form of instructional manual for use by OWNER's personnel.
 - 1. Size: 8-1/2 in. by 11 in. or 11 in. by 17 in. folded, with standard 3-hole punching.
 - 2. Text: Manufacturer's printed data, or neatly typewritten.
 - 3. Drawings:
 - a. Provide reinforced punched binder tab, bind in with text.
 - b. Fold larger drawings to size of text pages and place in envelopes which are to be bound into manual. Place suitable identification on outside of each envelope.
 - 4. Cover: Identify each manual with typed or printed title "OPERATING AND MAINTENANCE INSTRUCTIONS and following."
 - a. Title of Project.
 - b. Identity of CONTRACTOR.
 - c. Identity of general subject matter covered in manual.
 - d. Identity of section number as set forth in Contract Documents.
 - e. Date of installation.
 - 5. Binders:
 - a. Commercial quality binders with durable and cleanable plastic covers.
 - C. Product Data:
 - 1. Include only those sheets pertinent to specific product.
 - 2. Annotate each sheet to:
 - a. Identify specific product or part installed.
 - b. Identify data applicable to installation.
 - c. Delete references to inapplicable information.
 - 3. Provide table of contents.
 - 4. Project installation schedule listing dates and locations of products installed.

1.09 ACTION ON SUBMITTALS

A. ENGINEER's Action:

1. General:

- a. Except for submittals for record and similar purposes, where action and return on submittals required or requested, ENGINEER will review each submittal, mark with appropriate action, and return. Where submittal must be held for coordination, ENGINEER will so advise CONTRACTOR without delay.
- b. ENGINEER will stamp each submittal with action stamp, appropriately marked with submittal action.

2. Notification of Insufficient Information:

- a. If information submitted is not sufficient to complete review of submittal, ENGINEER will send transmittal to CONTRACTOR notifying CONTRACTOR that additional information is required.
- b. Submittal will not be returned. Submittal will be placed in an "on hold" status until CONTRACTOR provides additional information.

B. Action Stamp:

1. Marking: No Exception Taken.

- a. Final Unrestricted Release: Where submittals are marked as "No Exceptions Taken," Work covered by submittal may proceed provided it complies with Contract Documents. Acceptance of Work depends on that compliance.

2. Marking: Make Corrections Noted.

- a. Final-But-Restricted Release: When submittals are marked as "Make Corrections Noted," Work covered by submittal may proceed provided it complies with ENGINEER's notations or corrections on submittal and with Contract Documents. Acceptance of Work depends on that compliance. Resubmittal is not required.

3. Marking: Rejected; See Remarks.

- a. Submittal Not Accepted: When submittals are marked as "Rejected; See Remarks," do not proceed with Work covered by submittal. Work covered by submittal does not comply with Contract Documents.
- b. Prepare new submittal for different material or equipment supplier or different product line or material of same supplier complying with Contract Documents.

4. Marking: Amend and Resubmit.

- a. Returned for Resubmittal: When submittals are marked as "Amend and Resubmit," do not proceed with Work covered by submittal. Do not permit Work covered by submittals to be used at Project site or elsewhere where Work is in progress.
- b. Revise submittal or prepare new submittal in accordance with ENGINEER's notations. Resubmit without delay. Repeat if required to obtain different action marking.

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

3.01 SUBMITTAL REQUIREMENTS

- A. Provide complete copies of required submittals as follows.
1. Construction Progress Schedule:
 - a. Digital copies of initial schedule.
 - b. Digital copies of each revision.
 2. Shop Drawings and Product Data: 6 hard copies or 1 PDF copy.
 3. Test Results: 1 PDF copy.
 4. Construction Photos: 1 PDF copy.
 5. Other Submittals:
 - a. 1 PDF copy if required for review.
 - b. 1 PDF copy if required for record.
 6. All digital files to have bookmarks for file management.

END OF SECTION

SECTION 01 41 00

REGULATORY REQUIREMENTS

PART 1 GENERAL

1.01 PERMITS

- A. OWNER has applied or is apply for the following permits:
 - 1. Wisconsin Department of Natural Resources (DNR) Drinking Water Well and Pump Station Permits.
 - 2. Public Service Commission Construction Authorization.
 - 3. Department of Safety and Professional Services facility approval.
- B. Comply with requirements of permits obtained by OWNER.
- C. Obtain other permits required for construction of Work, including, but not limited to, following.
 - 1. Written Permission for use of disposal sites for concrete, asphalt, and waste excavated materials.
 - 2. City of Madison construction permits.

1.02 NOTICES

- A. Provide notices in accordance with requirements of General Conditions to following agencies or individuals and to others as required elsewhere in Contract Documents.
 - 1. ENGINEER:
 - a. Notice: 3 working days prior to start of construction.
 - b. Notice: 3 days prior to start of pipe laying.
 - c. Notice: 3 days prior to start of additional crews.
 - 2. Fire, Police, Sheriff's Department, 911 Dispatch, DC Everest School District, and school bus company:
 - a. Notice: 24 hr minimum, or as required by local agencies, prior to performing operations affecting vehicular traffic.
 - 3. Wisconsin Department of Natural Resources, notice as required in permit forms.
 - 4. Utilities:
 - a. Notice: 72 hr minimum.
 - b. Notice: In accordance with permit or approval letters found in Appendix.
 - 5. Others as required in Contract Documents.

1.03 REGULATIONS

- A. Comply with local, state, and federal laws, rules, ordinances, and regulations. Give ENGINEER notice of variations in accordance with General Conditions.
- B. Maintain following separations between potable water works facilities (such as public and private wells and water distribution mains) and sanitary and storm sewers.
 - 1. Maintain minimum separation between water main and sewer.
 - a. Horizontal and vertical separation of parallel water main and sewer:
 - 1) Normal conditions: Locate sanitary sewer, storm sewer, or sewer manhole at least 8 ft horizontally from water mains, whenever possible; measure distance from edge to edge.
 - b. Provide minimum vertical separation of 18 in. between outside of water main and outside of sewer whenever water main crosses below sewer and 6-inches vertical separation when water main crosses above sewer. Arrange crossing so sewer joints will be equidistant and as far as possible from water main joints.
 - c. Water main shall not pass through or come into contact with any part of sewer manhole.

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

(Not Used)

END OF SECTION

SECTION 01 43 00

TESTING LABORATORY SERVICES

PART 1 GENERAL

1.01 PERFORMANCE REQUIREMENTS

- A. CONTRACTOR will employ and pay for services of independent testing laboratory to perform specified testing as described in Specifications.
 - 1. Cooperate with laboratory to facilitate execution of its required services.
 - 2. Employment of laboratory shall, in no way, relieve CONTRACTOR's obligations to perform Work of Contract.
- B. Related Requirements in Other Parts of Contract Documents:
 - 1. Inspections and testing required by laws, ordinances, rules, regulations, orders or approvals of public authorities, Conditions of Contract.

1.02 LIMITATIONS OF AUTHORITY OF TESTING LABORATORY

- A. Laboratory is not authorized to:
 - 1. Release, revoke, alter or enlarge on requirements of Contract Documents.
 - 2. Approve or accept any portion of Work.
 - 3. Perform duties of CONTRACTOR.

1.03 CONTRACTOR'S RESPONSIBILITIES

- A. Cooperate with laboratory personnel and provide access to Work.
- B. Provide to laboratory preliminary design mix proposed to be used for concrete and other material mixes which require control by testing laboratory.
- C. Furnish copies of product test reports.
- D. Furnish incidental labor and facilities.
 - 1. Provide access to Work to be tested.
 - 2. Obtain and handle samples at Project site or at source of product to be tested.
 - 3. Facilitate inspections and tests.
 - 4. Store and cure test samples.
- E. Notify laboratory and ENGINEER sufficiently in advance of operations to allow for laboratory assignment of personnel and scheduling of tests.
 - 1. When tests or inspections cannot be performed after such notice, reimburse OWNER for laboratory personnel and travel expenses incurred due to CONTRACTOR's negligence.

- F. Make arrangements with laboratory and pay for additional samples and tests required for CONTRACTOR's convenience.
- G. Pay for services of testing laboratory to perform additional inspections, sampling, and testing required when initial tests indicate Work does not comply with Contract Documents.

1.04 MEASUREMENT AND PAYMENT

- A. Consider work of this section incidental and include payment as part of appropriate lump sum or unit prices specified in Bid Form.

1.05 LABORATORY DUTIES:

- A. Cooperate with ENGINEER and CONTRACTOR; provide qualified personnel to perform Work after due Notice to Proceed.
- B. Perform specified inspections, secure samples, and test materials.
 - 1. Comply with specified standards.
 - 2. Ascertain compliance of materials with Contract Documents.
- C. Promptly notify ENGINEER and CONTRACTOR of observed irregularities or deficiencies of Work, equipment, or material.
- D. Promptly submit written report of each test and inspection; one copy each to ENGINEER, OWNER, material supplier, and CONTRACTOR, and one copy to record document file. Each report shall include following.
 - 1. Date issued.
 - 2. Project title and number.
 - 3. Testing laboratory name, address, and telephone number.
 - 4. Name and signature of laboratory inspector.
 - 5. Date and time of sampling or inspection.
 - 6. Record of temperature and weather conditions if test performed in field.
 - 7. Date of test.
 - 8. Identification of product and Specification section.
 - 9. Location of sample or test in Project.
 - 10. Type of inspection or test.
 - 11. Results of tests and compliance with Contract Documents.
 - 12. Interpretation of test results, when requested by ENGINEER.
- E. Perform additional tests as required by ENGINEER or CONTRACTOR.

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

(Not Used)

END OF SECTION

SECTION 01 50 14

TEMPORARY CONSTRUCTION FACILITIES AND UTILITIES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Water for construction.
2. Water for testing.
3. Sanitary facilities.
4. Temporary fire protection.
5. Temporary site work.
6. Stormwater discharge.
7. Security.
8. Temporary parking.
9. Field offices and buildings.

B. Measurement and Payment:

1. Consider Work of this section incidental and include payment as part of appropriate lump sum or unit prices specified in Bid Form.

1.02 QUALITY ASSURANCE

A. Items provided under this section shall be listed or labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in OSHA Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code, Article 100.

B. Regulatory Requirements:

1. National Electrical Code: Components and installation shall comply with NFPA 70.

C. Comply with federal, state, and local codes and regulations, and with utility company requirements.

PART 2 PRODUCTS

2.01 WATER FOR CONSTRUCTION

- ###### A. Water is available from hydrants. Secure permission from the Madison Water Utility, obtain necessary permits, and notify ENGINEER and Fire Department before obtaining water from fire hydrants. Make arrangements and pay costs for water, connecting to hydrants, and temporary piping required to transport water to point of use.

- B. Connection to hydrant shall prevent backflow to system. Backflow prevention device and meter may be supplied by Owner.
- C. Use only special hydrant operating wrenches to open hydrants. Make certain hydrant valve is open full. If hydrants are damaged, CONTRACTOR shall be responsible and shall notify appropriate agency so damage can be repaired as quickly as possible. Fire hydrants shall be completely accessible to Fire Department.

2.02 WATER FOR TESTING

- A. OWNER will provide water necessary for testing prior to acceptance of the Work, unless specifically stated otherwise in Specifications for equipment, system, or facility.
- B. During water main flushing, record amount of time each hydrant is flushed and location of hydrant. At end of water main flushing, provide information to ENGINEER.

2.03 SANITARY FACILITIES

- A. Provide temporary sanitary toilet facilities conforming to state and local health and sanitation regulations, in sufficient number for use of ENGINEER's, CONTRACTOR's, and Subcontractor's employees. Contractor may use bathroom on site provided it is maintained per this Section.
- B. Maintain in sanitary condition and properly supply with toilet paper.

2.04 TEMPORARY FIRE PROTECTION

- A. Provide and maintain in working order, minimum of one fire extinguisher as would be reasonably effective in extinguishing fires during early stages by personnel at Project site.

2.05 TEMPORARY SITE WORK

- A. Construct and maintain temporary site roadways, private existing roads, and public roads in clean, dust free, snow free, ice free, driveable condition necessary to carry out construction operations.
- B. Maintain private and public roads used during construction free from accumulations of dirt, mud and construction debris resulting from construction operations. Roads shall be considered "maintained" when material has been removed by a sweeper.
- C. Tracking of mud onto private and public streets shall be immediately cleaned up. Failure to clean streets will be grounds for stoppage of Work by OWNER.

2.06 STORMWATER DISCHARGE

- A. Comply with provisions of Section 01 57 00 for storm water discharge.

2.07 SECURITY

- A. Security will not be provided by OWNER.

- B. CONTRACTOR shall be responsible for loss or injury to persons or property where Work is involved, and shall provide security and take precautionary measures to protect CONTRACTOR's, OWNER's interests, and public.
 - C. CONTRACTOR shall minimize the length of trench left open during non-work hours and shall fence off the trench and utilize equipment and or barricades overnight to protect the traveling public.
- 2.08 TEMPORARY PARKING
- A. Parking on the site is permitted.
 - B. Parking along the public road is not permitted.
- 2.9 FIELD OFFICES AND BUILDINGS
- A. If required by CONTRACTOR, erect where designated by OWNER, and maintain in good condition, temporary field office, tool, and storage building(s) or trailer(s) for CONTRACTOR's use.
 - 1. Tool storage building(s) or trailer(s) shall be of ample size to provide space for tools and equipment.
 - 2. Building(s) or trailer(s) shall be well constructed, surfaced with plywood, drop siding, Masonite, or other similar material, painted and void of advertisements.
 - B. Engineer's Field office is not required.

PART 3 EXECUTION

3.01 REMOVAL AND RESTORATION

- A. Remove temporary materials, equipment, and structures when no longer required.
- B. Clean and repair damage caused by temporary installations or use of temporary facilities to original conditions.
- C. Restore drainage, and evenly grade, seed or plant to provide appearance equal to or better than original.

3.02 DAMAGE TO EXISTING PROPERTY

- A. CONTRACTOR is responsible for replacing or repairing damage to existing buildings, structures, sidewalks, roads, parking lot surfacing, and other existing assets.
- C. CONTRACTOR shall have option of having OWNER contract for such Work and have cost deducted from Contract amount.

END OF SECTION

SECTION 01 57 00

PROTECTION OF ENVIRONMENT

PART 1 GENERAL

1.01 SUMMARY

- A. CONTRACTOR, in executing Work, shall maintain Work areas on- and off-site free from environmental pollution that would be in violation of federal, state or local regulations.
- B. Provide erosion control in accordance with construction site erosion and sediment control measures shown on Contract Drawings.
- C. Measurement and Payment:
 - 1. Comply with Section 01 29 02.

1.02 PROTECTION OF SEWERS

- A. Prevent construction material, pavement, concrete, earth or other debris from entering existing sanitary sewer or storm sewer and sewer structures.

1.03 STORMWATER DISCHARGE

- A. CONTRACTOR shall comply with Water Resources Application for Project Permits (WRAPP) (Notice of Intent for Construction Site Erosion Control and Storm Water Management Plan) prepared in accordance with Wisconsin Pollutant Discharge Elimination System WPDES General Permit included with Construction Documents.
 - 1. CONTRACTOR shall inspect construction site and shall make corrections or repairs required.
 - 2. CONTRACTOR shall keep plan on-site during contract time, available for review by Wisconsin Department of Natural Resources (WDNR).
 - 3. CONTRACTOR shall inspect erosion control measures on a weekly basis or within 24 hours of a rainfall event of 0.5 inches or larger and any repairs required shall be completed within 24 hours of inspection.
 - 4. CONTRACTOR shall file weekly erosion control inspection reports with the City of Madison Public Works Department and keep copy of inspection reports on site for review by the WDNR.

1.04 EROSION CONTROL

- A. Refer to "City Specifications".

1.05 DISPOSAL OF EXCESS EXCAVATED AND OTHER WASTE MATERIALS

- A. Excess excavated material not required or not suitable for backfill and other waste material shall be disposed of in accordance with local regulatory requirements.

- B. Make arrangements for disposal at other sites subject to submission of proof to ENGINEER that OWNER(s) of proposed site(s) has valid fill permit issued by appropriate governmental agency and submission of haul route plan, including map of proposed route(s).
- C. Provide watertight conveyance for liquid, semi-liquid or saturated solids which tend to bleed during transport. Liquid loss from transported materials is not permitted, whether being delivered to construction site or hauled away for disposal. Fluid materials hauled for disposal must be specifically acceptable at selected disposal site.

1.06 PROTECTION OF AIR QUALITY

- A. Minimize air pollution by requiring use of properly operating combustion emission control devices on construction vehicles and equipment and encourage shutdown of motorized equipment not in use.
- B. Do not burn trash on construction site.
- C. If temporary heating devices are necessary for protection of Work, they shall not cause air pollution.
- D. Brush, logs or stumps from clearing and grubbing operations shall not be burned or buried on-site. Dispose of all cleared and grubbed materials off-site.

1.07 THAWING OF FROZEN GROUND

- A. Obtain permit from appropriate local authority before building fire to thaw frozen ground, and comply with conditions of permit.
- B. Use fuel which does not create air pollution or inconvenience public.
- C. ENGINEER reserves right to prohibit fires for thawing whenever deemed undesirable.

1.08 USE OF CHEMICALS

- A. Chemicals used during project construction or furnished for project operation, whether herbicide, pesticide, disinfectant, polymer, reactant or of other classification, shall be approved by U.S. EPA or U.S. Department of Agriculture or any other applicable regulatory agency.
- B. Use and disposal of chemicals and residues shall comply with manufacturer's instructions.
- C. Copies of Manufacturer's Material Safety Data Sheets shall be on-site during use and storage of all chemicals on site.

1.09 NOISE CONTROL

- A. Conduct operations to cause least annoyance to residents in vicinity of Work, and comply with applicable local ordinances.
- B. Equip compressors, hoists, and other apparatus with mechanical devices necessary to minimize noise and dust. Equip compressors with silencers on intake lines.
- C. Equip gasoline or oil-operated equipment with silencers or mufflers on intake and exhaust lines.

- D. Line storage bins and hoppers with material that will deaden sounds.
- E. Conduct operation of dumping rock and of carrying rock away in trucks so as to cause minimum of noise and dust.
- F. Route vehicles carrying rock, concrete or other material over such streets as will cause least annoyance to public and do not operate on public streets between hours of 6:00 p.m. and 7:00 a.m., or on Saturdays, Sundays or legal holidays unless approved by OWNER.

1.10 DUST CONTROL

- A. Take special care in providing and maintaining temporary site roadways, private roads, and public roads used during construction operations in clean, dust free condition.
- B. Comply with local environmental regulations for dust control. If CONTRACTOR's dust control measures are considered inadequate by ENGINEER, ENGINEER may require CONTRACTOR to take additional dust control measures.

1.11 FUEL AND LUBRICANTS

- A. Project site is within Well recharge area. All chemicals, fuels, and lubricants shall be stored in secondary containment on the site.
- B. Minimize use of potentially hazardous materials including fuels and lubricants.
- C. Keep motorized equipment in good working order with no fuel or lubricant leakage. Protect ground surface from leakage using tarps or other methods.
- D. If grease, oil, solvent, or other residue from CONTRACTOR operations occurs, CONTRACTOR shall conduct remedial investigation and remediate as required by OWNER.
- E. Do not change oil on equipment or store or dispose of fuels, solvents, lubricants, or other potentially hazardous materials on site.
- F. OWNER may require CONTRACTOR to remove damaged or leaking equipment from Project site.

PART 2 PRODUCTS

2.01 INLET PROTECTION

- A. Type D inlet protection shall conform to the requirements of Subsection 628.3.13 of the “State Specifications” and Drawings Detail.

2.02 EROSION MAT

- A. Erosion mat shall conform to requirements of Wisconsin Department of Transportation, Erosion Control Product Acceptability List, for Class I, Type B products and be North American Green S150 or equal. Use biodegradable anchors/stakes.

PART 3 EXECUTION

(Not Used)

END OF SECTION

SECTION 01 61 00
CONTROL OF MATERIALS

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

1. Section Includes:

- a. Definitions.
- b. Submittals.
- c. Spare parts.
- d. Quality assurance.
- e. Delivery, storage and handling.
- f. Warranty.
- g. Products.
- h. Manufacturer's instructions.
- i. Special tools.
- j. Nameplates.
- k. Loads.
- l. General material and equipment requirements.
- m. Materials and Equipment.
- n. Field Quality Control; Installation, Instructional, and Post Startup Services.

1.02 DEFINITIONS:

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
 2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
 3. Comparable Product: Product that is demonstrated and accepted through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

1.03 SUBMITTALS:

- A. Submittals: Submit in accordance with Section 01 33 00.

1.04 SPARE PARTS:

- A. Provide spare parts (or extra materials) for Products as specified in the individual technical specification sections.
- B. Pack spare parts to protect them during storage. Tag spare parts and containers to clearly identify them in accordance with Contractor's parts numbering system as reviewed by the Engineer. All parts shall be cross-referenced to their applicable the Specification Section.

1.05 QUALITY ASSURANCE:

- A. Comply with the requirements specified in Section 01 43 00.
- B. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

1.06 DELIVERY STORAGE AND HANDLING:

- A. Arrange deliveries of materials and equipment in accordance with construction Progress Schedule, coordinate to avoid conflict with Work and conditions at site.
- B. Provide equipment and personnel to handle materials and equipment by methods recommended by manufacturer to prevent soiling or damage to materials or equipment, or their packaging.
- C. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- D. Owner assumes no responsibility for damage or loss due to storage of materials and equipment.
- E. Interior Storage:
 - 1. Store with seals and labels intact and legible.
 - 2. Store materials and equipment subject to damage by elements in weathertight enclosures.
 - 3. Maintain temperature and humidity within ranges required by manufacturer's instructions.
- F. Inspection and Maintenance:
 - 1. Arrange storage to provide easy access for inspection, maintenance, and inventory.
 - 2. Make periodic inspections of stored materials and equipment to ensure materials and equipment maintained under specified conditions are free from damage or deterioration, and coverings are in-place and in condition to provide required protection.
 - 3. Perform maintenance on stored material and equipment in accordance with manufacturer's written instructions and in presence of Owner or Engineer.
 - a. Notify Engineer 24 hours before performance of maintenance.
 - b. Submit report of completed maintenance and condition of coverings to Engineer with each Application for Payment.
 - c. Failure to perform maintenance, to notify Engineer of intent to perform maintenance or to submit maintenance report may result in rejection of material or equipment.

- G. Assume responsibility for protection of completed construction and repair and restore damage to completed Work equal to original condition.
 - H. Wheeling of loads over finished floors, with or without plank protection, is not permitted in anything except rubber-tired wheelbarrows, buggies, trucks or dollies. This applies to finished floors and exposed concrete floors, as well as those covered with composition tile or other applied surfacing.
 - I. Where structural concrete is also finished surface, avoid marking or damaging surface.
- 1.07 WARRANTY:
- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
 - 1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
 - 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.
 - B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
 - 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 - 2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
 - 3. See other Sections for specific content requirements and particular requirements for submitting special warranties.
 - C. Submittal Time: Comply with requirements in Section 01 77 00.
- 1.08 PRODUCTS:
- A. Furnish products of qualified manufacturers suitable for intended use. Furnish products of each type by single manufacturer unless specified otherwise.
 - B. Do not use materials and equipment removed from existing premises, except as specifically permitted by Contract Documents.
 - C. Furnish interchangeable components from same manufacturer for components being replaced.
- 1.09 ACCEPTANCE OF MATERIALS:
- A. Unless otherwise specified, only new materials and equipment shall be incorporated in the work. All materials and equipment furnished by the Contractor shall be subject to the inspection and acceptance of the Engineer. No material shall be delivered to the work without prior acceptance of the Engineer.

- B. As specified in Section 01 33 00, the Contractor shall submit to the Engineer, data relating to materials and equipment he proposes to furnish for the work. Such data shall be in sufficient detail to enable the Engineer to identify the particular product and to form an opinion as to its conformity to the specifications.
- C. Facilities and labor for handling and inspection of all materials and equipment shall be furnished by the Contractor. If the Engineer requires, either prior to beginning or during the progress of the work, the Contractor shall submit additional samples or materials for such special tests as may be necessary to demonstrate that they conform to the specifications. Such samples shall be furnished, stored, packed, and shipped at the Contractor's expense. Except as otherwise noted, the Owner will make arrangements for and pay for the tests.
- D. Any delay of acceptance resulting from the Contractor's failure to submit samples or data promptly shall not be used as a basis of a claim against the Owner or the Engineer.
- E. In order to demonstrate the proficiency of workmen or to facilitate the choice among several textures, types, finishes, and surfaces, the Contractor shall provide such samples of workmanship or finish as may be required.
- F. The materials and equipment used on the work shall correspond to the accepted samples or other data.

1.10 MANUFACTURER'S INSTRUCTIONS:

- A. Installation of equipment and materials shall comply with manufacturer's instructions. Obtain and distribute printed copies of such instructions to parties involved in installation, including 2 copies to Engineer.
 - 1. Maintain one set of complete instructions at Site during installation and until completion of Work.
- B. Handle, store, install, connect, clean, condition, and adjust materials and equipment in accordance with manufacturer's written instructions and in conformance with Specifications.
 - 1. If Site conditions or specified requirements conflict with manufacturer's instructions, consult Engineer for further instructions. Do not proceed with Work without written instructions.

1.11 SPECIAL TOOLS:

- A. For each type of equipment furnished, the Contractor shall provide a complete set of all special tools (including grease guns or other lubricating devices) which may be necessary for the adjustment, operation, maintenance, and disassembly of such equipment. Tools shall be high-grade, smooth, forged, alloy, tool steel.
- B. Special tools are considered to be those tools which because of their limited use are not normally available, but which are necessary for the particular equipment.
- C. Pack items to protect them during storage. Tag items and containers to clearly identify them in accordance with Contractor's part system, as reviewed by the Engineer. Cross-reference all items to their applicable Specification Section.

- D. Special tools shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such special tools until completion of the work, at which time they shall be delivered to the Owner.
- E. The Contractor shall furnish and erect one or more steel wall cases with flat key locks and clips or hooks to hold each tool in arrangement.

1.12 NAMEPLATES:

- A. With the exceptions mentioned below, each piece of equipment shall be provided with a nameplate of non-corrodible metal, securely fastened in place and clearly and permanently inscribed with the manufacturer's name, model or type designation, serial number, principal rated capacities, electrical or other power characteristics, and similar information.

1.13 LOADS:

- A. Provide anchorage and supports for products, including equipment, assemblies, and pipe, designed to resist the following loads.
 1. Horizontal forces: 100 percent of dead and live loads acting in any direction in the horizontal plane applied to the center of gravity of the load.
 2. Vertical forces: 50 percent of the dead and live load, acting either upward or downward applied at the center of gravity of the load.
 3. Cantilevered anchorages/supports: 100 percent of the dead and live loads acting in any direction applied at the center of gravity of the load.

1.14 GENERAL MATERIAL AND EQUIPMENT REQUIREMENTS:

- A. The requirements of this Paragraph shall constitute the standards for the material and equipment specified herein. Should these requirements conflict with the Supplier's recommendations or in any way be less stringent than the Supplier's requirements, they shall be superseded by the Supplier's requirements.
- B. Bolts, Anchor Rods and Nuts:
 1. All necessary bolts, anchor rods, nuts, washers, plates and bolt sleeves shall be furnished by the contractor in accordance herewith. Anchor rods shall have suitable washers and hexagonal nuts.
 2. All anchor rods, nuts, washers, plates, and bolt sleeves shall be galvanized unless otherwise indicated or specified.
 3. Unless otherwise specified, stud, tap, and machine bolts, and nuts shall conform to the requirements of ASTM Standard Specification for Carbon Steel Externally and Internally Threaded Standard Fasteners, Designation A325. Hexagonal nuts of the same quality of metal as the bolts shall be used. All threads shall be clean cut and shall conform to ANSI Standard B1.1 for Unified Inch Screw Threads (UN and UNR Thread Form).
 4. Bolts, anchor rods, nuts, and washers, specified to be galvanized, shall be zinc coated, after being threaded, by the hot-dip process in conformity with the ASTM Standard Specification for Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip, Designation A123, or the ASTM Standard Specifications for Zinc Coating (Hot Dip) on Iron and Steel Hardware, Designation A153, as is appropriate.

5. Bolts, anchor rods, nuts, and washers specified to be stainless steel shall be Type 304 or Type 316 stainless steel, as indicated.
6. Anchor rods shall be set accurately. They shall be carefully held in suitable templates of acceptable design. Where indicated on the Drawings, specified, or required, anchor bolts shall be provided with square plates at least 4 inches by 4 inches by 3/8 inch or shall have square heads and washers and set in the concrete forms with suitable pipe sleeves, or both. If anchor are set after the concrete has been placed, all necessary drilling and grouting or caulking shall be done by the Contractor and care shall be taken not to damage the structure or finish by cracking, chipping, spalling, or otherwise during the drilling and caulking.

C. Concrete Inserts For Hangers:

1. Concrete inserts for hangers shall be designed to support safely, in the concrete that is used, the maximum load that can be imposed by the hangers used in the inserts. Inserts for hangers shall be of a type which will permit adjustment of the hangers both horizontally (in one plane) and vertically and locking of the hanger head or nut. All inserts shall be galvanized by the hot-dip process in conformity with the ASTM Standard Specification for Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip, Designation A123, or the ASTM Standard Specifications for Zinc Coating (Hot Dip) on Iron and Steel Hardware, Designation A153, as is appropriate.

D. Equipment Foundations, Installation and Grouting:

1. The Contractor shall furnish the necessary materials and construct suitable concrete foundations for all equipment installed by him, even though such foundations may not be indicated on the Drawings. The tops of foundations shall be at such elevations as will permit grouting as specified below.
2. All such equipment shall be installed by skilled mechanics and in accordance with the instructions of the manufacturer.
3. In setting pumps, motors, and other items of equipment customarily grouted, the Contractor shall make an allowance of at least 1 in. for grout under the equipment bases. Shims used to level and adjust the bases shall be steel. Shims may be left embedded in the grout, in which case they shall be installed neatly and so as to be as inconspicuous as possible in the completed work. Unless otherwise permitted, all grout shall be a suitable non-metallic, non-shrink grout.
4. Grout shall be mixed and placed in accordance with the recommendations of the manufacturer. Where practicable, the grout shall be placed through the grout holes in the base and worked outward and under the edges of the base and across the rough top of the concrete foundation to a peripheral form so constructed as to provide a suitable chamfer around the top edge of the finished foundation.
5. Where such procedure is impracticable, the method of placing grout shall be as accepted by the Engineer. After the grout has hardened sufficiently, all forms, hoppers, and excess grout shall be removed, and all exposed grout surfaces shall be patched in an accepted manner and given a burlap-rubbed finish.

E. Sleeves:

1. Unless otherwise indicated on the drawings, or specified, form openings for the passage of pipes, conduits, and circular ducts through floors and walls using sleeves of standard

weight, galvanized-steel pipe. Provide sleeves of ample diameter to pass the pipe and its insulation, if any, and to permit expansion as may occur. Provide sleeves that are flush at the walls and at the bottom of slabs and project 4 inches above the finished floor surface. Threaded nipples shall not be used as sleeves.

2. Sleeves in exterior walls below ground or in walls that have liquids on one or both sides, shall have a 2-inch annular fin of 1/8 inch plated welded with a continuous weld completely around the sleeve at mid-length. Galvanize sleeves after the fins are attached.
3. Sleeves shall be set accurately before the concrete is placed or shall be built in accurately as the masonry is being built.

F. Protection Against Electrolysis:

1. Where dissimilar metals are used in conjunction with each other, provide insulation between adjoining surfaces to eliminate direct contact and any resultant electrolysis. Provide bituminous insulation, heavy bituminous coatings, nonmettalic separators or washers, impregnated felt, or other means to provide insulation.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT:

A. Material and Equipment Incorporated into Work:

1. Conform to applicable specifications and standards.
2. Comply with size, make, type, and quality specified or as accepted by Submittal.

B. Manufactured and Fabricated Materials and Equipment:

1. Design, fabricate, and assemble in accordance with engineering and shop practices standard with industry.
2. Manufacture like parts of duplicate units to standard sizes and gauges, to be interchangeable.
3. Two or more items of same kind shall be identical, by same manufacturer.
4. Material and equipment shall be suitable for service conditions.
5. Equipment capabilities, sizes, and dimensions shown or specified shall be adhered to, unless variations are specifically accepted, in writing.
6. Equipment shall be adapted to best economy in power consumption and maintenance. Parts and components shall be proportioned for stresses occurring during continuous or intermittent operation, and for additional stresses occurring during fabrication or installation.
7. Design so working parts are readily accessible for inspection and repair, easily duplicated, and replaced.

C. Do not use material or equipment for purpose other than for which it is designed or specified.

PART 3 - EXECUTION

3.01 FIELD QUALITY CONTROL; INSTALLATION, INSTRUCTIONAL, AND POST STARTUP SERVICES:

A. General:

1. Provide on-site services of Supplier's representatives for equipment provided by Contractor during construction, installation, equipment startup, and training of Owner's personnel for equipment or plant operation as specifically required in Specification section for equipment or system.
2. Include and pay costs for Supplier's services.
3. Work day is defined as 8 hour period during Owner's or Contractor's typical calendar day. Work day for purposes of this section does not include travel to or from Site.
4. Specifications include minimum mandays to provide basis for bidding. If additional time is required to perform services Contractor shall include that time in Contract Price.

B. Installation Services:

1. Where installation services are called for in Specifications, provide competent and experienced technical representatives of manufacturers of material or equipment and systems to resolve assembly or installation procedures attributable to, or associated with, equipment furnished.
2. After equipment is installed, representatives shall perform initial equipment and system adjustment and calibration to conform to Specifications and manufacturer's requirements and instructions.
3. Provide "Certificate of Installation Services" stating proper adjustments have been made to equipment or system and equipment or system is ready for startup and system demonstration. Use Form 01 61 00-1 and furnish 2 copies to Engineer.

C. Training:

1. Do not start training until Installation Services have been completed.
2. Where training is called for in Specifications, provide competent and experienced technical representative of Supplier to provide detailed instructions to Owner's personnel for operation of equipment. Training services shall include operation and maintenance of instrumentation and equipment in classroom and on-site. Training shall include electrical, mechanical, and safety aspects of equipment.
3. Submit documentation identifying name of specific representative, factory authorization, and background of named individual(s) to conduct training. Submit information 30 days before scheduled training period for review and acceptance by Engineer.
4. Coordinate training periods with Owner and Supplier's representatives.
 - a. No training shall be conducted unless instructor has been accepted by Engineer.
 - b. Notify Engineer at least 48 hours before training sessions are to begin so Engineer can make arrangements with Owner's operating personnel.
 - c. Reschedule canceled training sessions 48 hours in advance.
 - d. Failure of Supplier's or manufacturer's representative to appear for scheduled training, failure to notify Engineer 24 hours in advance of need to cancel scheduled training or failure to arrive within 30 minutes of start of scheduled training shall result in reimbursement to Owner for time lost by Owner's personnel in waiting for

arrival of manufacturer's representative. Except in case of failure to arrive on time, time will not exceed 1 hour for each employee scheduled to receive training. Failure to arrive on time will be reimbursed by actual time late, up to 1 hour, after 1 hour training will be rescheduled.

- e. Failure of Supplier's or manufacturer's representative to appear for scheduled training, failure to notify Engineer 24 hours in advance of need to cancel scheduled training or failure to arrive within 30 minutes of start of scheduled training shall result in reimbursement to Owner for expenses and time incurred by Engineer in traveling and time spent on-site. Minimum time billed shall be 8 hours.

5. Similar types of equipment differing in model, size or manufacturer shall require equal service time as stated in specific Specification section.

6. O&M data shall constitute basis of instruction.

- a. Review data contents with personnel in full detail to explain aspects of operations and maintenance.

7. Instructional Services shall be completed before start of performance testing required in Section 01 78 24.

8. Provide "Certificate of Instructional Services", cosigned by Owner and Supplier's representative, verifying training has been accomplished to satisfaction of each party. Use form in Section 01 78 24 and furnish 2 copies to Engineer.

C. Post Startup Services:

1. After equipment/system has been in operation for at least 6 months, but no longer than 11 months, each equipment manufacturer or authorized equipment representative shall make final inspection when required in Specifications. Final inspection will provide assistance to Owner's operating personnel in making adjustments or calibrations required to ensure equipment or system is operating in conformance with design, manufacturer, and Specifications.

2. Provide "Certificate of Post Startup Services", cosigned by Owner and equipment representative, verifying this service has been performed. Use form similar to Form 01 61 00-2 and furnish 2 copies to Engineer.

3.02 CLOSEOUT ACTIVITIES:

A. Provide in accordance with Section 01 77 00.

FORM 01 61 00-1
EQUIPMENT MANUFACTURER'S CERTIFICATE OF INSTALLATION SERVICES

Owner - Madison Water Utility

Project - UW15 PFAS Treatment

Contract No. _____

AECOM No. 60686092

EQUIPMENT SPECIFICATION SECTION _____

EQUIPMENT DESCRIPTION _____

I _____, Authorized representative of
(Print Name)

(Print Manufacturer's Name)

hereby CERTIFY that _____
(Print equipment name and model with serial No.)

conforms to the requirements of the Contract and is ready for permanent operation and that nothing in the installation will render the manufacturer's warranty null and void.
on

Date: _____ Time: _____

CERTIFIED BY: _____ DATE: _____
(Signature of Manufacturer's Representative)

FORM 01 61 00-2
EQUIPMENT MANUFACTURER'S CERTIFICATE OF POST STARTUP SERVICES

Owner - Madison Water Utility

Project - UW15 PFAS Treatment

Contract No. _____

AECOM No. 60686092

EQUIPMENT SPECIFICATION SECTION _____

EQUIPMENT DESCRIPTION _____

I _____, Authorized representative of
(Print Name)

(Print Manufacturer's Name)

hereby CERTIFY that _____
(Print equipment name and model with serial No.)

Post Startup Services for the subject project (has) (have) been performed in a satisfactory manner, and that Owner assigned operating personnel have been suitably instructed in the operation, lubrication, and care of the unit(s) on

Date: _____ Time: _____

CERTIFIED BY: _____ DATE: _____
(Signature of Manufacturer's Representative)

OWNER'S ACKNOWLEDGMENT OF POST STARTUP SERVICES

(I) (We) the undersigned, authorized representatives of the Owner and/or Plant Operating Personnel have received Post Startup Services for the equipment as required by the contract on:

_____ Date: _____

END OF SECTION

SECTION 01 73 29

CUTTING, CORING AND PATCHING

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Section Includes:

1. Alterations to existing buildings or structures.
2. Cutting, coring, and patching.

B. All cutting, coring, and rough patching shall be performed by the Contractor. Finish patching shall be the responsibility of the Contractor and shall be performed by the trade associated with the application of the particular finish.

C. Work Includes:

1. Alterations:

- a. Cutting, moving or removal of items as shown on Drawings.
- b. Cutting, moving or removal of items not shown to be cut, moved or removed, but which must be cut, moved or removed to allow new Work to proceed. Patch or reinstall Work or items which are to remain in finished Work after cutting, moving or removal, and make joints and finishes match adjacent or similar Work.
- c. Removal of existing surface finishes as needed to install new Work and finishes.
- d. Removal of abandoned items and removal of items serving no useful purpose, such as piping and electrical conduit.
- e. Repair or removal of dangerous or unsanitary conditions.
- f. Removal of unsuitable or extraneous materials not marked for salvage, such as abandoned furnishings, debris, grease buildup, rotted wood, rusted trench covers, and deteriorated concrete and masonry.

2. Cutting and Patching:

- a. Uncovering Work for installation of ill-timed Work.
- b. Removal and replacement of defective Work and Work not conforming to Contract Documents.

- c. Uncovering Work to provide observation by Engineer or inspection or tests by others of covered Work.
 - d. Removal of samples of installed materials for testing.
 - e. To make several parts fit properly.
3. Temporary enclosures and services.

1.02 REFERENCES:

- A. American Society for Testing and Materials International (ASTM):
 - 1. E84: Standard Test Method for Surface Burning Characteristics of Building Materials

1.03 ALTERATIONS, CUTTING, AND PROTECTION:

- A. Each Contractor is responsible to survey and record condition of existing facilities to remain in-place that may be affected by alteration operations. After alteration work is complete, survey conditions again and restore existing facilities to pre-alteration condition.
- B. Perform Work of moving, removal, cutting, and patching with trades qualified to perform Work in manner causing least damage to each type of Work.
 - 1. Cut finish surfaces such as masonry, tile, plaster or metals, by methods to terminate surfaces in straight line at natural point of division.
- C. Protect existing finishes, equipment, and adjacent Work which is to remain, from damage.
 - 1. Protect existing and new Work from weather and extremes of temperature.
 - a. Maintain existing interior work area above 60 degrees F (15 degrees C).
 - b. Provide weather protection, waterproofing, heat, and humidity control as needed to prevent damage to remaining existing and new Work.
- D. Provide shoring, needling, and bracing to keep building(s) or structures structurally secure and free of damaging deflection for installation of new structural members.
- E. Do not pile material to endanger building or structure.

1.04 HOLES IN EXISTING CONCRETE:

- A. When the Contractor is required to make new holes in existing concrete for piping, conduit, cables, or equipment, the Contractor shall accurately and carefully mark out the

locations and the extent of cutting required and coordinate with the trade(s) involved. The Contractor shall make new holes using one of the methods described below:

1. Prior to drilling any openings, the Contractor shall determine the location, if any, of existing services concealed in and/or behind the construction to be drilled. X-ray the walls or slabs, if required to determine the location.
2. The Contractor shall chip with an electric hammer with chisel point. Adjust the location of holes as necessary to avoid electrical conduits if encountered. Cut reinforcing steel after permission is received.

1.05 PROTECTION AND CONTINUITY OF UTILITIES AND OPERATIONS:

- A. Protect existing utilities so they will continue to function during and after construction.
- B. Where interference with such facilities occurs, cooperate with Owner of facility and, if necessary, alter facility to eliminate interference.
- C. Service Continuity:
 1. Facility is not in operation during Construction.

1.06 QUALITY ASSURANCE:

- A. Comply with the requirements specified in Section 01 43 00.
- B. Adhere strictly to the manufacturer's current printed recommendations regarding temperature at time of application for all work involving epoxy, cement base coating and protective coating.
- C. Use only products of the specified Repair Mortar System Manufacturer(s) or equal.
- D. Any changes in the specified repair mortar work methods shall be allowed only with the written acceptance of the Engineer.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Concrete repair mortar shall be a non-shrink, commercial formulation requiring only the addition of water with minimum 28-day compressive strength of 5,000 psi.
- B. Provide a non-shrink cementitious repair mortar material as manufactured by:
 1. Sika Repair 224 manufactured by Sika Corp.,
 2. EMACO S88CI manufactured by Master Builder, Inc.,

3. Underlayment F-120 by Sauereisen, Inc.,

C. Materials for finish patching shall be equal to those of adjacent construction.

2.02 SALVAGED MATERIALS:

A. Salvage sufficient quantities of cut or removed material to replace damaged Work of existing construction or patch new Work when material not readily obtainable on current market.

B. In addition to items specified above or indicated on Drawings to be salvaged, items marked or listed by Engineer for salvage shall remain property of Owner and be carefully removed and stored.

C. Salvaged items remaining after completion of Work shall be delivered to place of storage designated by Owner or disposed of by Contractor.

2.03 PRODUCTS FOR PATCHING, EXTENDING, AND MATCHING:

A. Provide same products, salvaged materials, types of construction or finish as that in existing structure, as needed to patch, extend or match existing Work.

1. Generally, Contract Documents will not define products or standards of workmanship present in existing construction, determine products by inspection and necessary testing and workmanship by use of existing as sample of comparison.

PART 3 - EXECUTION

3.01 GENERAL:

A. All cutting and coring shall be performed in such a manner as to limit the extent of patching.

B. All holes cut through concrete and masonry walls, slabs or arches shall be core drilled unless otherwise accepted. No structural members shall be cut without acceptance of the Structural Engineer of Record and all such cutting shall be done in a manner directed by him. No holes may be drilled in beams or other structural members. All work shall be performed by mechanics skilled in this type of work.

C. Rough patching shall be such as to bring the cut or cored area flush with existing construction unless otherwise shown. Finish patching shall match existing surfaces.

3.02 PREPARATION:

A. Where new work conceals existing surfaces or spaces Contractor shall remove foreign substances such as accumulated dirt, dust, grease, sludge, and odoriferous material before concealing existing surfaces.

- B. Where surfaces are to remain exposed Contractor shall remove foreign substances described above.

3.03 TEMPORARY ENCLOSURES:

- A. Exterior: Provide temporary weathertight enclosure for successive areas of building as Work progresses, to provide:
 - 1. Acceptable working conditions.
 - 2. Weather protection for materials.
 - 3. Effective temporary heating.
 - 4. Prevention of entry by unauthorized persons.
- B. Remove temporary materials, equipment, and services:
 - 1. When construction needs can be met by use of permanent construction.
 - 2. At completion of Project.

3.04 REMOVAL, RELOCATION AND SECURING MATERIALS AND EQUIPMENT:

- A. Where existing materials and equipment are removed or relocated, remove materials no longer used such as studs, straps, conduits, ducts, wires, anchors, piping and supports. Remove or cut off concealed or embedded materials such as conduit, boxes, anchors, piping or other materials to not less than 3/4-inches below finished surface.
- B. Materials that cannot be removed shall be secured to adjacent structure to prevent coming loose.
- C. Repair affected surfaces to conform to type, quality, and finish of adjacent surfaces.

3.05 CUTTING:

- A. Inspect existing conditions of Work, including components subject to damage or movement during cutting, patching, excavating or backfilling.
- B. After uncovering Work, inspect conditions affecting installation of new materials.
- C. Do not cut or notch structural members without specific written acceptance of Engineer.
- D. Cutting shall be performed with a concrete saw and diamond saw blades of proper size.
- E. Corners of square or rectangular openings shall be cored. Do not overcut corners of openings. Corners shall be chipped out square, if required, so as not to cause cracking at the corners.

- F. Provide for control of slurry generated by sawing operation on both sides of element.
- G. When cutting reinforced concrete, the cutting shall be done so as not damage bond between the concrete and reinforcing steel left in structure. Cut shall be made so that steel neither protrudes nor is recessed from face of the cut.
- H. Adequate bracing and/or shoring of area to be cut shall be installed prior to start of cutting. Check area during sawing operations for cracking and provide additional bracing as required to prevent a partial release of cut area during sawing operations.
- I. Provide equipment of adequate size to remove cut panel.

3.06 CORING:

- A. Coring shall be performed with an accepted non-impact rotary tool with diamond core drills. Size of holes shall be suitable for pipe, conduit, sleeve, equipment or mechanical seals to be installed.
- B. Provide protection for existing equipment, utilities and critical areas against water or other damage caused by drilling operation.
- C. Slurry or tailings resulting from coring operations shall be removed from the area following drilling.

3.07 PATCHING:

- A. Prepare surfaces to receive cementitious repair mortar in accordance with manufacturer's instructions.
- B. Mix the cementitious repair mortar material components in accordance with the manufacturer's instructions. Concrete surfaces should be surface saturated dry (SSD) with no standing water prior to mortar application.
- C. Work a wet scrub coat of the mortar per the manufacturer's recommendations into the pores and voids in the substrate and over the substrate prior to mortar application by trowel.
- D. Apply the cementitious repair mortar using a steel trowel to work the material into the surface. Fill voids from deepest to shallowest areas as the application work proceeds. Strictly follow the manufacturer's application requirements.
- E. Once the repair areas are filled with repair mortar, strike off the mortar level with the surrounding concrete substrate. Do not leave a broom finish. Finish with a steel trowel until closed up at the surface and flat.
- F. Cure the repair mortar in strict accordance with the manufacturer's instructions.

3.08 CLEANING:

- A. Perform periodic and final cleaning as specified in Section 01 74 23, and:
 - 1. Clean Owner-occupied areas daily.
 - 2. Clean spillage, overspray, and heavy collection of dust in Owner-occupied areas immediately.
- B. At completion of alterations work in each area, provide final cleaning and return space to condition suitable for use by Owner.
- C. Remove debris from site each day. Removed material, except that listed or marked by Engineer for retention, becomes property of Contractor.

3.09 CLOSEOUT ACTIVITIES:

- A. Provide in accordance with Section 01 77 00.

END OF SECTION

SECTION 01 74 23

CLEANING UP

PART 1 - GENERAL

1.01 SUMMARY:

- A. Execute cleaning during progress of Work and at completion of Work.
- B. Refer to specification sections for specific cleaning for Products or Work.

1.02 DISPOSAL REQUIREMENTS:

- A. Conduct cleaning and disposal operations to comply with local codes, ordinances, regulations, and anti-pollution laws. Do not burn or bury rubbish or waste materials on Project site. Do not dispose of volatile wastes, such as mineral spirits, oil, or paint thinner, in storm or sanitary drains. Do not dispose of wastes into streams or waterways.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Use only those cleaning materials which will not create hazards to property and persons or damage surfaces of material to be cleaned.
- B. Use only cleaning materials recommended by manufacturer of surface to be cleaned.

PART 3 - EXECUTION

3.01 CLEANING DURING CONSTRUCTION:

- A. Comply with General Conditions.
- B. At all times maintain areas covered by the contract and adjacent properties and public access roads free from accumulations of waste, debris, and rubbish caused by construction operations.
- C. During execution of work, clean site, adjacent properties, and public access roads and dispose of waste materials, debris, and rubbish to assure that buildings, grounds, and public properties are maintained free from accumulations of waste materials and rubbish. Unneeded construction equipment shall be removed and all damage repaired so that the public and property owners will be inconvenienced as little as possible.
- D. Provide on-site containers for collection and removal of waste materials, debris, and rubbish in accordance with applicable regulations.

3.02 FINAL CLEANING:

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - d. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - e. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - f. Sweep concrete floors broom clean in unoccupied spaces.
 - g. Remove labels that are not permanent.
 - h. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - i. Leave Project clean and ready for occupancy.
- C. Construction Waste Disposal: Comply with waste disposal requirements in Division 01 Section 01 57 00, Protection of Environment.
- D. Touch-up paint or repaint damaged finishes on electrical items delivered to Project with finish coat of paint. Engineer will make final determination of items to be repainted or touched-up.
- E. Prior to substantial completion or Owner occupancy, Contractor with Engineer and Owner, shall conduct inspection of sight-exposed interior and exterior surfaces and work areas to verify Work and site is clean.

END OF SECTION

SECTION 01 77 00
CONTRACT CLOSEOUT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. See Madison Water Utility Definitions of Beneficial Occupancy, Substantial Completion, and Final Completion.

1.02 SUMMARY:

- A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Final completion procedures.
 - 3. Warranties.
 - 4. Final cleaning.
 - 5. Repair of the Work.
 - 6. Specific closeout and special cleaning requirements for the Work in those Sections.

1.03 SUBMITTALS:

- A. Submit shop drawings in accordance with Section 01 33 00.
- B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- C. Certified List of Incomplete Items: Final submittal at Final Completion.
- D. Certificate of Insurance: For continuing coverage.
- E. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.04 SUBSTANTIAL COMPLETION PROCEDURES:

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction

- photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
2. Submit closeout submittals specified in individual Divisions 02 through 33 Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 3. Submit maintenance material submittals specified in individual Divisions 02 through 33 Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Engineer. Label with manufacturer's name and model number where applicable.
 4. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Advise Owner of pending insurance changeover requirements.
 2. Complete startup and testing of systems and equipment.
 3. Perform preventive maintenance on equipment used prior to Substantial Completion.
 4. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
 5. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
 6. Terminate and remove temporary facilities from Project site, along construction tools, and similar elements.
 7. Remove labels that are not permanent labels.
 8. Complete final cleaning requirements, including touchup painting.
 9. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Engineer, that must be completed or corrected before certificate will be issued.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 2. Results of completed inspection will form the basis of requirements for final completion.

1.05 STARTING OF SYSTEMS:

- A. Conform to the requirements of Section 01 78 23 and Section 01 78 24.
- B. Coordinate schedule for start-up of various equipment and systems.
- C. Notify Engineer seven days prior to start-up of each item.
- D. Verify each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions which may cause damage.

- E. Verify tests, meter readings, and specified electrical characteristics agree with those required by equipment or system manufacturer.
 - F. Verify wiring and support components for equipment are complete and tested.
 - G. Execute start-up under supervision of applicable manufacturer's representative or Contractors' personnel in accordance with manufacturers' instructions.
 - H. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.
 - I. Submit a written report in accordance with Section 01 33 00 that equipment or system has been properly installed and is functioning correctly.
- 1.06 DEMONSTRATION AND INSTRUCTIONS:
- A. Conform to the requirements of Section 01 78 23 and Section 01 78 24.
 - B. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.
 - C. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at equipment location.
 - D. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.
 - E. Required instruction time for each item of equipment and system is specified in individual sections.
- 1.07 PROTECTING INSTALLED CONSTRUCTION:
- A. Protect installed Work and provide special protection where specified in individual specification sections.
 - B. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
 - C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
 - D. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- 1.08 SPARE PARTS AND MAINTENANCE PRODUCTS:
- A. Furnish spare parts, maintenance, and extra products in quantities specified in individual specification sections.
 - B. Deliver to and place in location as directed by Owner; obtain receipt prior to final payment.
 - C. Coat parts to protect from moisture.

D. Crate in containers designed for prolonged storage suitable for handling.

E. Stencil on containers:

1. Manufacturer/supplier name.
2. Unit name.
3. Spare part name.
4. Manufacturer catalogue number.
5. Other identifying information.
6. Precautionary information.

1.09 FINAL COMPLETION PROCEDURES:

A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:

1. Submit a final Application for Payment according to Division 01 Section 01 29 02, Measurements and Payment.
2. Certified List of Incomplete Items: Submit certified copy of Engineer's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Engineer. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.

B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.10 LIST OF INCOMPLETE ITEMS (PUNCH LIST):

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Engineer.
 - d. Name of Contractor.
 - e. Page number.

1.11 SUBMITTAL OF PROJECT WARRANTIES:

- A. Time of Submittal: Submit written warranties on request of Engineer for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
 - 1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
 - 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
 - 3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
 - 4. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
- C. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

3.01 FINAL CLEANING:

- A. General: Perform final cleaning in accordance with Section 01 74 23.
- B. Construction Waste Disposal: Comply with waste disposal requirements in Division 01 Section "Temporary Facilities."

3.02 REPAIR OF THE WORK:

- A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.
- B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
 - 1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.

2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that that already show evidence of repair or restoration.
 - a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

3.03 ADJUSTING:

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

END OF SECTION

SECTION 01 78 23

OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. This section includes procedural requirements for providing, compiling and submitting operation and maintenance data required for this project.

1.02 SUMMARY:

- A. This section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. General contents of data.
 - 2. Specific data for each equipment and system.
 - 3. Manual for materials and finishes.
 - 4. Assembly.

1.03 SUBMITTALS:

- A. O&M Manual Content: Operations and maintenance manual submittal requirements are specified in individual Specification Sections for the Products for which they must be supplied. Submit reviewed manual content formatted and organized by this Section and as defined in Section 01 33 00.
 - 1. Engineer will comment on whether content of operations and maintenance submittals are acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. O&M Manual Submittal: Submit digital or 3 copies of each manual. Engineer will return one copy with comments.
 - 1. The contractor to correct or revise each manual to comply with Engineer's comments.
- C. Submit 3 copies and 1 digital copy of each corrected manual as a final manual within 15 days of receipt of Engineer's comments and prior to commencing startup, commissioning, and/or training.

1.04 FORMAT (HARDCOPY):

- A. Prepare data in the form of an O&M instructional manual.

- B. Binders: Commercial quality, 8-1/2 x 11-inch three-hole post type binders with hardback, 3-inch maximum binder size. When multiple binders are used, correlate data into related consistent groupings.
 - 1. Engrave on covers and end of binder, title OPERATIONS AND MAINTENANCE INSTRUCTIONS, name of Project, Owner's project number, date of Contract, and volume number with subject matter of contents, and Engineer's name.
- C. Arrange contents by Specification Section numbers and sequence of Table of Contents of this Project Manual.
- D. Provide tabbed fly leaf for each separate product and system, with printed description of product and major component parts of equipment. Insert type tab labels must be secured or bonded to prevent the labels from falling out.
- E. Text: Manufacturer's printed data, or typewritten data on 20 pound paper.
- F. Remove bindings of individual manuals.
- G. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages and insert into clear plastic envelopes that can be secured into the three-hole post binders.
- H. The electronic O&M data must be organized in a logical manner to aid operation in troubleshooting and information retrieval.

1.05 FORMAT (ELECTRONIC DOCUMENTATION):

- A. The Contractor must provide Operation and Maintenance Manual information specific to the configuration of the project in electronic form. Documents should be formatted like a web site complete with index page and Table of Contents. The electronic format must be such that the Owner is able to load the files onto a server to provide online access via any standard web browser. The Contractor shall make use of PDF file formats. The complete document shall be provided on a CD or USB storage device.
- B. The electronic O&M data must be organized in a logical manner to aid operation in troubleshooting and information retrieval including bookmarks in PDF files.

1.06 QUALITY ASSURANCE:

- A. Preparation of data shall be performed by personnel:
 - 1. Trained and experienced in O&M of described equipment.
 - 2. Familiar with requirements of this section.
 - 3. Skilled as technical writers to the extent required to communicate the essential data to the Reader.
 - 4. Skilled as drafters competent to prepare any required drawings.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

3.01 GENERAL CONTENTS OF DATA:

- A. Each individual manual shall contain equipment data pertaining to not more than one Specification section number as indicated in the Contract Documents.
 - 1. Completed Form 01 78 23-1, Contractor's Submittal Form. An electronic copy of Form 01 78 23-1 will be provided to the Contractor
- B. Title Sheet: First page in data listing following:
 - 1. Title: "OPERATION AND MAINTENANCE INSTRUCTIONS".
 - 2. Title of Project: As shown on Contract Documents.
 - 3. Name(s) of applicable building(s) or structure(s) in which equipment is located.
 - 4. Name of equipment as described in Contract Documents.
 - 5. Contractor's name, address, and telephone number.
 - 6. Subcontractor's name, address, and telephone number if equipment is provided by Subcontractor.
 - 7. Contractor's or Subcontractor's purchase order number, manufacturer's shop order number or other such numbers required for parts and service ordering.
 - 8. Manufacturer's name, address, and telephone number.
 - 9. Name, address, and telephone number for local source of supply for parts and service.
- C. Equipment List: Immediately following title sheet containing the following:
 - 1. Table of Contents: Immediately following equipment list. Arrange in logical, systematic order and shall include as minimum each tabbed divider. Each page shall be numbered.
 - 2. Tabbed Dividers: Insert tabbed section dividers between each major section
 - a. Provide title of section on each tab.
 - b. Provide table of contents for each tabbed section, arranged in systematic order.
 - 3. Equipment Data Sheets: Provide catalog sheets showing configuration, manufacturer's specifications, models, options, and styles of equipment and major components being provided. Product data sheets will show project specific information with inapplicable information deleted by crossing out or removal. Include in tabbed section(s).
 - 4. Text:
 - a. Include only those sheets applicable to Project.
 - b. Each sheet shall:
 - (1) Identify specific equipment or part installed.
 - (2) Identify text applicable to equipment or part installed.
 - (3) Do not include inapplicable information or neatly strike it out.

5. Drawings:
 - a. Supplement text with drawings to clearly illustrate following:
 - (1) Equipment and components.
 - (2) Relations of component parts of equipment and systems.
 - (3) Control and flow diagrams.
 - b. Actual drawings of equipment from manufacturer. "Typical" drawings are not acceptable, unless they accurately illustrate actual installation for this contract.
6. Specially written information, as required to supplement text for particular installation.
 - a. Provide explanation of interrelationships of equipment and components, and effects one component has on another or entire system.
 - b. Provide overall instructions and procedures for equipment tying in instructions and procedures for separate components into unified instructional package.
 - c. Provide glossary of any special terms used by the manufacturer if applicable.
 - d. Organize in consistent format under separate headings for different O&M procedures.
 - e. Provide logical sequence of instructions in order of O&M action required for each procedure.

3.02 SPECIFIC DATA FOR EACH ITEM OF EQUIPMENT AND/OR SYSTEM:

- A. For each item of equipment and system include:
 1. Completed Equipment Data Form on copy of Form 01 78 23-2 to Section 01 78 23. An electronic copy of Form 01 78 23-2 will be provided to the contractor.
- B. Include data and information in accordance with Specification Sections.
 1. Manufacturer's printed instructions regarding safety precautions for both:
 - a. Protection of personnel operating equipment and systems.
 - b. Prevention of damage to equipment and systems.
 2. List of original all of the manufacturer's components, spare parts with diagram, and recommended quantities to be maintained in storage by the Owner.
 3. Other data as required under pertinent sections of Specifications.
- C. Prepare and include additional data when need for such data becomes apparent during instruction of Owner's personnel. Differences between the equipment O&M manual and the manufacturers training session shall result in the training and/or O&M Manual being corrected.

FORM 01 78 23-1 Page 1 of 3
 CONTRACTOR SUBMITTAL FORM

TO: (Engineer) (Address) (City, State, Zip) (Attn:)		DATE:	
		SPECIFICATION SECTION TITLE:	
		SECTION NO.:	
		MANUFACTURER/VENDOR:	
FROM: (Contractor) (Address) (City, State, Zip)		NO. OF COPIES SUBMITTED TO ENGINEER:	
		SIGNATURE OF CONTRACTOR:	

GENTLEMEN:
 We have checked the O&M manual submittal dated _____, 20__, and have found it to be in accordance with the requirements of Specification Section 01 78 23 as noted below.

FORMAT
 Size: 8-1/2 x 11 or 11 x 17
 Paper: 20-lb minimum
 Text: Printed data/neatly typed
 Drawings: Standard size bound in text; in text-size labeled envelopes
 Tabbed Section Dividers
 Cover Label: Title
 Project name
 Building/structure ID
 Equipment name
 Specification section
 Binders: 3-ring

FORM 01 78 23-1 Page 2 of 3
 CONTRACTOR SUBMITTAL FORM

Provided	Not Applicable	Page No.	
3.01 GENERAL CONTENTS			
			A. Section number - one specification only
			B. Title Page
			1. Title
			2. Project title
			3. Building/structure ID
			4. Equipment name
			5. Contractor ID
			6. Subcontractor ID
			7. Purchase order data
			8. Manufacturer ID
			9. Service/parts supplier ID
			C. Product List
			D. Table of Contents
			E. Tabbed Sections
			F. Pertinent data sheets
			1. Annotated as needed
			G. Text
			1. Pertinent to project
			2. Annotated
			H. Drawings
			1. Supplement text
			a. Illustrate product and components
			b. Relations of equipment systems
			c. Control and flow diagrams
			2. Actual drawing of project equipment
			I. Special Information
			1. Interrelationships of equipment and components
			2. Instructions and procedures provided
			3. Instructions organized in consistent format
			4. Instructions in logical sequence
			5. Glossary
			J. Warranty, Bond, Service Contract

FORM 01 78 23-1 Page 3 of 3
 CONTRACTOR SUBMITTAL FORM

Provided	Not Applicable	Page No.	
3.02 SPECIFIC CONTENTS (EQUIPMENT/SYSTEMS ONLY)			
			A. Each electrical and electronic system
			1. Description
			a. Equipment functions
			b. Normal operating characteristics
			c. Performance curves
			d. Engineering data
			e. Test data
			f. Replaceable parts list (with numbers)
			g. Nameplate data
			h. P&ID numbers
			2. Circuit and Panel Board Directories
			a. Electrical
			b. Controls
			c. Communications
			3. Instrumentation
			a. Loop Diagrams
			b. Components list each circuit/loop
			4. Operation Procedures
			a. Routine/normal operating instructions
			b. Sequences required
			c. Special operating instruction
			5. Maintenance Procedures
			a. Routine/normal instructions
			b. Troubleshooting guide
			c. Disassembly/reassembly
			d. Adjusting and checking
			6. Safety Precautions/Features
			7. Spare Parts List
			8. Additional Data

FORM 01 78 23-2 Page 1 of 3
EQUIPMENT DATA FORM

PROJECT NAME			
CONTRACT NO.			
CONTRACTOR			
EQUIPMENT NO.		ASSET NO.*	
DESCRIPTION		MAINT. NO.*	
LOCATION			
MANUFACTURER			
PURCHASED FROM			
VENDOR ORDER NO.		PURCHASE \$	
DATE OF PURCHASE			
LOCAL SUPPLIER			
ADDRESS			
PHONE NO.			
MODEL NO.			
NO. OF UNITS		SERIAL NOS.	
*By Owner			

LUBRICANT/RECOMMENDED SPARE PARTS LIST

EQUIPMENT NO.		ASSET NO.*	
DESCRIPTION		MAINT. NO.*	

LUBRICANT LIST

REFERENCE SYMBOL	LUBRICANT TYPE (MILITARY STANDARD)	RECOMMENDED LUBRICANT AND MANUFACTURER
List symbols in "Maintenance Operation" (Page 3).	List general lubricant type.	List specific lubricant name, viscosity, and manufacturer.

RECOMMENDED SPARE PARTS LIST

PART NO. **	DESCRIPTION	UNIT	QUANTITY	UNIT COST

ADDITIONAL DATA AND REMARKS

* By Owner
 ** Identify parts provided by this contract with two asterisks.
 Note: Attach additional sheets if necessary; identify each sheet at top with equipment number and description.

END OF SECTION

SECTION 01 78 24

TRAINING

PART 1 - GENERAL

1.01 SUMMARY:

- A. Section includes administrative and procedural requirements for instructing the Owner's personnel, including the following:
 - 1. Quality Assurance
 - 2. Coordination
 - 3. Facilities for training.
 - 4. Schedule.
 - 5. Preparation.
 - 6. Instruction.
 - 7. Training content.
 - 8. Training documentation.
- B. Payment for work covered by this section shall be included in the lump sum cost of the Project.

1.02 QUALITY ASSURANCE:

- A. Instructor Qualifications:
 - 1. A factory-authorized service representative with minimum 5 years experience in operation and maintenance procedures and in providing training for the products and systems installed under this Contract.
 - 2. Owner or Engineer may request documentation of instructor experience.

1.03 COORDINATION:

- A. Contractor to coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of the Owner's personnel.
- B. Contractor to coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Contractor to coordinate content of training modules with content of accepted emergency, operation, and maintenance manuals. Do not submit instruction program(s) for review until the operation and maintenance data required under Section 01 78 23 has been reviewed and accepted by Engineer.

PART 2 - PRODUCTS

2.01 TRAINING MATERIALS:

- A. Copies of O&M Manual or applicable portions of the O&M Manual.

PART 3 - EXECUTION

3.01 FACILITIES FOR TRAINING:

- A. Use designated facilities for specified field training programs.
- B. Facilities include installation sites, which shall be used for hands-on training programs.
- C. Coordinate use of Owner's facilities with Owner.

3.02 SCHEDULE:

- A. Coordinate training periods with Engineer and Supplier's representatives.
 - 1. Reschedule canceled training sessions 7 calendar days in advance.
 - 2. Failure of supplier's or manufacturer's representative to appear for scheduled training, failure to notify Engineer 48 hours in advance of need to cancel scheduled training, or failure to arrive within 30 minutes of start of scheduled training shall result in reimbursement of Owner and Engineer for time lost by Owner's operating personnel and Engineer in waiting for arrival of manufacturer's representative. Except in case of failure to arrive on time, time will not exceed 1 hour for each Owners employee scheduled to receive training and the Engineer. Failure to arrive on time will be reimbursed by actual time late, up to 1 hour, after 1 hour training will be rescheduled.
- B. Training Procedures:
 - 1. The instructor shall arrive at the training site at least one hour before training is scheduled to be delivered in order to review and complete final preparations for presentation of the training session. The instruction shall comply with all safety requirements.
 - a. Information presented in the training program shall be based on the Instructor and Trainee Manuals.
 - b. The Engineer will monitor and evaluate the performance of the instructor and the quality of the training session. Unacceptable sessions are those where the accepted lesson plan was not presented, where inadequate time was taken to present lesson plan or the training was not understood by the trainees. The adequacy of the training shall be determined solely by the Engineer. Contractor shall repeat any training sessions deemed unacceptable, at no additional cost to the Owner.
 - c. A safety briefing shall be conducted by the instructor prior to use of any equipment.

3.03 PREPARATION:

- A. Assemble educational materials necessary for instruction, including documentation and training modules. Assemble training modules into a training manual organized in coordination with requirements of this Section and in Section 01 78 23 "Operations and Maintenance Data".

- B. Set up instructional equipment at instruction location.

3.04 INSTRUCTION:

- A. Prepare instruction program and training, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 - 1. Owner will furnish the Contractor with names and positions of participants after the final course outline is accepted.
- C. Manufacturer's Training Location and Reference Material:
 - 1. Conduct training on-site in the completed and fully operational facility using the actual equipment in-place.
 - 2. Conduct training using final operation and maintenance data submittals as training aides.
- D. Cleanup:
 - 1. Collect used and leftover educational materials and remove from the Project site if unwanted by the Owner.
 - 2. Remove instructional equipment.
 - 3. Restore systems and equipment to condition existing before initial training use.

3.05 TRAINING CONTENT:

- A. Maintenance of Instrumentation:
 - 1. Training requirements:
 - a. Describe overall function of each instrument and control loop installed under this Contract.
 - b. Locating probable source of malfunction in instrumentation equipment determining symptoms of trouble, establishing probable cause and effecting solution.
 - c. Taking appropriate preventive and corrective maintenance procedures necessary to keep instrumentation system in proper operating condition, including calibration and testing.
 - 2. Course Materials:
 - a. Pertinent portions of submittals specified in Specifications such as calibration data and maintenance instructions.
 - b. Detailed course outlines and troubleshooting guides for field use. Troubleshooting guides shall include symptoms, probable causes and solutions for all cases of trouble described during training program.
 - 3. Training program shall not include any time specified for system start-up instruction or acceptance testing.

B. Maintenance of Process Equipment:

1. Training requirements:
 - a. Describe functions of process equipment.
 - b. Component preventive and corrective maintenance activities required to keep unit equipment in good operating conditions.
 - c. Instruct trainees in locating probable source of equipment malfunctions, determining symptoms of trouble, establishing probable cause, and effecting solution.
2. Course materials:
 - a. Pertinent portions of operation and maintenance manuals as well as alignment tolerances, lubrication schedules, vibration analysis instructions and parameters, and special calibration test and procedures.
 - b. Detailed course outlines and trouble-shooting guides for each piece of equipment. Trouble-shooting guides shall include symptoms, probable causes, and solutions for trouble described during training program.
3. Method of training maintenance personnel shall include Contractor using Owner's equipment to demonstrate trouble-shooting, preventive and corrective maintenance procedures.

3.06 TRAINING DOCUMENTATION:

- A. On completion of his training, the manufacturer's or supplier's representative shall submit in triplicate to the Engineer a complete signed Form 01 78 24-1 Demonstration his training is complete.
- B. If the Owner approves the training, the acceptance will be documented in a completed Form 01 78 24-2.
- C. Differences between the equipment O&M manual and the manufacturers training session shall result in the training and/or O&M Manual being corrected.

FORM 01 78 24-1
EQUIPMENT MANUFACTURER'S CERTIFICATE OF INSTRUCTION

Owner – Madison Water Utility

Project – UW15 PFAS Treatment

Contract No. _____

AECOM No. 60686092

EQUIPMENT SPECIFICATION SECTION _____

EQUIPMENT DESCRIPTION _____

I _____, Authorized representative of
(Print Name)

(Print Manufacturer's Name)

hereby CERTIFY that _____
(Print equipment name and model with serial No.)

installed for the subject project (has) (have) been installed in a satisfactory manner, (has) (have) been satisfactorily tested, (is) (are) ready for operation, and that Owner assigned operating personnel have been suitably instructed in the operation, lubrication, and care of the unit(s) on

Date: _____ Time: _____

CERTIFIED BY: _____ DATE: _____
(Signature of Manufacturer's Representative)

FORM 01 78 24-2

OWNER'S ACKNOWLEDGMENT OF MANUFACTURER'S INSTRUCTION

(I) (We) the undersigned, authorized representatives of the _____
and/or Plant Operating Personnel have received classroom and hands-on instruction on the operation,
lubrication, and maintenance of the subject equipment and (am) (are) prepared to assume normal
operational responsibility for the equipment:

_____ Date: _____

_____ Date: _____

_____ Date: _____

END OF SECTION

SECTION 01 78 39

PROJECT RECORD DOCUMENTS

PART 1 GENERAL

1.01 SUMMARY

A. Maintain at site one record copy of:

1. Drawings.
2. Project Manual.
3. Addenda.
4. Change orders and other modifications.
5. ENGINEER'S Field Orders, Work Change Directives, Written Amendments, or clarifications.
6. Approved submittals.
7. Field test records.
8. Construction photographs.
9. Associated permits.

1.02 SUBMITTALS

A. At Substantial Completion:

1. Deliver 1 marked up set of record documents to ENGINEER for use in preparation of record drawings at completion of project
2. Deliver 1 set of construction photographs to ENGINEER and OWNER at completion of project.

B. Submit with transmittal letter containing following:

1. Date.
2. Project title and number.
3. CONTRACTOR's name and address.
4. Title of record document.
5. Signature of CONTRACTOR or authorized representative.

1.03 MEASUREMENT AND PAYMENT

- A. Consider cost of Work specified in this Section incidental to and include costs as part of appropriate lump sum or unit prices specified in Bid Form.

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

3.01 MAINTENANCE OF DOCUMENTS AND SAMPLES

- A. Store record documents and samples apart from documents used for construction.
 - 1. Provide files and racks for storage of documents.
 - 2. Provide secure storage space for storage of samples.
- B. Maintain record documents in clean, dry, legible condition and in good order. Do not use record documents for construction purposes.
- C. Make record documents and samples available for inspection by ENGINEER and OWNER.
- D. Failure to properly maintain record documents may be reason to delay portion of progress payments until records comply with Contract Documents.

3.02 RECORD DOCUMENTS

- A. General:
 - 1. Maintain 1 complete set of Drawings and Project Manual, including Addenda, legibly annotated to show changes made during construction.
 - 2. Label each document "PROJECT RECORD" in neat, large, printed letters.
 - 3. Record information concurrently with construction progress:
 - a. Do not conceal Work until information is recorded.
 - 4. Give particular attention to concealed piping that would be difficult to measure and record at later date.
- B. Drawings:
 - 1. Graphically depict changes by modifying or adding to plans, details, sections, elevations, or schedules.
 - 2. Make changes on each sheet affected by changes.
 - 3. Dimensions:
 - a. Horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
- C. Specifications:
 - 1. Mark Specification sections to show substantial variations in actual Work performed in comparison with text of Specifications and modifications.
 - 2. Include variations in products delivered to site and from manufacturer's installation instructions and recommendations.
 - 3. Give particular attention to substitutions and selection of options and similar information.
 - 4. Note related record drawing information and Product Data.

END OF SECTION

DIVISION 2
EXISTING CONDITIONS

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SECTION 02 41 19
SELECTIVE DEMOLITION

PART 1 - GENERAL

PART 2 - PRODUCTS

2.1 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 ANSI/ASSP A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Survey of Existing Conditions: Record existing conditions by use of measured drawings, and preconstruction photographs or video.
 - 1. Inventory and record the condition of items to be removed and salvaged.
 - 2. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
 - 1. Arrange to shut off utilities with utility companies.
 - 2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
 - 3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.

- a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
- b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
- c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
- d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
- e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
- g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

3.3 SELECTIVE DEMOLITION, GENERAL

- A. General: 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, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 - 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 adequate ventilation when using cutting torches.
 - 6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 - 7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 - 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.
- B. 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.
- C. 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. Protect items from damage during transport and storage.
- D. Removed and Reinstalled Items:
1. Clean and repair items to functional condition adequate for intended reuse.
 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 3. Protect items from damage during transport and storage.
 4. 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.
- E. 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 cleaned and reinstalled in their original locations after selective demolition operations are complete.
- 3.4 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. Roofing: Remove no more existing roofing than what can be covered in one day by temporary roofing and so that building interior remains watertight and weathertight.
1. Remove existing roof membrane, flashings, copings, and roof accessories.
 2. Remove existing roofing system down to substrate.

END OF SECTION

DIVISION 3
CONCRETE

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SECTION 03 10 00
CONCRETE FORMWORK

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. Provide design and furnish materials for fabricating, erecting and removing formwork, falsework and shoring for cast-in-place concrete as indicated and in compliance with Contract Documents.
- B. Use formwork to cast all cast-in-place concrete structures.
- C. Provide and remove all formwork for electrical work as shown on the drawings or specified under electrical work.

1.02 REFERENCES:

- A. American Concrete Institute (ACI):
 - 1. 117/117R: Standard Tolerances for Concrete Construction and Materials.
 - 2. 309.2R: Identification and Control of Visible Effects of Consolidation on Formed Concrete Surfaces.
 - 3. 318/318R: Building Code Requirements for Structural Concrete and Commentary.
 - 4. 347: Guide to Formwork for Concrete.
- B. Engineered Wood Association (APA)
- C. National Institute of Product Standards and Technology
 - 1. Voluntary Product Standard PS 1 Structural Plywood
- D. National Sanitation Foundation (NSF):
 - 1. 61: Drinking Water System Components – Health Effects

1.03 DESIGN REQUIREMENTS:

- A. Design formwork in conformance with methodology of ACI 347R for anticipated loads, lateral pressures, depth of concrete placement and rate of concrete placement. Design shall consider any special requirements due to the use of self-consolidating, plasticized and/or retarded set concrete. All forms and shoring shall be designed at the contractor's expense.

1.04 QUALIFICATIONS:

- A. Formwork Designer: Formwork, falsework, and shoring design shall be by an engineer licensed in the State where the Project is located.

1.05 SUBMITTALS:

- A. Submit product data for form ties, spreaders, chamfer strips, form coatings, and bond breakers.
- B. LEED Submittals
 - 1. Comply with the requirements specified in Section 01 81 13.
 - 2. Product Data and Certificates for Credit MR 7: Chain of Custody Certificates certifying that the products specified to be made from certified wood complies with the forest certification requirements. Include evidence that the mill is certified for chain of custody by and FSC-accredited certification body.
 - a. For each certified wood product used, include a statement indicating cost.
- C. Submit following shop drawings in accordance with 01 33 00.
 - 1. Layout of panel joints and tie hole pattern.
 - 2. Form Ties-Tapered Through-Bolts: Proposed method of sealing form tie holes.
 - 3. ANSI/NSF 61 Certification that form release agents proposed for use in structures to contain potable water are non-toxic and have no adverse effect on the quality or appearance of potable water.

1.06 QUALITY ASSURANCE:

- A. Comply with requirements in section 01 43 00 and as specified.
- B. Design of Formwork:
 - 1. The Contractor shall assume responsibility for the design, engineering and construction of formwork. Forms shall be designed to produce concrete members identical in shape, lines and dimensions to members shown on the Contract Documents.
 - 2. When high range water reducer (superplasticizer) is used in concrete mix or when self consolidated concrete is specified, forms shall be designed for full hydrostatic pressure per ACI 347.
 - 3. The formwork shall be designed for the loads and lateral pressures in accordance with ACI 347 and wind loads as specified by the local building code.
 - 4. Construction and contraction joints, openings, offsets, keyways, recesses, moldings, chamfers, blocking, screeds, bulkheads, waterstops, anchorages, inserts, and other features shall be provided.
 - 5. Formwork shall be designed to be readily removable without impact, shock, or damage to 'green' concrete surfaces and adjacent materials.
 - 6. The maximum panel deflection shall be 1/360 of the span between structural members.

- C. Unless otherwise specified herein, formwork shall be constructed so that the concrete surfaces will conform to the tolerance limits as given in ACI 117.
 - D. Materials, fabrications and workmanship found defective shall be promptly removed and replaced and new acceptable work shall be provided in accordance with Contract requirements at no additional cost to the owner.
- 1.07 DELIVERY, STORAGE AND HANDLING:
- A. Comply with the requirements in section 01 66 10.
 - B. Materials shall be delivered to the site in an undamaged condition and at such intervals as will avoid delay in the work.
 - C. Material shall be stored and protected in a clean, properly drained location. Material shall be kept off the ground under a weather-tight covering permitting good air circulation. Formwork materials shall be stored on dry wood sleepers, pallets, platforms or other appropriate supports which have slope for positive drainage. Materials shall be protected from distortion, excessive stresses, corrosion and other damage. Materials shall not be stored on the structure in a manner that might cause distortion or damage to the supporting structure.

PART 2 - PRODUCTS

2.01 LUMBER:

- A. Lumber used in form construction shall be Douglas fir, No. 2 grade, S4S, Standard Grading and Dressing Rules No. 16, West Coast Lumber Inspection Bureau; or Southern Yellow Pine, No. 2, S4S, Standard Grade Rules Southern Pine Inspection Bureau. Boards shall be 6 inches or more in width.

2.02 PLYWOOD:

- A. Only grade-marked plywood conforming to APA shall be provided.
- B. Plywood used in form construction shall be Grade B-B, Class 1 plyform, mill-oiled, and sanded on both sides in conformance with U.S. Product Standard PS 1 Structural Plywood.
- C. Thickness shall be sized to maintain alignment and surface smoothness, but not less than 5/8-inch (16 mm) thick.

2.03 STEEL FORMS:

- A. Commercial grade sheets not less than 16 gage shall be provided.
- B. Stock material that is free from warps, bends, kinks, cracks, and rust or other matter that could stain the concrete shall be provided.

2.04 FORM MATERIAL LOCATIONS:

- A. Wall Forms and Underside of Slabs and Beams:

1. Materials: Plywood, hard plastic finished plywood, overlaid waterproof particleboard, or steel in new and undamaged condition, of sufficient strength and surface smoothness to produce specified finish.

B. Column Forms:

1. Rectangular Columns: As specified for walls.
2. Circular Columns: Fabricated steel or fiber reinforced plastic with bolted together sections or spirally wound laminated fiber form internally treated with release agent for height of column.

C. All Other Forms: Materials as specified for wall forms.

D. Rustication Grooves and Chamfer Strips: Nonabsorbent material, compatible with form surface, fully sealed on all sides prohibiting loss of paste or water between the two surfaces.

2.05 FORM TIES:

- A. Locate form ties on exposed surfaces in a uniform pattern. Place form ties so they remain embedded in the concrete except for a removable portion at each end. Form ties shall have conical or spherical type inserts with a maximum diameter of 1 inch (25.4 mm). Construct form ties so that no metal is within 1-1/2 inch (38.1 mm) of the concrete surface when the forms, inserts, and tie ends are removed. Do not use wire ties. Ties shall withstand all pressures and maintain forms within acceptable deflection limits.

- B. Flat bar ties for panel forms shall have plastic or rubber inserts having a minimum depth of 1-1/2 inch (38.1 mm) and sufficient dimensions to permit patching of the tie hole.

- C. Tapered form ties shall be tapered through-bolts or through-bolts that utilize a removable tapered sleeve.

- D. Wire ties are not permitted.

- E. Water Stop Ties: For water-holding structures, basements, pipe galleries, and accessible spaces below finish grade, furnish one of the following:

1. Neoprene water stop 3/16-inch (4.8 mm) thick and 15/16 inch (23.8 mm) diameter whose center hole is one-half diameter of tie, or molded plastic water stop of comparable size.

F. Elastic Vinyl Plug:

1. Design and size of plug shall allow insertion with tool to enable plug to elongate and return to original length and diameter upon removal forming watertight seal.

2. Manufacturer:

- a. Dayton Superior, Miamisburg, OH; A58 Sure Plug.

G. Mechanical EPDM Rubber Plug:

1. Mechanical plug for taper tie

2. Manufacturers:
 - a. Sika Corporation.
 3. Friction fit plugs will not be allowed.
- 2.06 BOND BREAKER:
- A. Bond breaker shall be a V.O.C.-compliant nonstaining type that will provide a positive bond prevention.
 - B. Manufacturers:
 1. Dayton Superior; Sure Lift J6WB.
 2. Nox-Crete, Inc.; Silcoseal 97EC.
- 2.07 FORM LINERS:
- A. Form liners shall be provided as shown on documents.
 - B. Products:
 1. Dura-Tex; Symons Corporation, Des Plaines, IL.
- 2.08 FORM CAULKING:
- A. Form caulking shall be a one-component, gun-grade silicone sealant that is capable of producing flush, watertight and non-absorbent surfaces and joints. Sealant shall be compatible with the type of forming material and concrete ingredients used.
 - B. Products:
 1. Series 1200 Construction Caulking; GE Silicones, Waterford, NY.
 2. Dow Corning 999-A; Dow Corning Co., Midland, MI.
- 2.09 CHAMFER STRIPS:
- A. Provide 3/4 inch by 3/4-inch (19.1 mm by 19.1 mm) chamfer strips milled from clear, straight-grain pine, surfaced each side, or having extruded vinyl type with or without nailing flange unless otherwise shown on the Contract Documents.
- 2.10 INSERTS:
- A. Provide galvanized cast steel or galvanized welded steel inserts, complete with anchors to concrete and fittings such as bolts, wedges and straps.

2.11 DOVETAIL ANCHOR SLOTS:

- A. Provide dovetail anchor slots manufactured from 22 gage, galvanized steel with removable felt or polyurethane filler shall be provided where specified or shown on the Contract Documents.

2.12 FORM RELEASE AGENT:

- A. Form release agent shall not bond with, stain, or adversely affect concrete surfaces and shall not impair subsequent treatments of concrete surfaces when applied to forms. A ready-to-use water-based material formulated to reduce or eliminate surface imperfections and containing no mineral oil or organic solvents.
- B. Certified as meeting the requirement of ANSI/NSF 61 for contact with potable water.
- C. Manufacturers and Products:
 1. Master Builders Solutions, Inc.;; MBT, Rheofinish 211.
 2. Cresset Chemical Company; Crete-Lease 20-VOC.
 3. Unitex Chemicals; Farm Fresh.
 4. Dayton Superior; Magic Kote

PART 3 - EXECUTION

3.01 FORM TOLERANCES:

- A. Comply with the requirements of ACI 117 for tolerances for formed surfaces except as specified in Table 03 10 00-1.

Table 03 10 00-1-1	
Vertical alignment (plumbness)	1/4-inch (6 mm) in any 10 feet (3 meters) and 1-inch (25 mm) maximum for entire length
Variation in the lines and surfaces of foundation mats, base slabs and walls	1/4-inch (6 mm) in any 10 feet (3 meters) and 1-inch (25 mm) max. for entire length
Variation from the level or from the grades indicated on the drawings	1/4-inch (6 mm) in any 10 feet (3 meters)
Variation of the linear building lines from established position in plan	1/2-inch (13 mm) in any 20 feet (6 meters) and 1-inch (25 mm) maximum for entire length
Variation of distance between walls	1/4-inch (6 mm) in any 10 feet (3 meters) and 1-inch (25 mm) maximum for entire length and height
Variation in the sizes and locations of sleeves, floor openings and wall openings	Minus 1/4-inch (6 mm) Plus 1/2-inch (13 mm)
Variation in cross-sectional dimensions of columns and beams and in the thickness of slabs and walls	Minus 1/4-inch (6 mm) Plus 1/2-inch (13 mm)

Table 03 10 00-1-1	
Offset between adjacent panels of formwork facing material	1/2-inch (13 mm) (ACI 117 Class C finish).
Offset between adjacent panels of formwork facing material for exposed surfaces where appearance is of importance	1/8-inch (3 mm) (ACI 117 Class A finish).

- B. Tolerances are not cumulative
- C. Where equipment is to be installed, comply with manufacturer's tolerances if more restrictive than above.
- D. Failure of the forms to produce the specified concrete surface and surface tolerance shall be grounds for rejection of the concrete work. Rejected work shall be repaired or replaced at no additional cost to the Owner.

3.02 PREPARATION:

- A. Clean form surfaces to be in contact with concrete or foreign material prior to installation. Tape, gasket, plug, and/or caulk joints, gaps, and apertures in forms so that the joint will remain watertight and withstand placing pressures without bulging outward or creating surface irregularities.
- B. Coat form surfaces in contact with concrete with a form release agent prior to form installation.
- C. Keep form coatings off steel reinforcement, items to be embedded, and previously placed concrete.
- D. Steel Forms: Apply form release agent to steel forms as soon as they are cleaned to prevent discoloration of concrete from rust.
- E. Form liners to be installed for architectural concrete finish shall be in accordance to the manufacturer recommendations.

3.03 ERECTION AND INSTALLATION:

- A. Forms shall be constructed in accordance with ACI 347 to required dimensions, plumb, straight and mortar tight, and all joints and seams shall be made mortar-tight. Forms shall be substantial, properly braced, and tied together to maintain position and shape and to resist all pressures to which they may be subject. Unless otherwise indicated on the Contract Documents, formwork shall be constructed so that the concrete surfaces will conform to the tolerance limits in ACI 117 and herein specified.
- B. Provide means for holding adjacent edges and ends of form panels tight and in accurate alignment to prevent the formation of ridges, fins, offsets, or similar surface defects in the finished concrete. Forms shall be tight and shall prevent the loss of mortar and fines during placing and vibration of concrete.
- C. Provide one cleanout and inspection opening 12 inches wide by 18 inches high (305 mm wide by 450 mm high) every 7 feet (2130 mm)] at the bottom of each lift of forms.

- D. Provide exterior corners in concrete members with chamfers as specified.
- E. Provide means for removing forms without injury to the surface of finished concrete.
- F. Do not embed any form-tying device or part thereof other than metal in the concrete.
- G. Locate large end of taper tie on the "wet" side of the wall.
- H. Use only form or form-tying methods that do not cause spalling of the concrete upon form stripping or tie removal.
- I. Form surfaces of concrete members except where placement of the concrete against the ground is shown in the drawings or as indicated below. The dimensions of concrete members shown in the drawings apply to formed surfaces, except where otherwise indicated. Add [**2 inches (50.8 mm)**] of concrete where concrete is placed against trimmed undisturbed ground in lieu of forms. Placement of concrete against the ground shall be limited to footings and other nonexposed concrete and only where the character of the ground is such that it can be trimmed to the required lines and will stand securely without caving or sloughing.
- J. Openings shall be of sufficient size to permit final alignment of pipes or other items without deflection or offsets of any kind. Allow space for packing where items pass through the wall to ensure watertightness. Provide openings with continuous keyways and water stops. Provide a slight flare to facilitate grouting and the escape of entrained air during grouting. Provide formed openings with additional reinforcement as shown in the typical structural details. Reinforcing shall be at least 2 inches (50.8 mm) clear from the opening surfaces and encased items.
- K. Set anchor bolts and other embedded items accurately before placing concrete and hold securely in position until the concrete is placed and set. Check special castings, channels, or other metal parts that are to be embedded in the concrete prior to and again after placing concrete. Check nailing blocks, plugs, and strips necessary for the attachment of trim, finish, and similar work prior to placing concrete.

3.04 PROTECTION:

- A. During installation, the forms shall not be used as a storage platform nor as a working platform until the forms have been permanently fastened in position.

3.05 PIPES AND WALL CASTINGS CAST IN CONCRETE:

- A. Install wall spools, wall flanges, and wall anchors before placing concrete. Do not weld, tie, or otherwise connect the wall castings or anchors to the reinforcing steel.
- B. Support pipe and fabricated fittings to be encased in concrete on concrete piers or pedestals. Carry concrete supports to firm foundations so that no settlement will occur during construction.
- C. Pipes or wall castings located below operating water level shall have water stop ring collars and shall be cast in place. Do not block out such piping and grout after the concrete section is cast unless permitted, authorized or directed by the Engineer. Pipes fitted with thrust rings shall be cast in place.

3.06 REMOVAL OF FORMS:

- A. Forms shall be removed in accordance with ACI 347 recommendations without damage to concrete and in a manner to ensure complete safety to the structure. Forms, form ties and bracing shall not be removed without specific permission of the Contractor's Registered Professional Engineer.
- B. The following table indicates the minimum allowable time after the last cast concrete is placed before forms, shoring, or wall bracing may be removed; during which the air surrounding the concrete is above [50 degrees F (10 degrees C)].

Table 03 10 00-2	
Sides of footings and encasements	24 hours
Walls, vertical sides of beams, girders, columns, and similar members not supporting loads	48 hours
Slabs, beams, and girders	10 days (forms only)
Shoring for slabs, beams, and girders	Until concrete strength reaches 70 percent specified 28-day strength
Wall bracing	Until top or roof slab concrete reaches 70 percent specified 28-day strength

- C. Removal times will be increased if the concrete temperature following placement is permitted to drop below 50 degrees F (10 degrees C).
- D. Do not remove supports and reshore.

3.07 PATCHING OF TAPERED TIE HOLES:

- A. Clear tie hole of all loose debris with a taper tie void brush and flush debris from tie hole with air or water.
- B. Install elastic vinyl plug from larger tie hole end in accordance with manufacturer's instructions using an insertion tool as recommended by the manufacturer.
- C. Coat entire annular surface of the hole with epoxy bonding compound prior to filling with non-shrink, non-metallic patching mortar. Apply epoxy in accordance with manufacturer's instructions.
- D. Fill each side of hole with mortar. Apply mortar to the "wet" side of the wall first. Consolidate mortar solidly into the hole.
- E. Clear tie hole of all loose debris with a taper tie void brush and flush debris from tie hole with air or water.
- F. Install mechanical plug in accordance with manufactures instructions.

- G. Coat entire annular surface of the hole with epoxy bonding compound prior to filling with non-shrink, non-metallic patching mortar. Apply epoxy in accordance with manufacturer's instructions.
- H. Fill each side of hole with mortar. Apply mortar to the "wet" side of the wall first. Consolidate mortar solidly into the hole.

3.08 ALUMINUM SURFACES IN CONTACT WITH CONCRETE:

- A. Coat aluminum surfaces that will be in contact with concrete per Section 09 47 00.

3.09 CLOSEOUT:ACTIVITIES:

- A. Provide in accordance with Section 01 77 00.

END OF SECTION

SECTION 03 15 00

CONCRETE JOINTS AND ACCESSORIES

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. This section describes materials, testing, and installation of concrete joints and accessories as indicated and in compliance with Contract Documents.

1.02 REFERENCES:

- A. ASTM International (ASTM):

1. A276: Standard Specification for Stainless Steel Bars and Shapes.
2. C920: Specification for Elastomeric Joint Sealants
3. C1193: Guide for Use of Joint Sealants
4. D412: Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers – Tension.
5. D570: Standard Test Method for Water Absorption of Plastics
6. D624: Standard Test method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
7. D638: Standard Test Method for Tensile Properties of Plastics
8. D746: Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
9. D747: Standard Test Method for Apparent Bending Modulus of Plastics by Means of a Cantilever Beam.
10. D792: Standard Test Methods for Density and Specific Gravity of Plastics by Displacement.
11. D994: Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type)
12. D1171: Standard Test Method for Rubber Deterioration – Surface Ozone Cracking Outdoors or Chamber (Triangular Specimens)
13. D1259: Standard Test Methods for Nonvolatile Content of Resin Solutions.
14. D1752: Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
15. D2240: Standard Test Method for Rubber Property – Durometer Hardness

B. National Sanitation Foundation (NSF):

1. 61: Drinking Water System Components – Health Effects

C. Environmental Protection Agency (EPA):

1. 40 CFR 59: National Volatile Organic Compound Emission Standards for Consumer and Commercial Products.

D. Corps of Engineers:

1. CRD-C 572: Specifications for Polyvinylchloride Waterstop.

E. Federal Specifications:

1. TT-S-00230C: Sealing Compound: Elastomeric Type, Single Component

1.03 SUBMITTALS:

A. LEED Submittals

1. Product Data for Credit EQ 4.1: For installation of bond breakers, sealants and sealant primers to be used in areas inside the weatherproofing, include printed statement of VOC content.

B. Submit following shop drawings in accordance with 01 33 00.

1. Manufacturer's printed data and application instructions for specified materials and locations where materials are to be used.
2. Submit material one samples of each type of water stops.
3. Submit layouts for joints.
4. Certification that materials used within the joint system are compatible with each other.
5. For potable water, provide certification that joint materials meet the requirements of ANSI/NSF 61 for contact with potable water.

1.04 QUALITY ASSURANCE:

A. Comply with requirements in section 01 43 00 and as specified.

B. Do not add, relocate or omit joints without written permission from the Engineer.

C. Reject material exceeding expiration date for use.

D. Clean concrete surfaces to receive expansion joint compound in accordance with the printed instructions of the joint compound manufacturer.

E. In structures to contain potable water, use joint materials that are ANSI/NSF 61 approved for contact with potable water.

1.05 DELIVERY, STORAGE AND HANDLING:

- A. Comply with the requirements in section 01 66 10.
- B. Transport, handle and deliver materials to the job site in the manufacturer's sealed bags, unopened containers or banded pallets.
- C. Store materials off the ground on a platform or skids and protect with covers from snow, rain and ground splatter.
- D. Store expansion joint compounds in a dry location where they cannot freeze.
- E. Store plastic products under cover in a dry location, out of direct sunlight.

1.06 MANUFACTURER'S SERVICES:

- A. Prior to joint preparation for joints receiving sealant materials, require joint manufacturer's technical representative to demonstrate, on site, joint preparation, priming, and sealant materials application for the Contractor's personnel performing joint work.

PART 2 - PRODUCTS

2.01 PVC WATERSTOP:

- A. Waterstops shall be extruded from a PVC compound and shall be lock-rib, center-bulb, retro-fit or flat-strip type. Water stop shall comply with Corps of Engineers Specification CRD-C-572.
- B. PVC waterstops for construction joints: flat ribbed type, 6 inches (150 mm) wide unless otherwise noted on the Contract Drawings, with a minimum thickness of 3/8-inches (10 mm).

1. Products:

- a. Sika Greenstreak; Model 679
- b. BoMetals, Inc.; Model FR-638
- c. Sika Corporation; Model R638
- d. Or accepted equivalent product.

- C. PVC waterstop for contraction joints shall be ribbed with a center bulb, 6 inches (150 mm) wide with a minimum thickness of 3/8-inches (10 mm). The center bulb shall have an O.D. not less than 7/8-inches (22 mm).

1. Products:

- a. Greenstreak; Model 732
- b. BoMetals, Inc.; Model RCB-638LB
- c. Vinylex; Model RB638H

- d. Or accepted equivalent product.
- D. PVC waterstop for expansion joints shall be ribbed with a center bulb, 9 inches (230 mm) wide with a minimum thickness of 3/8-inches (10 mm). The center bulb shall have an O.D. not less than 1-3/8 inches (35 mm).
- 1. Products:
 - a. Greenstreak; Model 738
 - b. BoMetals, Inc.; Model RCB-938VLB
 - c. Vinylex; Model RB938H
 - d. Or accepted equivalent product.
- E. PVC waterstops for sealing existing concrete structures and new concrete placement shall be retrofit type, 6 inches (150 mm) wide and 3-3/16 inches (80 mm) height with a minimum thickness of 3/8-inches (10 mm). Attach waterstop to existing concrete using 1/4-inch by 2-1/4 inch (6 mm by 57 mm) stainless steel sleeve expansion bolt with stainless steel batten bars.
- 1. Products:
 - a. Greenstreak; Model 609
 - b. BoMetals, Inc.; Model RF-638
 - c. Or accepted equivalent product.
- F. Provide waterstops resistant to chemical action with Portland cement, alkalis, acids, and not affected by mildew or fungi. It shall show no effect when immersed for 10 days in a 10 percent solution of sulfuric or hydrochloric acid, saturated lime solution or salt water. Water stops shall be such that any cross section will be dense, homogeneous, and free from porosity and other imperfections. They shall be symmetrical in shape. When tested in accordance with Federal Standard No. 601, the material shall meet the requirements in Table 03 15 10-1.

TABLE 03 15 10-1	
Requirement	ASTM Spec.
Tensile strength, 2,000 psi	D638
Hardness, Shore durometer, 60-70	D2240
Elongation, ultimate, 280	D638
Water absorption, dry weight, maximum (48 hours) 0.32 percent	D570
Specific gravity, 1.3	D792
Stiffness in flexure, 920 psi	D747
Cold brittleness, -35 degrees F	D746
Tear resistance, 290 lbs/inch	D624

2.02 THERMOPLASTIC ELASTOMERIC RUBBER (TPE-R) WATER STOP:

A. TPER waterstop for construction joints shall be flat ribbed type, 6 inches (150 mm) wide unless otherwise noted on the drawings, with a minimum 3/16-inch (5 mm) thickness.

1. Products:

- a. BoMetals; Model TFR-6316)
- b. JP Specialties; Model JP 636
- c. WESTEC Barrier Technologies; Model 619
- d. Or accepted equivalent product.

B. TPER waterstop for contraction joints shall be ribbed with a center bulb, 6 inches (150 mm) wide with a minimum 3/16-inch (5 mm) thickness. The center bulb shall have an outside diameter not less than 7/16-inch (11 mm).

1. Products:

- a. BoMetals, Inc.; Model TCB-6316
- b. JP Specialties, Inc.; Model JP 636
- c. WESTEC Barrier Technologies; Model 619
- d. Or accepted equivalent product.

C. TPER waterstop for expansion joints shall be ribbed with a center bulb, 9 inches (230 mm) wide with a minimum 3/16-inch (5 mm) thickness as shown below. The center bulb shall have an outside diameter not less than 7/16-inch (11 mm).

1. Products:

- a. BoMetals, Inc.; Model TCB-9316
- b. JP Specialties, Inc.; Model JP 936
- c. WESTEC Barrier Technologies; Model 620
- d. Or accepted equivalent product.

D. TPER waterstops for sealing existing concrete structures and new concrete placement shall be retro-fit type, 4-1/2 inches (115 mm) wide and 3-3/16 inches (80 mm) height with a minimum thickness of 3/16-inch (5 mm). Attach waterstop to existing concrete using 1/4-inch by 2-1/4 inch (6 mm by 57 mm) stainless steel sleeve expansion bolt with stainless steel batten bars.

1. Products:

- a. BoMetals, Inc.; Model TRF-6316

- b. JP Specialties, Inc.; Model JP450T
 - c. Or accepted equivalent product.
- E. Provide waterstop resistant to chemical action with portland cement, alkalies, acids, and not affected by mildew or fungi. It shall show no effect when immersed for 10 days in a 10 percent solution of sulfuric or hydrochloric acid, saturated lime solution or salt water. Water stops shall be such that any cross section will be dense, homogeneous, and free from porosity and other imperfections. They shall be symmetrical in shape. When tested in accordance with Federal Standard No. 601, the material shall meet the requirements in Table -2.

TABLE -2	
Requirement	ASTM Spec.
Ozone resistance	D1171
Tensile strength, 2,000 psi	D638
Hardness, Shore durometer, 60-85	D2240
Elongation, ultimate, 280 percent	D638
Cold brittleness, -35 degrees F	D746
Tear resistance, 290 lbs/inch	D624

2.03 ELASTOMERIC JOINT SEALANT:

- A. Federal Specification TT-S-00230C Type 1, Class A, single component, cold applied, pourable, polyurethane.
 - 1. Products:
 - a. Euclid Chemical Corp; Eucolastic 1
 - b. Tremco; Vulkem 45
 - c. Or accepted equivalent product.

2.04 JOINT SEALANT FOR CONCRETE STRUCTURES:

- A. Joint sealant shall be a multipart, gray, nonstaining, nonsagging, gun grade polyurethane sealant, which cures at ambient temperature to a firm, flexible, resilient, tear-resistant rubber. Sealant shall comply with ASTM C920, Type M, Grade P, Class 25 for horizontal joints and Grade NS, Class 25 for vertical joints and be recommended by the manufacturer for continuous immersion in water. Troweling of sealants into joints will not be permitted. Sealant shall meet requirements in Table 03 15 10-3.

TABLE 03 15 10-3	
Characteristic or Parameter	Technical Requirements
Pot life	1 to 3 hours
Hardness	35 Shore A, +/- 5

TABLE 03 15 10-3	
Characteristic or Parameter	Technical Requirements
Elongation	650 percent, ASTM D412
Tensile strength	200 psi, ASTM D412
Peel strength on concrete	No adhesion loss at 25 pounds
Temperature service range	40 to 167 degrees F
Immersion in water	Continuous

B. Products:

1. Tremco; Vulkem 227 or Vulkem 245 (for Type M, Grade P, Class 25)
2. Sika Corporation; Sikaflex-2CNS (for Grade NS, Class 25), Sikaflex-2CSL
3. Or accepted equivalent product.

2.05 BOND BREAKER TAPE:

- A. Provide an adhesive-backed glazed butyl or polyethylene tape that will adhere to the premolded joint material or concrete surface. The tape shall be the same width as the joint. The tape shall be compatible with the sealant.

2.06 PREFORMED CONTROL JOINT:

- A. One-piece, flexible, PVC joint former.
1. Vinylex Corp.; Kold-Seal Zip-Per Strip KSF-150-50-50
 2. Or accepted equivalent product.

- B. Provide the preformed control joint material in full-length unspliced pieces.

2.07 PREMOLDED JOINT FILLER FOR LIQUID CONTAINMENT STRUCTURES:

- A. Self-expanding cork per ASTM D1752, Type III.
- B. Sponge Rubber per ASTM D1752, Type I. Preformed, nonextruded type constructed of closed-cell neoprene.

2.08 VOC LIMITS FOR SEALANTS, AND SEALANT PRIMERS:

- A. VOC limits for sealants, and sealant primers to comply with content limits when calculated according to 40 CFR 59, Subpart D (EPA Method 24), or applicable state and local codes containing more stringent requirements.

2.09 BOND BREAKER FOR JOINT COMPOUNDS:

- A. Provide polyethylene tape.

PART 3 - EXECUTION

3.01 PVC & TPE-R WATERSTOPS:

- A. Heat splice at ends and intersections. Provide waterstops that provide a continuous, uninterrupted watertight diaphragm throughout the entire joint system below the high water level and below grade .
- B. Construct forms for construction joints to prevent injury to water stops. Hold water stops securely in position in the construction joints by wire ties, continuous bars, and rings as shown on contract drawings. Install water stops in construction, contraction and expansion joints in liquid containment structures and shown on contract drawings.
- C. Use factory-made crosses, tees and ells. Make field splices with a thermostatically controlled heating iron in conformance with the manufacturer's current recommendations. Allow at least 10 minutes before pulling or straining the new splice in any way. The finished splices shall provide a cross section that is dense and free of porosity with tensile strength of not less than 80 percent of the unspliced materials.
- D. Provide waterstops with an integral fastening system consisting of grommets or pre-punched holes.

3.02 JOINTS:

- A. Make joints only at locations shown on the contract drawings or as permitted by the Engineer. Any addition or relocation of construction joints proposed by the Contractor, must be submitted to the Engineer for written permission.
- B. Relocate additional joints where they least impair strength of the member. In general, locate joints within the middle third of spans of slabs, beams and girders. If a beam intersects a girder at the joint, offset the joint a distance equal to twice the width of the member being connected. Locate joints in walls and columns at the underside of floors, slabs, beams or girders and at tops of footing or floor slabs.
- C. Cast slabs and beams monolithically without horizontal joints unless specifically indicated on the drawings.
- D. Do not use horizontal joints within foundation mats, base slabs, footings, pile caps, slabs on grade or elevated beams and slabs.
- E. Provide joints in concrete fills and toppings at the same location as the joints in the supporting concrete.
- F. Provide waterstops in all wall and slab joints in liquid containment structures and at locations shown on the contract Drawings. Do not provide metal waterstops unless permitted by Engineer.
- G. Construction Joints
 - 1. Provide flat ribbed waterstops at construction joints where shown on contract drawings and specified herein.

2. Where joint key ways are shown on contract drawings form keyways by beveled strips or boards placed at right angles to the formed face. Except where otherwise shown on contract drawings or specified, keyways shall be at least 1-1/2 inches (38 mm) in depth over at least 25 percent of the width of the section.
3. After the pour has been completed to the construction joint and the concrete has hardened, thoroughly clean the entire surface of the joint of surface laitance, loose concrete, foreign material, and expose clean aggregate by sandblasting or waterblasting the surface of construction joints before placing the new concrete. Cover horizontal construction joints with mortar. Spread uniformly and work thoroughly into irregularities of the surface. The water-cement ratio of the mortar in place shall not exceed that of the concrete to be placed, and the consistency of the mortar shall be suitable for placing and working.
4. In case of emergency, place additional construction joints. (An interval of 45 minutes between two consecutive batches of concrete shall constitute cause for an emergency construction joint.)

H. Contraction Joints:

1. Provide center-bulb waterstop at contraction joints where shown on contract drawings and specified herein.
2. Where specifically noted on the Drawings, coat the concrete surface with a bond breaker prior to placing new concrete against it. Avoid coating reinforcement or waterstops with bond breaker at these locations.
3. Full contraction joints
 - a. Do not extend reinforcement or other embedded items bonded to the concrete (except dowels bonded on only one side of joint) continuously through any expansion joint.
 - b. Where shown on contract drawings provide stainless steel expansion joint dowels. Secure tightly stainless steel expansion joints in forms with rigid ties. Orient dowels to permit joint movement.
4. Partial contraction Joints
 - a. Extend every other bar of reinforcement steel through partial contraction joints or as indicated on the drawings.

I. Control Joints:

1. Do not use of control joints in liquid contain structures.

3.03 INSTALLATION OF JOINT SEALANTS:

- A. Immediately before installing the joint sealant, clean the joint cavity by sandblasting or power wire brushing. Install bond breaker tape per manufacturer's instructions.
- B. Apply masking tape along the edges of the exposed surface of the exposed joints.

- C. Application criteria for the sealant materials, such as temperature and moisture requirements and primer cure time, shall be in accordance with the recommendations of the sealant manufacturer.
 - D. After the joints have been prepared as described above, apply the joint sealant. Apply the primer, if required, and joint sealant only with the equipment and methods recommended by the joint sealant manufacturer.
 - E. Trowel the joints smooth with a tuck pointing tool wiped with a solvent recommended by the sealant manufacturer.
 - F. After the sealant has been applied, remove the masking tape and any sealant spillage.
 - G. Sealants used in water retaining structures shall achieve final cure at least seven days before the structure is filled with water.
- 3.04 LEAKAGE TESTING:
- A. Not Used.
- 3.05 CLOSEOUT ACTIVITIES:
- A. Provide in accordance with Section 01 77 00.

END OF SECTION

SECTION 03 21 00
REINFORCEMENT BARS

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide concrete reinforcement as indicated and in compliance with Contract Documents:

1. Section Includes:
 - a. Reinforcement bars.
 - b. Welded wire reinforcement.
 - c. Reinforcement accessories.

1.02 REFERENCES:

A. ASTM International (ASTM):

1. A82: Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
2. A184: Standard Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement.
3. A185/A185M: Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
4. A496: Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.
5. A497: Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete Reinforcement.
6. A555: Standard Specification for General Requirements for Stainless Steel Wire and Wire Rods.
7. A615: Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
8. A616: Standard Specification for Rail-Steel Deformed and Plain Bars for Concrete Reinforcement.
9. A617: Standard Specification for Axle-Steel Deformed and Plain Bars for Concrete Reinforcement.
10. A706: Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.

11. A767: Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.
12. A775: Standard Specification for Epoxy-Coated Reinforcement Steel Bars.
13. A884: Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement.
14. A955/A955M: Standard Specification for Deformed and Plain Stainless Steel Bars for Concrete Reinforcement.

B. American Concrete Institute (ACI):

1. 301: Standard Specification for Structural Concrete.
2. 315: Details and Detailing of Concrete Reinforcement.
3. 318: Building Code Requirements for Structural Concrete.
4. 350: Building Code Requirements for Environmental Engineering Concrete Structures
5. SP-66: ACI Detailing Manual.

C. Concrete Reinforcing Steel Institute (CRSI):

1. Manual of Standard Practice.
2. Placing Reinforcing Bars.

D. American Welding Society (AWS):

1. D1.4: Structural Welding Code, Reinforcement Steel.

E. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

1.03 SUSTAINABLE DESIGN:

A. Comply with the requirements specified in Section 01 81 13.

B. Product Data for Credits MR 4.1 and Credit MR 4.2: For products having recycled content, provide documentation indicating percentages (by weight) of post-consumer and pre-consumer recycled content.

1. For each recycled product used, include a statement indicating costs.

C. Product Certificates for Credit MR 5.1: For products extracted, harvested and manufactured within 500 miles of the project site, provide documentation indicating percentages (by weight) of regional materials that meet the criteria.

1. For each regional product used, include a statement indicating costs.

1.04 SUBMITTALS:

- A. Unless otherwise acceptable to the Engineer, each submittal shall include reinforcement only for the individual structure to which it pertains.
- B. Shop Drawings:
 - 1. Submit bar lists and placing drawings for all reinforced concrete and masonry structures in accordance with Section 01 33 00.
 - 2. Detail reinforcement in conformance with ACI SP-66.
 - 3. Clearly indicate bar sizes, spacings, locations and quantities of reinforcement steel and wire reinforcement, bending schedules, and supporting and spacing devices. Show joints, with applicable joint reinforcement.
 - 4. Coordinate bar splicing and placement with Contractor's concrete placing schedule and joint locations. Do not add or delete joints without permission from the Engineer.
 - 5. Show wall reinforcement in elevation.
 - 6. Show slab reinforcement in plan view.
 - 7. Show location and size of all penetrations greater than 12-inches (300 mm) in diameter or least dimension of the opening with the corresponding added reinforcement around the penetrations.
 - 8. Clearly show marking for each reinforcement item.
 - 9. Indicate locations of reinforcement bar cut-offs, splices and development lengths.
- C. Submit Certificates: Submit AWS qualification certificates for welders employed on the Work for the appropriate electrode and class of material. Testing shall be conducted and witnessed by an independent testing laboratory prior to welding reinforcement in work. Maintain qualification and certification records at the job site, readily available for examination of test results.
- D. Submit certified copies of mill test reports of reinforcement analysis dated within the last three months for each shipment of reinforcement with specific lots in shipments identified.
- E. Chemical composition of reinforcement steel: Ladle analysis indicating percentage of carbon, phosphorous, manganese and sulfur present in steel.
- F. Where mechanical couplers are required or permitted to be used to splice reinforcement steel, submit Manufacturer's literature that contains instructions and recommendations for installation for each type of coupler used; certified test reports that verify the load capacity of each type and size of coupler used; and Shop Drawings that show the location of each coupler with details of how they are to be installed in the formwork.

1.05 QUALITY ASSURANCE:

- A. Comply with requirements in Section 01 61 00 and as specified.

- B. Do not fabricate reinforcement until shop and placement drawings have been reviewed and accepted by the Engineer.
 - C. Perform concrete reinforcement work in accordance with CRSI Manual of Practice, ACI 301, ACI SP-66, and ACI 318/318M.
 - D. Testing shall conform to Section 01 43 00.
- 1.06 QUALIFICATIONS:
- A. Welders: AWS qualified within previous 12 months.
- 1.07 INSPECTION AND TESTING:
- A. In no case shall any reinforcement steel be covered with concrete until the installation of the reinforcement has been observed by the Engineer and the Engineer's authorization to proceed with the concreting has been obtained. The Engineer shall be given 48 hours minimum prior notice of the readiness of placed reinforcement for observation. The forms shall be kept open until the Engineer has finished observations of the reinforcement steel.
 - B. Provide Engineer with access to fabrication plant to facilitate inspection of reinforcement. Notify Engineer of commencement and duration of shop fabrication, in sufficient time to allow for proper inspection.
- 1.08 DELIVERY STORAGE AND HANDLING:
- A. Comply with the requirements in Section 01 66 10.
 - B. Keep reinforcement steel free from mill scale, rust, dirt, grease or other foreign matter.
 - C. Ship and store reinforcement steel with bars of the same size and shape fastened in bundles with durable tags, marked in a legible manner with waterproof markings showing the same "mark" designations as those shown on the submitted placing drawings.
 - D. Store reinforcement steel off the ground, protected from moisture and kept free from dirt, oil or other injurious contaminants.
 - E. Provide equipment for handling epoxy coated reinforcement steel with protected contact areas. Lift bundles of coated reinforcement at multiple pick-up points to minimize bar to bar abrasion from sags in bundles. Do not drop or drag coated reinforcement steel or bundles.
 - F. Store coated reinforcement steel on protective cribbing.
 - G. Coating damage due to handling, shipment and placing need not be repaired in cases where damaged area is 0.1 sq. inch (65 sq. mm) or smaller. Repair damaged areas larger than 0.1 sq. inch (65 sq. mm). Maximum amount of damage, including repaired and unrepaired areas, shall not exceed 2 percent of surface area of each bar.

PART 2 - PRODUCTS

2.01 REINFORCEMENT STEEL:

- A. Reinforcement Steel: ASTM A615/A615M, 60 ksi (420 MPa) yield grade; deformed billet steel bars, unfinished.
- B. Epoxy Coated Reinforcement Steel: Deformed bars conforming to ASTM A615, Grade 60 (420), with epoxy coating in accordance with ASTM A775.
- C. Use Grade 60 (420) stainless steel reinforcement bars that conform to the requirements of ASTM A955 and applicable UNS designation.
- D. Reinforcement Steel Plain Bar and Rod Mats: ASTM A704/A704M, ASTM A615/A615M, Grade 60 (420); steel bars or rods, unfinished.
- E. Spiral reinforcement shall be cold-drawn steel wire conforming to the requirements of ASTM A82.

2.02 ACCESSORY MATERIALS:

- A. Tie Wire: Minimum 16 gage annealed type.
- B. Chairs, Bolsters, Bar Supports, and Spacers: sized and shaped for strength and support of reinforcement during concrete placement.
- C. Special Chairs, Bolsters, Bar Supports, and Spacers Adjacent to Weather Exposed Concrete Surfaces: plastic coated steel type; size and shape.
- D. Use wire reinforcement supports coated with dielectric material including epoxy or other polymer for a minimum distance of 2 inches (51 mm) from the point of contact with epoxy-coated reinforcement.
- E. Provide 3-inch (75 mm) by 3-inch (75 mm) plain precast concrete blocks, precast concrete doweled blocks or concrete brick for support of bottom reinforcement in foundation mats, base slabs, footings, pile caps, grade beams and slabs on grade. Provide block thickness to produce concrete cover of reinforcement as indicated.
- F. Mechanical Couplers
 - 1. Reinforcement Tension Bar Splicers:
 - a. Manufacturers: Cadweld or Lenton rebar splicers by Erico Products, Inc. and Dayton Barsplice, Inc.
 - b. Manufacturers: DB-SAE splicer system by Richmond Screw Anchor Company, Inc., C2D rebar flange coupler by Williams Form Engineering Corporation and Lenton Form Saver by Erico Products, Inc.
 - c. Develop minimum 125 percent of yield capacity of bars spliced in tension when tested as assembly in accordance with ASTM A370 and A615.
 - G. Reinforcement Compression Bar Splicers:

1. Manufacturers: G-Loc splicers by Gateway Building Products Division and Speed-Sleeve by Erico Products, Inc.

H. Provide epoxy for grouting reinforcement bars specifically formulated for such application for the moisture condition, application temperature, and orientation of the hole to be filled. Epoxy grout shall meet the requirements in Section 03 60 00 Grout.

2.03 FABRICATION:

A. Fabricate concrete reinforcement in accordance with CRSI Manual of Standard Practice, ACI SP-66, ACI 318, ACI 318M, ASTM A184/A184M.

B. Weld reinforcement in accordance with AWS D1.4 only when permitted by the Engineer.

C. Locate reinforcement splices not indicated on Drawings, at point of minimum stress. Review location of splices with Engineer.

D. Cold bend bars. Do not straighten or rebend bars.

E. Do not heat reinforcement steel to bend or straighten.

F. Bend bars around a revolving collar having a diameter of not less than that recommended by the ACI 318.

G. Cut bar ends that are to be butt spliced, or threaded by saw cutting. Terminate such ends in flat surfaces within 1 1/2 degrees of a right angle to the axis of the bar.

H. Apply epoxy coating to the deformed reinforcement bars under the following guidelines:

1. Shop bend reinforcement before coating.

2. Maintain thickness of the coating at 7 mil +/- 2 mil (0.175 mm +/- 0.050 mm).

3. Blast clean bars to near white metal before coating.

4. Clean and coat cut ends.

5. Patch damaged areas immediately before visible rust has formed. Patch at the fabrication plant.

6. Provide coatings free from holes, voids, contamination, cracks and damaged areas. Check coatings visually after curing.

7. Not more than two "holidays" (pinholes not visible to the naked eye) per 12 inch (300 mm) of bar are allowed in the coatings. Test coatings with a 67.5 volt holiday detector in accordance with the Manufacturer's instructions.

8. Check each production lot and certify that all the coated bars are supplied in the fully cured condition.

9. Evaluate the flexibility of the coating by selecting bars from production lots bent 120 degrees (after rebound) around a 6 inch (150 mm) diameter mandrel. Make the bend at a

uniform rate in not more than one minute. The longitudinal deformations may be placed in a plane perpendicular to the mandrel radius, and the test specimens shall be at a constant temperature between 70 degrees F (20 degrees C) and 85 degrees F (30 degrees C) throughout the bend test.

10. If no cracks in the coating of the bent specimen are visible to the naked eye the coating is satisfactory.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Place, support and secure reinforcement against displacement. Do not deviate from required position. Place reinforcement a minimum of 2 inches (51 mm) clear of any metal pipe or fittings.
- B. Position dowels accurately. Rigidly support, align and securely tie dowels normal to the concrete surface before concrete placement. Setting dowels into wet concrete is prohibited.
- C. Bars additional to those indicated that may be found necessary or desirable by the Contractor for the purpose of securing reinforcement in position shall be provided by the Contractor at no additional cost to the Owner.
- D. Do not extend continuous reinforcement or other fixed metal items through expansion joints. Provide 2 inches (51 mm) clearance from each face of expansion joint.
- E. Provide additional reinforcement bars to support top reinforcement in slabs. Do not shift reinforcement bars from positions in upper layers to positions in lower layers as a substitute for additional support bars.
- F. Support reinforcement steel in accordance with CRSI "Placing Reinforcement Bars" with maximum spacing of 4 feet-0 inches (1200 mm).
- G. Tie reinforcement steel at intersections in accordance with CRSI "Placing Reinforcement Bars":
 1. Maximum tie spacing for footings, walls and columns: every third intersection or 3 feet-0 inches (1,000 mm).
 2. Maximum spacing for slabs and other work: every fourth intersection or 3 feet-0 inches (1,000 mm).
 3. Tie a minimum of 25 percent of all intersecting bars in foundation mats, base slabs, footings, pile caps, slabs on grade and elevated slabs.
 4. Secure all dowels in place before placing concrete.
 5. Tie wires shall be bent away from the forms and from finished concrete surfaces in order to provide the required concrete coverage.
- H. Locate reinforcement to avoid interference with items drilled in later, such as concrete anchors.

3.02 CONCRETE COVER OVER REINFORCEMENT BARS:

- A. Conform to ACI 350 for concrete cover over reinforcement.

3.03 REINFORCEMENT AROUND OPENINGS AND PENETRATIONS:

- A. Accommodate placement of formed openings and penetrations.
- B. Unless specific additional reinforcement around openings and penetrations is shown on the Drawings, provide additional reinforcement steel on each side of opening or penetration equivalent to one half of the cross-sectional area of the reinforcement steel interrupted by an opening or penetration. The bars shall have sufficient length to be fully developed at each end beyond the opening or penetration.
- C. Refer to details on Drawings for additional diagonal bars around openings or penetrations and bar extension length on each side of openings or penetrations.
- D. Where welded wire fabric is used provide extra reinforcement using fabric or deformed bars around opening or penetration.

3.04 SPLICING OF REINFORCEMENT:

- A. Splices may be used to provide continuity due to bar length limitations. Do not splice reinforcement that is detailed to be continuous in the Drawings.
- B. Stagger bar splices.
- C. Provide tension lap splices at all laps in compliance with ACI 318. Class A splices may be used when 50 percent or less of the bars are spliced within the required lap length. Use Class B splices at all other locations.
- D. Except as otherwise indicated on the Drawings, stagger splices in circumferential reinforcement in circular walls using Class B tension splices. Do not splice adjacent bars within the required lap length.
- E. Make splices for reinforcement in tension tie members, with a full mechanical or full welded splice and staggered at least 30 inches (762 mm).
- F. Make splices in column spiral reinforcement, when necessary, by a lap of 1-1/2 turns.
- G. Make reinforcement continuous through construction joints.
- H. Reinforcement may be spliced at construction joints provided that entire lap is placed within only one concrete placement.

3.05 ACCESSORIES:

- A. Provide accessories such as chairs, chair bars and the like in sufficient quantities and strength to adequately support the reinforcement and prevent its displacement during the erection of the reinforcement and the placement of concrete.
- B. Use precast concrete blocks where the reinforcement steel is to be supported over soil.

- C. Provide stainless steel bar supports or steel chairs with plastic tips where the chairs are set on forms for a concrete surface that will be exposed to weather, high humidity or liquid (including bottom of slabs over liquid containing areas) unless otherwise noted on contract documents.
- D. Do not use metal chairs, ferrous clips, nails, etc. that extend to the surfaces of the concrete. Do not use stones, brick or wood block supports.
- E. Do not use alternate methods of supporting top steel in slabs, such as steel channels supported on the bottom steel or vertical reinforcement steel fastened to the bottom and top mats unless permitted by the Engineer.
- F. Mechanical Couplers:
 - 1. Couplers that are located at a joint face can be a type that can be set either flush or recessed from the face as indicated.
 - 2. Seal couplers during concrete placement to completely eliminate concrete or cement paste from entering.
 - 3. Recess couplers intended for future connections a minimum of 1/2 inch (12 mm) from the concrete surface. After the concrete is placed, plug the coupler with plastic plugs that have an O-ring seal and the recess filled with sealant to prevent any contact with water or other corrosive materials.
 - 4. Unless indicated otherwise, provide mechanical coupler spacing and size to match the spacing and size of the reinforcement indicated for the adjacent section.

3.06 PLACEMENT OF EPOXY COATED REINFORCEMENT:

- A. Pad bundling bands and lift with strong backs or a platform bridge to prevent abrasion of bars by sagging in the bundles.
- B. Do not be drop or drag bars or bundles.
- C. Patch and touch up coated bars after placing. Do not place concrete until patching is reviewed by the Engineer.
- D. In systems for lifting, transporting and storing coated bars, pad areas in contact with the bars.

3.07 FIELD QUALITY CONTROL:

- A. Remove reinforcement with kinks or bends not shown on shop or placement drawings. Remove such reinforcement from job site and replace with new fabricated steel. Do not field bend of reinforcement unless reinforcement is indicated or specified to be field bent.
- B. Protect reinforcement from rusting, deforming, bending, kinking and other injury. Clean in-place reinforcement that has rusted, or been splattered with concrete using sand or water blasting prior to incorporation into the Work.

3.08 CONTRACT CLOSEOUT:

- A. Provide in accordance with Section 01 77 00.

END OF SECTION

Reinforcement Bars
Section No. 03 21 00-10

SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. Provide cast-in-place concrete as indicated and in compliance with Contract Documents.

1.02 REFERENCES:

A. American Concrete Institute (ACI):

1. 211.1: Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
2. 214R: Recommended Practice for Evaluation of Strength Test Results of Concrete
3. 301: Standard Specifications for Structural Concrete
4. 304R: Guide for Measuring, Mixing, Transporting and Placing Concrete
5. 304.2R: Placing Concrete by Pumping Methods
6. 305R: Hot Weather Concreting
7. 306R: Cold Weather Concreting
8. 308: Standard Practice for Curing Concrete
9. 309R: Guide for Consolidation of Concrete
10. 311.4R: Guide for Concrete Inspection
11. 318: Building Code Requirements for Structural Concrete
12. 350: Code Requirements For Environmental Engineering Concrete Structures

B. ASTM International (ASTM):

1. A123: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
2. A153: Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
3. C31: Standard Practice for Making and Curing Concrete Test Specimens in the Field
4. C33: Standard Specification for Concrete Aggregates
5. C39: Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
6. C40: Standard Test Method for Organic Impurities in Fine Aggregates for Concrete
7. C42: Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
8. C87: Standard Test Method for Effect of Organic Impurities in Fine Aggregate on Strength of Mortar
9. C88: Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
10. C94: Standard Specification for Ready-Mixed Concrete
11. C109: Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in or [50-mm] Cube Specimens)
12. C123: Standard Test Method for Lightweight Particles in Aggregate
13. C136: Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
14. C138: Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete

Cast in Place Concrete
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15. C143: Standard Test Method for Slump of Hydraulic Cement Concrete
16. C150: Standard Specification for Portland Cement
17. C157: Standard Test Method for Length Change of Hardened Hydraulic Cement, Mortar and Concrete
18. C171: Standard Specification for Sheet Materials for Curing Concrete
19. C172: Standard Practice for Sampling Freshly Mixed Concrete
20. C192: Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
21. C231: Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
22. C260: Standard Specification for Air-Entraining Admixtures for Concrete
23. C289: Standard Test Method for Potential Alkali-Silica Reactivity of Aggregates (Chemical Method)
24. C295: Standard Guide for Petrographic Examination of Aggregates for Concrete
25. C309: Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
26. C311: Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland Cement Concrete
27. C494: Standard Specification for Chemical Admixtures for Concrete
28. C595: Standard Specification for Blended Hydraulic Cements
29. C618: Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
30. C881: Standard Test Method for Epoxy Resin Base Bonding Systems for Concrete
31. C882: Standard Test Method for Bond Strength of Epoxy Resin Systems Used with Concrete by Slant Shear
32. C989: Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
33. C1017: Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
34. C1064: Standard Test Method for Temperature of Freshly Mixed Portland Cement Concrete
35. C1107: Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
36. C1116: Standard Specification for Fiber Reinforced Concrete
37. C1240: Standard Specification for Silica Fume for Use as a Mineral Admixture in Hydraulic-Cement Concrete, Mortar, and Grout
38. D75: Standard Practice for Sampling Aggregates
39. E154: Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover
40. E1745: Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs
41. E329: Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials used in Construction

C. American Association of State Highway and Transportation Officials (AASHTO):

1. M182: Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats

D. National Sanitation Foundation (NSF):

1. 61: Drinking Water System Components – Health Effects

1.03 SUBMITTALS:

- A. Submit the following shop drawings in accordance with Section 01 33 00.
- B. Product Data:
 - 1. Manufacturer's specifications and instructions including Material safety Data Sheets (MSDS) for admixtures and curing materials. Manufacturer's certification of compatibility of all admixtures.
- C. Shop Drawings:
 - 1. Provide certificate that cement used complies with ASTM C150 and these specifications.
 - 2. Provide certificates that aggregates comply with ASTM C33. Submit gradation analysis with concrete mix designs.
 - 3. Provide certificate of compliance with these specifications from the manufacturer of the concrete admixtures.
 - 4. For each formulation of concrete proposed, provide concrete mix designs and laboratory 7-day and 28-day compressive tests, or submit test results of 7- and 28-day compressive tests of the mix where the same mix has been used on two previous projects in the past twelve months.
 - 5. For potable water service, provide certification that materials used in concrete, or the curing and repair of concrete, meet the requirements of ANSI/NSF 61 for contact with potable water.
 - 6. Proposed special procedures for protection of concrete under wet weather placement conditions.
 - 7. Proposed special procedures for protection and curing of concrete under hot and cold weather conditions.
- D. Test and Evaluation Reports
 - 1. Provide results of drying shrinkage tests from trial concrete mixes by the Contractor's testing laboratory firm.
- E. Manufacturers' Instructions
 - 1. Provide epoxy bonding compound manufacturer's specific instructions for use. Provide manufacturer's data sheets as to suitability of product to meet job requirements with regard to surface, pot life, set time, vertical or horizontal application, and forming restrictions.
- F. Field Quality Control Submittals
 - 1. Provide delivery tickets for ready-mix concrete or weighmasters certificate per ASTM C94, including weights of cement and each size aggregate and amount of water added at the plant and record of pours. Record the amount of water added on the job on the delivery ticket. Water added at the plant shall account for moisture in both coarse and fine aggregate.

1.04 SHRINKAGE TESTS:

- A. The testing laboratory shall perform drying shrinkage tests for the trial batches as specified herein.

- B. Fabricate, cure, dry, and measure specimens in accordance with ASTM C157 modified as follows:
1. Remove specimens from molds at an age of 23 hours +/- 1 hour after trial batching, place immediately in water at 70 degrees F +/- 3 degrees F (21 degrees C +/- 2 degrees C) for at least 30 minutes, measure within 30 minutes thereafter to determine original length, and then submerge in saturated lime water at 73 degrees F +/- 3 degrees F (23 degrees C +/- 2 degrees C). At age seven days, make measurement to determine expansion, expressed as a percentage of original length. This length at age seven days shall be the base length for drying shrinkage calculations (zero days' drying age).
 2. Then, store specimens immediately in a humidity-controlled room maintained at 73 degrees F +/- 3 degrees F (23 degrees C +/- 2 degrees C) and 50 percent +/- 4 percent relative humidity for the remainder of the test. Make and report measurements to determine shrinkage expressed as percentage of base length separately for 7, 14, 21, and 28 days of drying after 7 days of moist curing.
- C. Compute the drying shrinkage deformation of each specimen as the difference between the base length (at zero days' drying age) and the length after drying at each test age. Compute the average drying shrinkage deformation of the specimens to the nearest 0.0001 inch (0.00254 mm) at each test age. If the drying shrinkage of any specimen departs from the average of that test age by more than 0.0004 inch (0.0102 mm), disregard the results obtained from that specimen. Report results of the shrinkage test to the nearest 0.001 percent of shrinkage. Take compression test specimens in each case from the same concrete used for preparing drying shrinkage specimens. These tests shall be considered a part of the normal compression tests for the project.
- D. The maximum concrete shrinkage for specimens cast in the laboratory from the trial batch, as measured at 21-day drying age or at 28-day drying age, shall be 0.036 or 0.042 percent, respectively. Use a mix design for construction that has first met the trial batch shrinkage requirements. Shrinkage limitations apply only to Class A concrete.
- E. If the trial batch specimens do not meet the shrinkage requirements, revise the mix design and/or materials and retest.

1.05 QUALITY ASSURANCE:

- A. Provide in accordance with Section 01 43 00.
- B. Unless otherwise indicated, materials, workmanship, and practices shall conform to the following standards:
1. Local building codes.
 2. ACI 301, "Structural Concrete for Buildings."
 3. ACI 318, "Building Code Requirements for Reinforced Concrete."
 4. ACI 350, "Code Requirements For Environmental Engineering Concrete Structures."
 5. ANSI/NSF 61, "Drinking Water System Components – Health Effects."
- C. Where provisions of pertinent codes and standards conflict with this specification, the more stringent provisions govern.
- D. Concrete not meeting the minimum specified 28-day design strength shall be cause for rejection and removal from the work.

- E. Perform concrete work in conformance with ACI 301 unless otherwise specified.
- F. Do not use admixtures, including calcium chloride, which will cause accelerated setting of cement in concrete.
- G. Do not place concrete until design mix, material tests and trial concrete batch mix compression test results are accepted by the Engineer.
- H. Employ an independent testing laboratory, acceptable to the Engineer, to develop concrete mix designs and testing. Concrete testing shall be performed by an ACI Concrete Field Technician, Grade I or equivalent.
- I. The Contractor shall employ an independent testing laboratory, acceptable to the Engineer, to test conformity of materials to specifications. Concrete testing shall be performed by an ACI Concrete Field Technician, Grade I or equivalent. Allow free access to obtain test samples.
- J. Methods of Sampling and Testing:
 - 1. Fresh Concrete Sampling: ASTM C172
 - 2. Specimen Preparation: ASTM C31
 - 3. Compressive Strength: ASTM C39
 - 4. Air Content: ASTM C231
 - 5. Slump: ASTM C143
 - 6. Temperature: ASTM C1064
 - 7. Unit Weight: ASTM C138
 - 8. Obtaining Drilled Cores: ASTM C42
 - 9. Drying Shrinkage: ASTM C157
- K. Acceptance of Structure: Acceptance of completed concrete work requires conformance with dimensional tolerances, appearance and strength as indicated or specified.
- L. Hot weather concrete to conform to ACI 305R and as specified herein.
- M. Cold weather concrete to conform to ACI 306R and as specified herein.
- N. Reject concrete delivered to job site that exceeds the time limit or temperature limitations specified.
- O. Do not place concrete in water or on frozen or uncompacted ground.
- P. Workability
 - 1. Concrete shall be of such consistency and composition that it can be worked readily into the forms and around the reinforcement without excessive vibrating and without permitting the materials to segregate or free water to collect on the surface.
 - 2. Adjust the proportions to secure a plastic, cohesive mixture, and one that is within the specified slump range.
 - 3. To avoid unnecessary changes in consistency, obtain the aggregate from a source with uniform quality, moisture content, and grading. Handle materials to minimize variations in moisture content that would interfere with production of concrete of the established degree of uniformity and slump.

1.06 DELIVERY, STORAGE, AND HANDLING:

- A. Provide in conformance with Section 01 66 10 and as specified herein.
- B. Deliver concrete to discharge locations in watertight agitator or mixer trucks without altering the specified properties of water-cement ratio, slump, air entrainment, temperature and homogeneity.
- C. Reject concrete not conforming to specification, unsuitable for placement, exceeding the time or temperature limitations or not having a complete delivery batch ticket.

1.07 SITE CONDITIONS:

- A. Do not place concrete until conditions and facilities for making and curing control test specimens are in compliance with ASTM C 31 and as specified herein.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Cement:

- 1. Portland Cement, ASTM C150, Type II or Type I; or blended hydraulic cement, ASTM C595, Type IP (MS).
- 2. Use only one brand of cement in any individual structure. Use no cement that has become damaged, partially set, lumpy, or caked. Reject the entire contents of the sack or container that contains such cement. Use no salvaged or reclaimed cement.
- 3. Maximum tricalcium aluminate shall not exceed 8 percent. The maximum percent alkalis shall not exceed 0.6 percent.

B. Fly Ash:

- 1. Provide fly ash conforming to the following requirements:
 - a. Class F or Class C fly ash conforming to ASTM C 618 for chemical and physical properties.
 - b. Supplemental requirements in percent:
 - (1) Maximum carbon content: 3 percent
 - (2) Maximum sulfur trioxide (SO₃) content: 4 percent
 - (3) Maximum loss on ignition: 3 percent
 - (4) Maximum water requirement (as a percent of control): 100 percent
 - (5) Fineness, maximum retained on No. 325 sieve: 25 percent
- 2. Fly ash used in concrete that contacts potable water shall be certified as meeting the requirements of ANSI/NSF 61.

C. Ground Granulated Blast Furnace Slag (GGBF):

- 1. GGBF, when used, shall meet the requirements of ASTM C989, Grade 100 or better.

2. GGBF used in concrete that contacts potable water shall be certified as meeting the requirements of ANSI/NSF 61.
- D. Silica Fume:
1. Silica fume mineral admixture shall be the dry compacted or slurry form and shall meet the requirements of ASTM C1240. Silica Fume shall be considered to be a cementitious material. Application rate shall be 7 percent by weight of cement, unless indicated otherwise.
 2. Products:
 - a. Master Builders Solutions Systems; Rheomac SF100.
 - b. W.R. Grace & Company; Force 10,000 D.
 - c. Sika Corp.; Sikacrete 950 DP.
- E. Fine Aggregates:
1. Clean, sharp, natural sand conforming to requirements of ASTM C33 with a fineness modulus between 2.50 and 3.0.
- F. Coarse Aggregate:
1. Well graded crushed stone, natural rock conforming to requirements of ASTM C33.
 2. Limit deleterious substances in accordance with ASTM C33, Table 3, Severe Weathering Regions, limit clay lumps not to exceed 1.0 percent by weight, and limit loss when tested for soundness using magnesium sulfate to 12 percent.
- G. Water and Ice:
1. Use water and ice free from injurious amounts of oil, acid, alkali, salt, organic matter or other deleterious substances and conforms to requirements of ASTM C94.
 2. Water shall not contain more than 500 mg/L of chlorides nor more than 500 mg/L of sulfate.
 3. Heat or cool water to obtain concrete temperatures specified, and in conformance with ACI 305R and ACI 306R.
- H. Concrete Admixtures:
1. Maintain compressive strength and maximum water-cement ratios specified in Table 03 30 00-1 when using admixtures. Include admixtures in solution form in the water-cement ratio calculations.
 2. Do not use any admixture that contains chlorides or other corrosive elements in any concrete. Admixtures shall be nontoxic after 30 days. Use admixtures in compliance with the manufacturer's printed instructions. The manufacturer shall certify the compatibility of multiple admixtures used in the same mix. Do not use admixtures in greater dosages than recommended by manufacturer.
 5. Air Entrainment:
 - a. Class A concrete; an air-entraining admixture conforming to ASTM C260.
 - b. Products:
 - (1) BASF.; MB-AE 90.

- (2) Sika Corporation, AER.
 - c. Adjust the admixture content to accommodate fly ash or pozzolan requirements, and other admixtures when used, in order to obtain the specified air content.
6. Water Reducing:
- a. Class A concrete; a water-reducing admixture conforming to ASTM C494, Type A and compatible with the air-entraining admixtures. The amount of admixture added to the concrete shall be in accordance with the manufacturer's recommendations.
 - b. Products:
 - (1) Master Builders Solutions, Inc.; Polyheed Series
 - (2) Sika Corporation, Plastocrete 161
 - (3) WR Grace & Co.; Darex II-AEA
 - (4) Euclid Chemical Company; Eucon NW
7. Water Reducing and Retarding:
- a. Class A concrete; a water-reducing and retarding admixture conforming to ASTM C494, Type D and compatible with the air-entraining admixtures. The amount of admixture added to the concrete shall be in accordance with the manufacturer's recommendations.
 - b. Products:
 - (1) BASF Corporation; Pozzolith Series
 - (2) Sika Corporation; Plastiment
 - (3) Euclid Chemical company; Eucon WR-91
8. High-Range Water-Reducing Admixture (Superplasticizer):
- a. Class A concrete; a High-Range water-reducing admixture conforming to ASTM C494, Type F or ASTM C1017, Type I.
 - b. Products:
 - (1) BASF Corporation; Glenium Series
 - (2) WR Grace & Co.; Daracem 100
 - (3) Euclid Chemical company; Eucon SPC
9. Shrinkage Reducing Admixture:
- a. Class A concrete; shrinkage-reducing admixture is permitted to be used in the mix to meet shrinkage limitations provided that specified strength are met and there is no reduction in sulfate resistance and no increase in permeability. Quantity of shrinkage-reducing admixture used in the mix shall be added to the quantity of water for purposes of determining the water/cementitious materials ratio.
 - b. Products:
 - (1) BASF Corporation; Tetragurad AS20
 - (2) WR Grace & Co.; Eclipse
 - (3) Euclid Chemical company; Eucon SRA

I. Epoxy Bonding Agent:

1. Epoxy bonding agent shall conform to ASTM C881 Type I, II, IV or V; Grade 2 for epoxy resin adhesives. The class of epoxy bonding agent shall be suitable for ambient and substrate temperatures.
2. Products:
 - a. Sika Corp.; Sikadur 32
 - b. Euclid Chemical Company; Duralcrete
 - c. BASF Corporation, Concrecive Liquid LPL

J. Curing Compound:

1. Liquid form, which will form impervious membrane over, exposed surface of concrete when applied to fresh concrete by means of spray gun. Compound shall not inhibit future bond of floor covering or concrete floor treatment. Use Type I-D compound with red fugitive dye, Class B, having 18 percent minimum solids conforming to ASTM C309.
2. Provide a copy of manufacturer's certification that the curing compound meets the requirements of ANSI/NSF 61 for concrete surfaces that will be in contact with potable water.
3. Products:
 - a. BASF Building Systems; Kure 1315.
 - b. Euclid Chemical Company; Super Diamond Clear VOX.
 - c. W. R. Meadows, Inc.; VOCOMP-30.
 - d. Dayton Superior Corp; Safe Cure and Seal 30 percent.

K. Burlap Mats:

1. Conform to AASHTO M182.

L. Sisal-Kraft Paper and Polyethylene Sheets for Curing:

1. Conform to ASTM C171.

M. Floor Sealer:

1. H&C Concrete Sealer – Clear Gloss Oil Based with H&C SharkGrip slip resistant additive added to the final coat.

2.02 MIXES:

A. Conform to ASTM C94, except as modified by these specifications.

B. Air content as determined by ASTM C231:

1. 5 +/- 1-1/2 percent for concrete using 1-1/2 inch (38 mm) maximum aggregate size.
2. 6 +/- 1-1/2 percent for concrete using 3/4-inch (19 mm) maximum aggregate size.

- C. Provide concrete with the following compressive strengths at 28 days and proportion it for strength and quality requirements in accordance with ACI 318. The resulting mix shall not conflict with limiting values specified in Table 03 30 00-1.

Table 03 30 00-1				
Class	Type of Work	28-Day Minimum Compressive Strength (psi)[Mpa]	Minimum Cementitious Content (lbs per C.Y.)	Maximum Water/Cement Ratio
A	Concrete for all structures and concrete not otherwise specified. Concrete fill at structure foundations, concrete topping cradle, supports across pipe trenches, and reinforced pipe encasement.	4,000 [28]	560	0.44
		4,500 [31]	600	0.42
B	Pavement, concrete topping	3,000 [20]	500	0.54
C	Concrete fill below structure foundations, miscellaneous unreinforced concrete.	2,000 [13]	376	0.60
D	Prestressed concrete	6,000 [40]	710	0.40
E	Precast concrete	5,000 [35]	630	0.40

- D. Measure slump in accordance with ASTM C143:

1. Proportion and produce the concrete to have a maximum slump of 4 inches (102 mm). A tolerance of up to 1 inch (25 mm) above the indicated maximum is allowed for individual batches provided the average for all batches or the most recent 10 batches tested, whichever is fewer, does not exceed the maximum limit. Concrete of lower than usual slump may be used provided it is properly placed and consolidated.
2. Mixes containing water reducers shall have a maximum slump of 6 inches (152 mm) after the addition of a mid-range water reducer and maximum slump of 8 inches (203 mm) after the addition of a high range water reducer.

- E. Pozzolan Content:

1. Fly ash shall not exceed 20 percent of the total cementitious content.
2. Ground Granulated Blast Furnace Slag (GGBF) will be permitted as a substitute for fly ash at no additional cost to the Owner, in the event that Class F Fly Ash is not available. The slag substitution shall be in the same proportions and percentages of the total cementitious material as shown for fly ash. A higher percentage of GGBF will be allowed if permitted by the Engineer to suit project needs.
3. Use silica fume concrete where indicated on the drawings. Silica fume not to exceed 10 percent of the total weight of the silica fume plus cement.

F. Aggregate Size:

1. Aggregate size shall be 3/4-inch (19 mm) maximum for slabs and sections 8 inches (203 mm) thick and less. Aggregate size shall be 1 inch (25 mm) maximum for sections greater than 8 inches (203 mm) and less than 17 inches (432 mm). Aggregate size shall be 1-1/2 inches (38 mm) maximum for all larger slabs and sections. Aggregate size for floor topping shall be maximum [3/8inch (10 mm)].
2. Combined aggregate grading shall be as shown in the following table:

Table 03 30 00-2					
Sieve Sizes	Maximum Aggregate Size				
	1 1/2 inch		1 inch		3/4 inch
	Percent Passing				
2 inch	100		---		---
1 1/2 inch	90	to 100	100		---
1 inch	50	to 86	90	to 100	100
3/4-inch	45	to 75	55	to 100	90 to 100
3/8-inch	38	to 55	45	to 75	60 to 80
No. 4	30	to 45	35	to 60	40 to 60
No. 8	23	to 38	27	to 45	30 to 45
No. 16	17	to 33	20	to 35	20 to 35
No. 30	10	to 22	12	to 25	13 to 23
No. 50	4	to 10	5	to 15	5 to 15
No. 100	1	to 3	1	to 5	0 to 5
No. 200	0	to 2	0	to 2	0 to 2

3. Combined aggregate grading shall be as shown in the following table:

Table 03 30 0-2				
Maximum Aggregate Size	1-1/2 inch	1 inch	3/4-inch	3/8-inch
Aggregate Grade per ASTM C33	467	57	67	8

PART 3 - EXECUTION

3.01 INSPECTION:

- A. Examine the subgrade and the conditions under which work is to be performed and notify the Engineer in writing of unsatisfactory conditions. Do not proceed with the work until unsatisfactory conditions are corrected to comply with specified subgrade conditions in a manner acceptable to the Engineer.

3.02 MIXING AND TRANSPORTING CONCRETE:

- A. General: Conform to concreting procedures set forth in ASTM C94, ACI 304R and as specified herein.
 - 1. Transport concrete to discharge locations without altering the specified properties of water-cement ratio, slump, air entrainment, temperature and homogeneity.
 - 2. Discharge concrete into forms within 1-1/2 hours after cement has entered mixing drum or before the drum has revolved 300 revolutions after the addition of water, whichever occurs first.
 - 3. Do not add water at the jobsite unless permitted by the Engineer. If it is necessary to add water to obtain the specified slump, add water per ASTM C94, but do not exceed the maximum water content in the reviewed concrete design mix. Added water shall be incorporated by additional mixing of at least 35 revolutions.
 - 4. Do not add water to concrete containing high range water reducing admixture. Do not add water to concrete in delivery equipment not acceptable for mixing.
 - 5. Keep a record showing time and place of each pour of concrete, together with transit-mix delivery slips certifying the contents of the pour.
 - 6. Discharge of concrete shall be completed within the limits set out in Table 03 30 00-3.

Table 03 30 00-3	
Maximum Time to Concrete Discharge	
Concrete Temperature	Limit
Over 90 Degree F	Remove concrete from jobsite and discard concrete
86 to 90 Degree F	45 minutes
81 to 85 Degree F	60 minutes
70 to 80 Degree F	75 minutes
Below 70 Degree F	90 minutes

- B. Conveying: Convey concrete from agitator or mixer truck to place of final deposit in forms by one of the following methods:
 - 1. Buckets or hoppers with discharge gates having a clear opening equal to not less than one-third the maximum interior horizontal area or five times the maximum aggregate size being used, whichever is greater, and side slopes of not less than 60 degrees to horizontal.
 - 2. Buggies or wheelbarrows equipped with pneumatic tires.
 - 3. Round bottom, metal or metal-lined chutes with inclined slope of between 2 to 3 feet (600 to 900 mm) horizontally to 1 foot (300 mm) vertically and of sufficient capacity to avoid overflow.
 - 4. Circular drop pipes with a top diameter of at least eight times the maximum aggregate size, but not less than 6 inch (150 mm) or tapered to not less than six times maximum aggregate size.

3.03 CONCRETE ACCEPTANCE:

- A. Accept or reject each batch of concrete delivered to the point of agitator or mixer truck discharge. Sign delivery batch tickets to indicate concrete acceptance.

- B. Reject concrete delivered without a complete concrete delivery batch ticket as specified herein. The concrete supplier will furnish copies of the signed batch ticket to the Contractor and Engineer.
- C. The testing agency shall perform field tests at the point of agitator or mixer truck discharge. Accept or reject concrete on the basis of conformity with slump, air content and temperature specified.
- D. The testing agency shall inspect concrete transit truck's barrel revolution counter and gauge for measuring water added to the concrete. Reject concrete that exceeds the maximum barrel revolution of 300, the limits in Table 03 30 00-3 or concrete that has water content exceeding the specified water-cement ratio.
- E. Reject concrete not conforming to specification before discharging into the forms.

3.04 PREPARATION AND COORDINATION:

- A. Contractor shall notify the Engineer/Owner of readiness to place concrete in any portion of the work a minimum of 5 working days prior to concrete placement. Failure to provide this notification will be cause for delay in placing until observations can be completed.
- B. Reinforcement, installation of waterstop, positioning of embedded items, and condition of formwork will be observed by the Engineer/Owner prior to concrete placement.
- C. Coordinate the sequence of placement such that construction joints will occur only as designed.
- D. Schedule sufficient equipment for continuous concrete placing. Provide for backup equipment and procedures to be taken in case of an interruption in placing. Provide backup concrete vibrators at the project site. Test concrete vibrators the day before placing concrete.
- E. Compact the subgrade and/or bedding. Saturate the subgrade approximately eight hours before placement and sprinkle ahead of the placement of concrete in areas where vapor barrier is not used. Remove standing water, mud, and foreign matter before concrete is deposited.
- F. Where shown on contract drawings, intentionally roughen surfaces of set concrete in a manner to expose bonded aggregate uniformly at joints.
- G. Provide mud slabs to obtain a dry and stable working platform for placement of slabs.
- H. When shown on contract drawings, install a granular base beneath slabs on ground. Place granular material on a compacted subgrade and compact granular base.
- I. Where concrete is required to be placed and bonded to existing concrete, coat the contact surfaces with epoxy bonding agent. The method of preparation and application of the bonding agent shall conform to the manufacturer's recommendations.

3.05 CONCRETE PLACEMENT:

- A. Placement shall conform to ACI 304R as modified by these specifications.
- B. Alternate sections of concrete walls and slabs may be cast simultaneously. Do not place adjacent sections of walls and slabs until seven days after placement of first placed concrete.

- C. Do not place concrete until free water has been removed or has been diverted by pipes or other means and carried out of the forms, clear of the work. Do not deposit concrete underwater, and do not allow free water to rise on any concrete until the concrete has attained its initial set. Do not permit free or storm water to flow over surfaces of concrete so as to injure the quality or surface finish.
- D. Do not place concrete during inclement weather. Protect concrete placed from inclement weather. Keep sufficient protective covering ready at all times for this purpose.
- E. Deposit concrete at or near its final position to avoid segregation caused by rehandling or flowing. Do not deposit concrete in large quantities in one place to be worked along the forms with a vibrator.
- F. Deposit concrete continuously and in level layers 1 to 2 feet (305 to 610 mm) thick. Avoid inclined layers and cold joints. Place concrete at lower portion of slope first on sloping surfaces.
- G. Do not deposit partially hardened concrete in forms. Retempering of partially hardened concrete is not permitted. Remove partially hardened concrete from site at no additional compensation.
- H. Do not allow concrete to fall freely in forms to cause segregation (separation of coarse aggregate from mortar). Limit maximum free fall of concrete to 4 feet (1,220 mm). Do not move concrete horizontally more than four feet from point of discharge. Space points of deposit not more than eight feet apart.
- I. At least two hours shall elapse after depositing concrete in the columns or walls before depositing in beams, girders, or slabs supported thereon. Place beams, girders, brackets, column capitals, and haunches monolithically as part of the floor or roof system, unless otherwise shown on contract drawings.
- J. Consolidate concrete using mechanical vibrators operated within the mass of concrete and/or on the forms conforming to procedures set forth in ACI 309R and as specified herein.
- K. Conduct vibration to produce concrete of uniform texture and appearance, free of honeycombing, streaking, cold joints or visible lift lines.
- L. Conduct vibration in a systematic manner with regularly maintained vibrators. Furnish sufficient backup units at job site. Use vibrators having minimum frequency of 8,000 vibrations per minute and of sufficient amplitude to consolidate concrete. Use not less than one vibrator with crew for each 35 to 40 cubic yards (25 to 30 cubic meters) of concrete placed per hour.
- M. Insert and withdraw vibrator vertically at a uniform spacing over the entire area of placement. Space distances between insertions such that spheres of influence of each insertion overlap.
- N. Use additional vibration with pencil vibrators on vertical surfaces and on exposed concrete to bring full surface of mortar against the forms so as to eliminate air voids, bug holes and other surface defects. Employ the following additional procedures for vibrating concrete as necessary to maintain proper consolidation of concrete:
 - 1. Reduce distance between internal vibration insertions and increase time for each insertion.
 - 2. Insert vibrator as close to face of form as possible without contacting form or reinforcement.

3. Thoroughly vibrate area immediately adjacent to waterstops without damaging the waterstop.
4. Use spading as a supplement to vibration where particularly difficult conditions exist.

O. Pumping Concrete:

1. Conform to the recommendations of ACI 304.2R except as modified herein.
2. Base pump size on rate of concrete placement, length of delivery pipe or hose, aggregate size, mix proportions, vertical lift, and slump of concrete.
3. Use pipe with inside diameter of at least three times the maximum coarse aggregate size, but not less than 2 inches (50 mm).
4. Do not use aluminum pipes for delivery of concrete to the forms.

P. Waterstops:

1. Prevent displacement of waterstops during concrete placement,

3.06 CURING AND PROTECTION:

A. General:

1. Protect concrete from premature drying, hot or cold temperatures, and mechanical injury, beginning immediately after placement and maintain concrete with minimal moisture loss at relatively constant temperature.
2. Comply with curing procedures set forth in ACI 301, ACI 308 and as specified herein.
3. Perform hot weather concreting in conformance with ACI 305R and as specified herein when the ambient atmospheric temperature is 80 degrees F (27 degrees C) or above.
4. Perform cold weather concreting in conformance with ACI 306R.
5. Concrete required to be moist cured shall remain moist for the entire duration of the cure. Repeated wetting and drying cycles of the curing process will not be allowed.

B. Curing Duration:

1. Start initial curing after placing and finishing concrete as soon as free moisture has disappeared from unformed concrete surfaces. Initial curing starts as soon as concrete achieves final set. Forms left tightly in place are considered as part of the curing system, provided that wooden forms are kept continuously moist. Keep continuously moist for not less than 72 hours.
2. Begin final curing procedures immediately following initial curing and before the concrete has dried. Continue final curing for at least 7 days and in accordance with ACI 301 procedures for a total curing period, initial plus final, of at least 10 days.
3. Avoid rapid drying at the end of the final curing period

C. Curing Requirements:

1. Unformed Surfaces: Cover and cure entire surface of newly placed concrete immediately after completing finishing operations and water film has evaporated from surface or as soon as marring of concrete will not occur. Protect finished slabs from direct rays of the sun to prevent checking, crazing and plastic shrinkage.
2. Formed Surfaces: Minimize moisture loss for formed surfaces exposed to heating by the sun by keeping forms wet until safely removed. Keep surface continuously wet by warm

- water spray or warm water saturated fabric immediately following form removal unless otherwise permitted by the Engineer.
3. Water containment and below Grade Structures: Moist cure by the application of water to maintain the surface in a continually wet condition unless otherwise permitted by the Engineer. Use water that is free of impurities that could etch or discolor exposed concrete surfaces.
 4. Other concrete: Moist cure by moisture-retaining cover curing, or by the use of curing compound.
- D. Curing Methods:
1. Water Curing: Use water curing for unformed surfaces. Continuously water cure all exposed concrete for the entire curing period. Provide moisture curing by any of the following methods:
 - a. Keeping the surface of the concrete continuously wet by ponding or immersion.
 - b. Continuous water-fog spray or sprinkling.
 - c. Covering the concrete surface with curing mats, thoroughly saturating the mats with water, and keeping the mats continuously wet with sprinklers or porous hoses. Place curing mats so as to provide coverage of the concrete surfaces and edges, with a 4 inch (100 mm) lap over adjacent mats. Weight down the curing cover to maintain contact with the concrete surface.
 2. Sealing Materials:
 - a. Use common sealing materials such as plastic film or waterproofing (kraft) paper.
 - b. Lap adjacent sheets a minimum of 12 inch (300 mm). Seal edges with waterproof tape or adhesive. Use sheets of sufficient length to cover sides of concrete member.
 - c. Place sheet materials only on moist concrete surfaces. Wet concrete surface with fine water spray if the surface appears dry before placing sheet material.
 - d. The presence of moisture on concrete surfaces at all times during the prescribed curing period is proof of acceptable curing using sheet material.
 3. Membrane Curing Compound:
 - a. Apply membrane-curing compound uniformly over concrete surface by means of roller or spray at a rate recommended by the curing compound manufacturer, but not less than 1 gallon per 150 sq. ft. (1 liter per 4 sq. meters) of surface area. Agitate curing material in supply container immediately before transfer to distributor and thoroughly agitate it during application for uniform consistency and dispersion of pigment.
 - b. Do not use curing compounds on construction and expansion joints or on surfaces to receive liquid hardener, dustproofer/sealer, concrete paint, tile, concrete fills and toppings or other applications requiring positive bond.
 - c. Reapply membrane-curing compound to concrete surfaces that have been subjected to wetting within 3 hours after curing compound has been applied by method for initial application.
- E. Protection from environmental conditions: Maintain the concrete temperature above 50 degrees F (10 degrees C) continuously throughout the curing period. Make arrangements before concrete

placing for heating, covering, insulation or housing to maintain the specified temperature and moisture conditions continuously for the curing period.

1. When the atmospheric temperature is 80 degrees F (25 degrees C) and above, or during other climatic conditions which will cause too rapid drying of the concrete, make arrangements before the start of concrete placing for the installation of wind breaks or shading, and for fog spraying, wet sprinkling, or moisture-retaining covering.
 2. Protect the concrete continuously for the entire curing period.
 3. Maintain concrete temperature as uniformly as possible and protect from rapid atmospheric temperature changes.
 4. Avoid temperature changes in concrete that exceed 5 degrees F (3 degrees C) in any one hour and 50 degrees F (10 degrees C) in any 24-hour period.
- F. Protection from physical injury: Protect concrete from physical disturbances such as shock and vibration during curing period. Protect finished concrete surfaces from damage by construction equipment, materials, curing procedures and rain or running water. Do not load concrete in such a manner as to overstress concrete.
- G. Protection from Deicing Agents: Do not apply deicing chemicals to concrete.

3.07 FIELD QUALITY CONTROL:

A. Hot Weather Requirements

1. During hot weather, give proper attention to ingredients, production methods, handling, placing, protection, and curing to prevent excessive concrete temperatures or water evaporation in accordance with ACI 305R and the following.
2. When the weather is such that the temperature of the concrete as placed would exceed 90 degrees F (32.2 degrees C), use ice or other means of cooling the concrete during mixing and transportation so that the temperature of the concrete as placed will not exceed 90 degrees F (32.2 degrees C).
3. Take precautions when placing concrete during hot, dry weather to eliminate early setting of concrete. This includes protection of reinforcing from direct sunlight to prevent heating of reinforcing, placing concrete during cooler hours of the day, and the proper and timely application of specified curing methods.
4. There will be no additional reimbursement to the Contractor for costs incurred for placing concrete in hot weather.

B. Cold Weather Requirements

1. Provide adequate equipment for heating concrete materials and protecting concrete during freezing or near-freezing weather in accordance with ACI 306R and the following.
2. When the temperature of the surrounding atmosphere is 40 degrees F (4.4 degrees C) or is likely to fall below this temperature, use heated mixing water not to exceed 140 degrees F (60 degrees C). Do not allow the heated water to come in contact with the cement before the cement is added to the batch.
3. When placed in the forms during cold weather, maintain concrete temperature at not less than 55 degrees F (12.8 degrees C). Materials shall be free from ice, snow, and frozen lumps before entering the mixer.
4. Maintain the air and the forms in contact with the concrete at temperatures above 40 degrees F (4.4 degrees C) for the first five days after placing, and above 35 degrees F

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- (1.7 degrees C) for the remainder of the curing period. Provide thermometers to indicate the ambient temperature and the temperature 2 inches (50 mm) inside the concrete surface.
5. There will be no additional reimbursement made to the Contractor for costs incurred for placing concrete during cold weather.

C. Concrete Testing

1. Concrete quality testing will be performed on the concrete by independent testing agency retained by the Contractor.
2. The testing agency will use concrete samples provided by the Contractor at the point of agitator or mixer truck discharge to perform slump (per ASTM C143) , air content (per ASTM C231), and temperature tests (per ASTM C1064) and for field control test specimens.
3. The testing agency will submit test reports of concrete field measurements specified above to the Contractor and to the Engineer.
4. Provide and maintain facilities for safe storage and proper curing of concrete test specimens on the project site, as required by ASTM C31.
5. Concrete Quality Test Specimen:
 - a. Perform sampling and curing of test specimen in accordance with ASTM C31.
 - b. Testing agency personnel will record truck and load number from the delivery batch ticket, the concrete placement location of each specimen, the date, concrete strength, slump, air content and temperature.
 - c. The testing agency will cast a minimum of one set of six test specimens, each 4 inch (100 mm)] diameter by 8 inch (200 mm)] long cylinders, for each 50 cubic yard (38 cubic meters) of each mix design of concrete but not less than once a day [nor less than once for each 5,000 sq. ft. [450 sq. meters] of surface area of base slabs, walls, or elevated slabs.
 - d. Test cylinders in accordance with ASTM C39. Test one cylinder at 7 days for information; test three cylinders at 28 days for acceptance; and hold two reserve cylinders for verification. Strength acceptance will be based on the average of the strengths of the three cylinders tested at 28 days. If one cylinder of a 28-day test manifests evidence of improper sampling, molding, or testing, other than low strength, discard it and use a reserve cylinder for the test result
6. The Contractor may take field control test specimens for small quantities of concrete.
7. Concrete acceptance shall be based on the requirements of ACI 318 and ACI 350.
8. Field cured cylinders conforming to ASTM C31 will be required to determine field compressive strength of concrete. Laboratory cured cylinders for concrete quality testing shall not be used for determining field compressive strength.
9. Concrete Coring:
 - a. When the concrete quality test specimen compression tests fail to be in compliance with the Contract Documents or when the Engineer detects deficiencies in the concrete, the Contractor will take concrete cores at least 2 inches (50 mm) in diameter from the structure in conformance with ASTM C 42 at locations determined by the Engineer.
 - b. Obtain at least three representative cores from each member or area of concrete that is considered potentially deficient.
 - c. Obtain additional cores to replace cores that show evidence of having been damaged subsequent to or during removal from the structure.

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- d. The testing agency shall compression test the cores taken from the structure in conformance with ASTM C39 and submit test strength test results of cores specified above to the Contractor and to the Engineer.
- e. All costs associated with coring and testing of cores will be borne by the Contractor at no additional cost to the Owner.

3.08 CLOSEOUT ACTIVITIES:

- A. Provide in accordance with Section 01 77 00.

END OF SECTION

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SECTION 03 41 13

PRECAST CONCRETE HOLLOW CORE PLANKS

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. Provide precast, prestressed, concrete hollow core planks including grouting of joints as indicated and in compliance with Contract Documents.
- B. Provide structural concrete topping in accordance with contract documents and Section 03 30 00.

1.02 REFERENCES:

- A. American Association of State Highway and Transportation Officials (AASHTO):
 - 1. Standard Specifications for Highway Bridges
- B. American Concrete Institute (ACI):
 - 1. 301: Standard Specifications for Structural Concrete
 - 2. 304R: Guide for Measuring, Mixing, Transporting and Placing Concrete
 - 3. 305R: Hot Weather Concreting
 - 4. 306R: Cold Weather Concreting
 - 5. 308R: Guide to Curing Concrete
 - 6. 309R: Guide for Consolidation of Concrete
 - 7. 318: Building Code Requirements for Structural Concrete and Commentary
- C. American Institute of Steel Construction (AISC):
 - 1. AISC Manual of Steel Construction
- D. ASTM International (ASTM):
 - 1. A36/A 36M: Standard Specification for Carbon Structural Steel
 - 2. A123: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - 3. A153: Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 - 4. A185: Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete

5. A416: Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete
6. A615/A 615M: Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
7. A706/A 706M: Specification for Low-Alloy Steel Deformed Bars for Concrete Reinforcement
8. C33: Standard Specification for Concrete Aggregates
9. C150: Standard Specification for Portland Cement
10. D412: Standard Test Method for Rubber Properties in Tension

E. American Welding Society (AWS):

1. D1.1: Structural Welding Code, Steel.
2. D1.4: Structural Welding Code, Reinforcing Steel.

F. Prestressed Concrete Institute (PCI):

1. MNL.-116: Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products.

1.03 DESIGN CRITERIA:

A. Design precast concrete hollow core planks in accordance with ACI 318 and PCI standards.

B. Precast concrete hollow core plank shall be designed for the following:

1. Dead Loads: Weight of unit, and roof dead loads.
2. Live Loads: As show on contract documents.
3. Wind, Snow, Seismic, loads based on criteria shown on contract documents.
4. Design planks for piping and equipment loads to be supported by the member. As a minimum the planks shall be designed for a uniform piping load of 15 pounds per square foot (0.70 kPa) or a concentrated load of 2,000 pounds (9.0 kN) located at any point along the length of the member, whichever produces the most severe condition.
5. Handling and erection stresses.
6. Maximum deflection of span/240 for roof plank under live load.
7. Grouted keys shall be capable of transmitting horizontal shear force of 2,000 lbs/ft (9.0/ kN/m).

1.04 QUALIFICATIONS:

- A. Fabricator: Company specializing in manufacturing the work of this section with five years' experience.
- B. Erector: Company specializing in erecting the work of this section with five years' experience.
- C. Welder: Qualified within previous 12 months in accordance with AWS.
- D. Design planks under direct supervision of Professional Engineer experienced in design of this Work and licensed in the State that the units are to be installed in.

1.05 SUSTAINABLE DESIGN:

- A. Comply with the requirements specified in Section 01 81 13.
- B. Product Data for Credits MR 4.1 and Credit MR 4.2: For products having recycled content, provide documentation indicating percentages (by weight) of post-consumer and pre-consumer recycled content.
 - 1. For each recycled product used, include a statement indicating costs.
- C. Product Certificates for Credit MR 5.1: For products extracted, harvested and manufactured within 500 miles of the project site, provide documentation indicating percentages (by weight) of regional materials that meets the criteria.
 - 1. For each regional product used, include a statement indicating costs.

1.06 SUBMITTALS:

- A. Submit the following shop drawings in accordance with Section 01 33 00.
 - 1. Completely detailed shop drawings for all precast, prestressed concrete planks. Indicate all dimensions, plank layout, architectural details, prestressing strands, reinforcing steel, inserts, connections, openings, edge conditions, bearing requirements, support conditions, lifting devices and openings intended to be field cut.
 - 2. Mark each member for identification. Show mark on erection plan and place legibly on unit at time of manufacture.
 - 3. Indicate design load and fire rating of units.
 - 4. Drawings shall bear the signature and seal of a Registered Professional Engineer employed by the precast manufacturer and licensed in the State where the units are to be installed.
 - 5. Calculations showing load intensities and combinations and deflections and cambers considered in design. Calculation shall bear the signature and seal of a Registered Professional Engineer employed by the precast manufacturer and licensed in the state where the units are to be installed.
 - 6. Concrete mix design.

7. Test results of concrete mix used for production of the units.

1.07 QUALITY ASSURANCE:

- A. Comply with the requirements specified in Section 01 43 00.
- B. Fabrication and quality control shall conform to MNL-116.
- C. The precast concrete manufacturing plant shall conform to the requirements of the Prestressed Concrete Institute Plant Certification Program.
- D. Furnish written welding procedure for all welds in conformance with the AWS.
- E. If a welder or welding operator has not been engaged in a specific welding process for a period of 12 months or more, that individual shall be deemed unqualified and shall not perform work on the project until the individual has been qualified again by testing in conformance with AWS.
- F. Maintain duplicate qualification and certification records at the job site readily available for examination.

1.08 DELIVERY, STORAGE AND HANDLING:

- A. Comply with the requirements specified in Section 01 66 10.
- B. Store planks on clean blocking, off the ground and protected from rain and ground splatter. Cover planks with durable covers of canvas, heavy waterproof paper or plastic sheeting. Secure covers firmly and protect the planks from dust, dirt or other materials that may stain concrete.
- C. Separate stacked units with dunnage across the full width of each plank.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Furnish Portland cement conforming to ASTM C 150, Type I, II or III. Use one accepted brand from one mill throughout the contract term unless otherwise accepted by the **[Engineer][CM]**. Use cement of uniform color.
- B. Use Concrete Aggregates that conform to ASTM C 33. Size of coarse aggregate no larger than 3/4-inch (19 mm) but not exceeding space and cover requirements of prestressing and reinforcing steel.
- C. Water:
 - 1. Use water for concrete that is potable and free from injurious amounts of oil, acid, alkali, organic matter or other deleterious substances, and conforms to the requirements for water in ASTM C94, and as specified herein.
 - 2. The maximum water-soluble chloride ion in the water shall not exceed 0.060 percent by weight of cement.

- D. Concrete: Regular weight structural concrete with a minimum compressive strength of 5,000 psi (35 MPa) at 28 days.
- E. Provide tensioning steel tendons with uncoated, seven wire, lowlax prestressing strand conforming to ASTM A416, Grade 270.
- F. Provide reinforcement steel with deformed bars conforming to ASTM A615, Grade 60.
- G. Provide weldable reinforcement with deformed bars conforming to ASTM A706, Grade 60 (420), when welding is specified.
- H. Provide welded wire reinforcement conforming to ASTM A185.
- I. Steel Plates: ASTM A 36, Hot-Dip Galvanized
- J. Metal inserts: Hot-dip galvanized ferrous metal conforming to ASTM A123 and ASTM A153. Do not embed aluminum in concrete.
- K. Bearing strip: 1/8-inch (3 mm) thick multi-monomer plastic.
- L. Grout: Mixture having not less than one part portland cement to three parts fine sand and a minimum compressive strength of 3,000 psi (20 MPa) at 28 days.

PART 3 - EXECUTION

3.01 FABRICATION:

- A. Fabricate concrete planks in accordance with M.L.-116 and Sections 03 20 00 and 03 30 00.
- B. Extrude hollow-core planks in a factory with closely controlled mixing, placing and curing conditions. Cast solid planks in a factory. Do not cast units on site. Produce finished products free of honeycombs and voids with straight, true edges and surfaces.
- C. Machine finish top surface of plank except surfaces of planks to receive concrete topping shall be mechanically roughened by wire brush after casting.
- D. Provide a flat, smooth, steel form finish of uniform appearance on underside of plank.
- E. Cast all openings larger than -inch (150 mm)] in greatest dimension or having an area of more than 36 square inches (230 sq cm) into planks at time of fabrication and properly reinforce. Smaller openings may be core-drilled in the field when permitted by the Engineer who was responsible for the design of the precast planks.
- F. Incorporate welding clips, inserts, anchors, and sleeves indicated on drawings or required into planks at time of fabrication. Do not paint surfaces in contact with concrete or surfaces requiring field welding.
- G. Cure planks in accordance with MNL-116.

3.02 TOLERANCES:

- A. Erect members level and plumb within allowable tolerances. Conform to PCI MNL-116S.
- B. Exposed Joint Dimension: 3/8-inch (10 mm) +/- 1/4-inch (6 mm).

3.03 INSTALLATION:

- A. Inspect bearing surfaces and ensure that the bearing surfaces are level and at the proper elevation.
- B. Place continuous bearing strips along bearing surfaces such that planks are uniformly supported across the full widths of the units.
- C. Lift and support members during transportation and erection at same points where members will be supported in completed structure.
- D. Remove protruding elements of lifting devices after erection of members.
- E. Protect members during lifting, transportation and handling operations against overstress, damage to surfaces and excessive forces. Do not install cracked or damaged planks. Only minor surface patching is permitted.
- F. Erect and install planks in accordance with manufacturer's written instructions using experienced workmen. Accurately place and adjust planks to correct alignment and elevation before securing in place. Locate connections and welds in accordance with accepted shop drawings. Inspect welded connections before covering with concrete topping or roofing materials.
- G. Alignment: Level and match underside of adjacent planks by, jacking, shoring or loading to produce a uniform ceiling plane.
- H. Grout joints between planks using the specified grout. Make bottom of joints smooth in areas where underside of plank is exposed. Trowel top of joints smooth. Remove grout that seeps from joints between planks before it hardens.
- I. Field cutting or coring is not permitted without the written permission of the Engineer who was responsible for the design of the precast planks. Powder driven fasteners into planks are not permitted.
- J. When permitted by the Engineer who was responsible for the design of the precast planks, cutting or coring of plank may be performed after grout in shear keys have attained their design strength.

3.04 CLOSEOUT ACTIVITIES:

- A. Provide in accordance with Section 01 77 00.

END OF SECTION

SECTION 03 61 10
PATCHING MORTAR

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Polymer modified, cementitious, fast setting, mortar for repair of concrete surfaces.

1.02 SUBMITTALS

A. Product Data:

1. Manufacturer's literature.

B. Submit in accordance with Section 01 33 00.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Manufacturers:

1. Sikatop 122, by Sika Corporation.
2. Dura-top, by L&M Construction Chemicals.
3. MasterEmaco Gel Patch by Master Builders Solutions, Inc.

B. Polymer modified cementitious system consisting of 2 components.

1. Component A: Liquid polymer emulsion of acrylic copolymer base and additives.
2. Component B: Blend of selected Portland cements, specially graded aggregates, organic accelerator, and admixtures for controlling setting time, water reducers for workability, and corrosion inhibitor.
3. System shall not contain chlorides, nitrates, added gypsum, added lime or high alumina cements. System shall be noncombustible, before or after cure.
4. Color: Concrete gray.
5. Minimum Compressive Strength: 5,000 psi.
6. Bond Strength: 100% concrete substrate failure (pull off method), minimum 400 psi.
7. System shall not produce vapor barrier, shall be thermally compatible with concrete, and freeze-thaw resistant.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Prepare surface in accordance with manufacturer's written recommendations and Section 03 30 10.

3.02 APPLICATION

- A. Apply and cure patching mortar in accordance with manufacturer's written recommendations.

END OF SECTION

SECTION 03 62 00
NONSHRINK GROUT

PART 1 - GENERAL

1.01 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's literature.
- B. Submit in accordance with Section 01 33 00.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Manufacturers:
 - 1. Fluid Grout 100, by Five Star Products, Inc.
 - 2. Masterflow 713 Grout, by BASF Admixtures.
 - 3. Euco NS Grout, by Euclid Chemical Company.
 - 4. Crystex, by L&M Construction Materials, Inc.
 - 5. Sika Grout 212 by Sika Corporation.
- B. Grout:
 - 1. Cement base, nonmetallic, nongas forming, nonshrink, preblended and ready-to-use requiring only addition of water at Project site.
 - 2. Comply with ASTM C1107/C1107M Grade B.
 - 3. Of moderate fluidity with minimum compressive strength of 5,000 psi at 28 days and shall not bleed.
- C. Water:
 - 1. Clean and free from injurious chemicals and deleterious materials.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Clean grout contact surfaces of oil, grease, scale, and other foreign matter. Chip away unsound concrete leaving surface level but rough.
- B. Underside of base plates of machinery, rails, and bolts shall be free of grease, oil, dirt or coatings.

3.02 MIXING AND PLACING

- A. Mix and place in accordance with manufacturer's written instructions.
- B. Provide sealing materials where necessary to retain grout until hardened.
- C. Work grout from one side to other. Avoid trapping air under base plates.
- D. Remove plastic anchor bolt sleeve tops where used, and fill with grout at same time base plates are grouted.

3.03 CURING

- A. Cure with curing compound or as recommended by grout manufacturer.

END OF SECTION

SECTION 03 63 00

EPOXY GROUT

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Material for grouting reinforcing bars into existing concrete and other uses where noted.

B. Alternatives:

1. CONTRACTOR may use premixed adhesive anchor material as specified in Section 05 50 00 when approved by ENGINEER, rather than using field mixed grout as specified herein.

1.02 SUBMITTALS

A. Product Data:

1. Manufacturer's literature.

B. Submit in accordance with Section 01 33 00.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Epoxy:

1. Manufacturers:

- a. Sikadur Hi-Mod or Sikadur Hi-Mod gel, by Sika Corporation.
- b. Five Star Epoxy Grout, by Five Star Products, Inc.
- c. Masterflow 648 , by Master Builders Solutions, Inc.

B. Sand: Hard, durable, oven dry.

PART 3 - EXECUTION

3.01 PREPARATION

- ###### A. Clean contact surfaces of oil, grease, and other foreign matter. Chip away unsound concrete.

3.02 MIXING

- A. Mix components of epoxy compound as directed by manufacturer's instructions immediately before combining liquid with sand.
- B. After binder is thoroughly mixed, add sand as recommended by manufacturer.

3.03 PLACING

- A. Place in accordance with manufacturer's written instructions following requirements regarding temperature and pot life.
- B. Provide suitable materials where necessary to retain grout until hardened.

3.04 CURING

- A. Cure as recommended by manufacturer.

END OF SECTION

DIVISION 4

MASONRY

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SECTION 04 20 00

UNIT MASONRY AND ACCESSORIES

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. Provide unit masonry and accessories as indicated and in compliance with Contract Documents.
 - 1. The work under this Section includes the following:
 - a. Concrete masonry units.
 - b. Decorative concrete masonry units.
 - c. Face brick.
 - d. Mortar and grout.
 - e. Masonry joint reinforcement.
 - f. Ties and anchors.
 - g. Miscellaneous masonry accessories.
 - h. Cast stone window sill.

1.02 SUBMITTALS:

- A. Submit the following shop drawings in accordance with Section 01 33 00.
- B. Product Data: For each type of product indicated.
- C. Shop Drawings: For the following:
 - 1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
 - 2. Cast Stone: Show fabrication and installation details. Include dimensions, details of reinforcement and anchorage and indication of finished faces.
 - a. Include building elevations showing layout of units and location of joints and anchors.
- D. Samples for Verification: For each type and color of the following:
 - 1. Decorative CMUs.
 - 2. Face Brick
 - 3. Cast Stone Sill.
- E. Material Certificates: For each type and size of the following:
 - 1. Masonry units.
 - a. Include data on material properties.
 - b. For brick, include size-variation data verifying that actual range of sizes falls within specified tolerances.
 - c. For exposed brick, include test report for efflorescence according to ASTM C67.

- d. For surface-coated brick, include test report for durability of surface appearance after 50 cycles of freezing and thawing per ASTM C67.
 - e. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
- 2. Cementitious materials. Include brand, type, and name of manufacturer.
 - 3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
 - 4. Joint reinforcement.
 - 5. Anchors, ties, and metal accessories.
 - 6. Cast Stone. Include test reports based on testing according to ASTM C1364 including test for resistance to freezing and thawing.
- F. Mix Designs: For each type of mortar. Include description of type and proportions of ingredients.
- 1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91 for air content.
 - 2. Include test reports, according to ASTM C1019, for grout mixes required to comply with compressive strength requirement.

1.03 QUALITY ASSURANCE:

- A. Comply with the requirements specified in Section 01 43 00.
- B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.
- C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.
- D. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.

1.04 DELIVERY STORAGE AND HANDLING:

- A. Comply with the requirements specified in Section 01 66 10.
- B. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- D. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

- E. Deliver preblended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.
- F. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.05 PROJECT/SITE CONDITIONS:

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

PART 2 - PRODUCTS

2.01 MASONRY UNITS, GENERAL:

- A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.
- B. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

2.02 CONCRETE MASONRY UNITS:

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
 - 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
 - 2. Provide bullnose units for outside corners unless otherwise indicated.
- B. CMUs: ASTM C90.
 - 1. Density Classification: Normal weight.
 - 2. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
 - 3. Exposed Faces: Provide color and texture matching the range represented by Engineer's sample.
- C. Decorative CMUs: ASTM C90.
 - 1. Glazed concrete masonry units shall be used where indicated.
 - 2. All glazed concrete masonry units shall be made with lightweight aggregate and shall be autoclaved units conforming to ASTM C90 as applicable. The glazed surface shall have a smooth satin-gloss finish and externally heat-polymerized cast-on facing conforming to ASTM C744, Federal Specification SS-C-621b, and ASTM C67, paragraph 8 (50 cycles of Freezing and Thawing).
 - 3. Glazed masonry units shall be used with colors selected by OWNER from manufacturer's standard colors.
 - 4. The glazed facing shall be free from chips, cracks, crazes, or any other imperfections that would detract from the overall appearance of the wall when viewed from a distance of 5 feet at right angles to the wall. Only quality units shall be installed; all defective units shall be rejected.
 - 5. Glazed units shall MATCH EXISTING bY ASTRA-GLAZE-SW as manufactured by Trenwyth Industries, Inc. or equal. All units shall include W.R. Grace DRY-Block water repellent block admixture or equal. Provide bullnose edge units at all door and window openings.

2.03 BRICK:

- A. Face brick shall be ASTM C-216, latest edition, Grade SW, Type FBS, made from clay, shale, fine clay, or mixture thereof. All brick shall be free from cracks, laminations, and other defects

which may interfere with proper laying of brick or impair the strength or permanence of the structure.

- B. A certificate of conformance as to grade and type shall be supplied by the manufacturer.
- C. Brick shall MATCH EXISTING by ACME Brick Company, color shall be Amaretto, and finish shall be Velour.
- D. CONTRACTOR shall submit brick samples to ENGINEER for approval. The bricks to be used shall be of Modular Size (7-5/8 by 2-1/4 by 3-5/8) and stack bond

2.04 ANTIGRAFFITI COATING:

- A. Antigrffiti coating shall be a clear, two-component, acrylic polyurethane that contains UV block and is a transparent graffiti-resistant barrier on concrete and masonry surfaces. Product shall be SWD Invisi-Shield Anti-Graffiti Clear by Sherwin Williams Company, or equal.
- B. Antigrffiti coating shall be applied to all existing and new exterior masonry (brick, stone, cast stone) wall surfaces.
- C. All surfaces to be coated shall be power washed to remove all contaminants and foreign debris. Apply one coat of HB150 15% silaxone solution by Sherwin Williams to weatherproof surfaces with coverage per manufacturer's recommendations. Then apply two sprayed coats of antigrffiti coating in coverages and methods recommended by manufacturer.

2.05 MORTAR AND GROUT MATERIALS:

- A. Regional Materials: Provide aggregate for mortar and grout that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.
- B. Portland Cement: ASTM C150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
- C. Water: Potable.

2.06 REINFORCEMENT:

- A. Uncoated Steel Reinforcing Bars: ASTM A615/A615M or ASTM A996/A996M, Grade 60 (Grade 420).
- B. Masonry Joint Reinforcement, General: ASTM A951/A951M.
 - 1. Interior Walls: Hot-dip galvanized, steel.
 - 2. Exterior Walls: Hot-dip galvanized steel.
- C. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.

- D. Masonry Joint Reinforcement for Multiwythe Masonry:
1. Tab type, either ladder or truss design, with 1 side rod at each face shell of backing wythe and with rectangular tabs sized to extend at least halfway through facing wythe but with at least 5/8-inch (16-mm) cover on outside face.
 2. Adjustable (two-piece) type, either ladder or truss design, with one side rod at each face shell of backing wythe and with separate adjustable ties with pintle-and-eye connections having a maximum adjustment of 1-1/4 inches (32 mm). Size ties to extend at least halfway through facing wythe but with at least 5/8-inch (16-mm) cover on outside face.

2.07 TIES AND ANCHORS:

- A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated.
1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A82/A82M; with ASTM A153/A153M, Class B-2 coating.
 2. Galvanized Steel Sheet: ASTM A653/A653M, Commercial Steel, G60 (Z180) zinc coating.
 3. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- B. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 5/8-inch (16-mm) cover on outside face. Outer ends of wires are bent 90 degrees and extend 2 inches (50 mm) parallel to face of veneer.
- C. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch- hot-dip galvanized steel wire.
 2. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch (25 mm) of masonry face, made from hot-dip galvanized
- D. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
1. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch (25 mm) of masonry face, made from hot-dip galvanized steel wire
- E. Partition Top anchors: 0.105-inch- (2.66-mm-) thick metal plate with 3/8-inch- (9.5-mm-) diameter metal rod 6 inches (152 mm) long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.
- F. Rigid Anchors: Fabricate from steel.
1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A153/A153M.

G. Adjustable Masonry-Veneer Anchors:

1. General: Provide anchors that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to wood or metal studs, and as follows:
 - a. Structural Performance Characteristics: Capable of withstanding a 100-lbf (445-N) load in both tension and compression without deforming or developing play in excess of 0.05 inch (1.3 mm).
2. Contractor's Option: Unless otherwise indicated, provide any of the following types of anchors:
3. Screw-Attached, Masonry-Veneer Anchors: Units consisting of a wire tie and a metal anchor section.
 - a. Anchor Section: Rib-stiffened, sheet metal plate with screw holes top and bottom, 2-3/4 inches (70 mm) wide by 3 inches (76 mm) high; with projecting tabs having slotted holes for inserting vertical legs of wire tie specially formed to fit anchor section.

2.08 EMBEDDED FLASHING MATERIALS:

- A. Metal Flashing: Provide metal flashing complying Division 07 Section "Sheet Metal Flashing and Trim".

2.09 MORTAR AND GROUT MIXES:

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.
 1. Do not use calcium chloride in mortar or grout.
- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Pigmented Mortar: Use colored cement product Do not add pigments to colored cement products.
- D. Epoxy Pointing Mortar: Mix epoxy pointing mortar to comply with mortar manufacturer's written instructions.
 1. Application: Use epoxy pointing mortar for exposed mortar joints with the following units:
 - a. Pre-faced CMUs.

2.10 CAST STONE

A. Materials:

1. General: Comply with ASTM C1364.
2. Portland Cement: ASTM C150 Type I or Type III, containing not more than 0.60 percent total alkali when tested according to ASTM C114. Provide natural color or white cement as required to produce cast-stone color indicated.
3. Coarse Aggregates: Granite, quartz, or limestone complying with ASTM C 33/C 33M; gradation and colors as needed to produce required cast-stone textures and colors.
4. Fine Aggregates: Natural sand or crushed stone complying with ASTM C 33/C 33M, gradation and colors as needed to produce required cast-stone textures and colors.
5. Color Pigment: ASTM C 979/C 979M, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.
6. Embedded Anchors and inserts: Fabricated from stainless steel complying with ASTM A240, ASTM A276 or ASTM A666, Type 304.
7. Units shall be manufactured using the vibrant dry tamp or wet-cast method.
8. Units shall be resistant to freezing and thawing as determined by laboratory testing according to ASSTM C666, Procedure A, as modified by ASTM C1364.

B. Fabrication: Fabricate units with sharp arris and accurately reproduced details, with indicated texture on all exposed surfaces unless otherwise indicated.

1. Slope exposed horizontal surfaces 1:12 to drain unless otherwise indicated.
2. Provide drips on projecting elements.
3. Tolerance in length: Do not vary from indicated dimensions by more than 1/360 of the length of the unit or 1/8", whichever is greater.
4. Acid etch units after curing to remove cement film from surfaces to be exposed to view.
5. Colors and Textures: Provide units with fine-grained texture and buff color resembling smooth-finished Indiana limestone.

PART 3 - EXECUTION

3.01 EXAMINATION:

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

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

3.02 TOLERANCES:

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation do not vary by more than plus 1/2-inch (12 mm) or minus 1/4-inch (6 mm).
2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2-inch (12 mm).
3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4-inch (6 mm) in a story height or 1/2-inch (12 mm) total.

3.03 SETTING ANCHORED CAST STONE:

- A. Set cast stone as indicated on Drawings: Set units accurately in locations indicated. Install anchors, supports, fasteners and other attachments indicated or necessary to secure units in place.

3.04 FIELD QUALITY CONTROL:

- A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.
- B. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C140 for compressive strength.
- C. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C780.
- D. Mortar Test (Property Specification): For each mix provided, according to ASTM C780. Test mortar for compressive strength.

3.05 REPAIRING, POINTING, AND CLEANING:

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.

2. Clean cast stone with proprietary acidic cleaner applied according to manufacturer's written instructions.

3.06 PROTECTION:

- A. Protect the walls, including window sills, with non-staining waterproof coverings when work not in process.
- B. Provide minimum 24-inch overhang of protective covering on each side of wall and anchor securely.
- C. Protect facing materials from staining.

3.07 CONTRACT CLOSEOUT:

- A. Provide in accordance with Section 01 77 00.

END OF SECTION

DIVISION 5

METALS

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SECTION 05 50 00

MISCELLANEOUS METAL

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. This section includes metal fabrications not specifically included in other Sections and required for completion of work as shown on Contract Drawings and in accordance with Contract Documents.
- B. Furnish labor, materials, equipment and incidentals necessary to install the products specified.

1.02 REFERENCES:

- A. American Society of Mechanical Engineers (ASME):
 - 1. B18.5: Round Head Bolts.
- B. ASTM International (ASTM):
 - 1. A6: General Requirements for Rolled Structural Steel Bars, Plates, Shapes and Sheet Piling.
 - 2. A36: Standard Specification for Carbon Structural Steel.
 - 3. A48: Standard Specification for Gray Iron Castings.
 - 4. A53: Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - 5. A108: Standard Specification for Steel Bars, Carbon, Cold Finished, Standard Quality.
 - 6. A123/A123M: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 7. A153: Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 8. A193/A193M: Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications.
 - 9. A240: Standard Specification for heat-resisting chromium and chromium-nickel stainless steel plate, sheet, and strip for pressure vessels.
 - 10. A276: Standard Specification for Stainless Steel Bars and Shapes.
 - 11. A307: Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
 - 12. A325: Structural Bolts, Steel, Heat Treated 120/105 ksi Minimum Tensile Strength.
 - 13. A366: Standard Specification for Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality.
 - 14. A489: Standard Specification for Carbon Steel Lifting Eyes.
 - 15. A500: Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 - 16. A501: Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
 - 17. A502: Steel Structural Rivets.
 - 18. A536: Standard Specification for Ductile Iron Castings.
 - 19. A569: Steel, Carbon (0.15 Maximum, Percent) Hot-Rolled Sheet and Strip Commercial Quality.
 - 20. A570: Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality.

21. A572: Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
22. A576: Steel Bars, Carbon, Hot-Wrought, Special Quality.
23. A675: Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties.
24. A786: Rolled Steel Floor Plates.
25. A992: Standard Specification for Structural Shapes.
26. B26: Specification for Aluminum-Alloy Sand Castings.
27. B211: Specification for Aluminum-Alloy Bars, Rods, Profiles and Tubes.
28. B209: Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
29. B221: Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.
30. B247: Specification for Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings and Rolled Ring Forgings.
31. B308: Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
32. B 429: Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
33. D1056: Standard Specification for Flexible Cellular Materials—Sponge or Expanded Rubber.
34. F436: Standard Specification for Hardened Steel Washers.
35. F541: Standard Specification for Alloy Steel Eyebolts.
36. F593: Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
37. F594: Standard Specification for Stainless Steel Nuts.
38. F844: Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use.
39. F1554: Standard Specification of Anchor Bolts, steel, 36, 55 and 105-ksi Yield Strength.
40. F2329: Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners.

C. American Institute of Steel Construction (AISC):

1. ANSI/AISC 360-5: Specification for Structural Steel Buildings
2. AISC Manual of Steel Construction, Thirteenth Edition

D. American Welding Society (AWS):

1. A2.4: Standard Symbols for Welding, Brazing, and Nondestructive Examination.
2. D1.1: Structural Welding Code.
3. D1.2: Structural Welding Code - Aluminum.

E. National Association of Architectural Metal Manufacturers (NAAMM):

1. MBG 531: Metal Bar Grating Manual.
2. MBG 532: Heavy Duty Metal Bar Grating Manual.
3. MBG 533: Welding Specifications for Fabrication of Steel, Aluminum and Stainless Bar Grating.

F. Aluminum Association:

1. Aluminum Design Manual—Specifications and Guidelines for Aluminum Structures.
 - a. AA M31C22A41
 - (1) M31: Mechanical Finish, Fine Satin
 - (2) C22: Finish, Medium Matte

(3) A41: Clear Anodic Coating, Class I

G. International Code Council – Evaluation Services (ICC-ES):

1. ICC-ES Acceptance Criteria 01: Mechanical Anchors in Masonry Elements
2. ICC-ES Acceptance Criteria 58: Adhesive Anchors in Masonry Elements
3. ICC-ES Acceptance Criteria 193: Mechanical Anchors in Concrete Elements
4. ICC-ES Acceptance Criteria 308: Post-installed Adhesive Anchors in Concrete Elements

H. National Sanitation Foundation (NSF):

1. 61: Drinking Water System Components – Health Effects

I. Submit the following shop drawings in accordance with Section 01 33 00.

1. Submit shop drawings and product data showing materials of construction and details of installation for all items furnished under this Section. Shop drawings shall show sizes of members, method of assembly, anchorage and connection to other members.
2. Test Reports:
 - a. Submit certified copies of mill test reports on each steel, stainless steel, or aluminum proposed for use showing the physical properties and chemical analysis.
3. Product Data:
 - a. Manufacturer's catalog sheets on pre-manufactured items.
4. Miscellaneous Submittals:
 - a. Provide International Conference of Building Officials (ICBO) or other similar building code organization recommendations regarding safe allowable design loads for concrete anchors.
5. Stamped by Professional Engineer registered in State where the project is located.

1.03 SUSTAINABLE DESIGN:

A. Comply with the requirements specified in Section 01 81 13.

B. Submittals:

1. Comply with the requirements specified in Section 01 81 13.

C. Product Data for Credits MR 4.1 and Credit MR 4.2: For products having recycled content, provide documentation indicating percentages (by weight) of post-consumer and pre-consumer recycled content.

1. For each recycled product used, include a statement indicating costs.

- D. Product Certificates for Credit MR 5.1: For products extracted, harvested and manufactured within 500 miles (800 km) of the project site, provide documentation indicating percentages (by weight) of regional materials that meet the criteria.

- 1. For each regional product used, include a statement indicating costs.

1.04 DESIGN CRITERIA:

- A. Structural Connections: AISC Specification for Structural Steel Buildings. Design connections not fully detailed on the Drawings to resist the loads shown on the Contract Drawings or specified.
- B. Where beam end reactions are not shown, design the connection for one-half the total allowable uniform load in kips (kilonewtons) for beams laterally supported at the given span, as determined by the tables for allowable loads on beams in the AISC Manual of Steel Construction, in addition to any axial loads identified on the Contract Drawings.

1.05 QUALITY ASSURANCE:

- A. Comply with the requirements specified in Section 01 43 00.
- B. Test and inspect structural assemblies in accordance with Section 01 45 33.
- C. Design connections not detailed on the Drawings under direct supervision of a Professional Engineer experienced in design of this work and licensed in the State where the Project is located.
- D. Steel:
 - 1. Conform to codes for arc and gas welding in building construction of AWS and to AISC Specifications. Surfaces to be welded shall be free from loose scale, rust, grease, paint, and other foreign material, except mill scale that will withstand vigorous wire brushing may remain. Perform no welding when base metal is lower than 0 degrees F (-18 degrees C).
 - 2. Qualify welding operators in accordance with AWS D1.1. Qualification tests shall be run by a recognized testing laboratory acceptable to the Engineer at Contractor's expense.
- E. Aluminum:
 - 1. Weld with gas metal arc (GMA) or gas tungsten arc (GTA) processes in accordance with AWS.
- F. Adhesive Anchors:
 - 1. Adhesive Anchor Installers shall be trained and certified by manufacturer.
- G. Galvanized Coating:
 - 1. Company specializing in hot-dip galvanizing after fabrication and following procedures of Quality Assurance Manual of the American Galvanizers Association.

1.06 DELIVERY STORAGE AND HANDLING:

- A. Comply with the requirements specified in Section 01 66 10.

- B. Insofar as practical, factory assemble items specified herein. Package, ship and tag unassembled materials in a manner that will protect materials from damage and will facilitate identification and field assembly.
 - C. Package stainless steel items in a manner to provide protection from carbon impregnation.
 - D. Protect painted coatings and hot-dip galvanized finishes from damage due to metal banding and rough handling. Use padded slings and straps.
 - E. Deliver items to be incorporated into the work of other trades in sufficient time to be checked prior to installation.
 - F. Store fabricated items in a dry area, not in direct contact with ground.
- 1.07 FIELD MEASUREMENTS:
- A. The Contractor shall verify all dimensions and shall make any field measurements necessary and shall be fully responsible for accuracy and layout of the work.
 - B. The Contractor shall review the Contract Drawings and any discrepancies shall be reported to the Engineer for clarification prior to starting fabrication.

PART 2 - PRODUCTS

2.01 MISCELLANEOUS METAL SHAPES, CASTINGS, BOLTS AND ACCESSORIES:

A. Structural Steel Shapes:

- | | | |
|-----|------------------------------------|----------------------------|
| 1. | W Shapes: | ASTM A992, 50 ksi |
| 2. | M Shapes: | ASTM A36 |
| 3. | S, C and MC Shapes: | ASTM A36 |
| 4. | L Shapes: | ASTM A36 |
| 5. | HP Shapes: | ASTM A572 Grade 50] |
| 6. | HSS Square and Rectangular Shapes: | ASTM A500, Grade B, 46 ksi |
| 7. | HSS Round Shapes: | ASTM A500, Grade B, 42 ksi |
| 8. | Pipe Shapes: | ASTM A53, Grade B, 35 ksi |
| 9. | Plates and Bars: | ASTM A36 |
| 10. | Steel Sheets: | ASTM A366 |

B. Stainless Steel Shapes:

- | | | |
|----|----------------------------------|----------------------------|
| 1. | Exterior and Submerged Uses: | AISI, Type 316 |
| 2. | Industrial Uses: | AISI, Type 316 |
| 3. | Interior and Architectural Uses: | AISI, Type 304 |
| 4. | For Welding: | AISI, Type 304L, Type 316L |
| 5. | Shapes and Bars | ASTM A276 |
| 6. | Plate, Sheet and Strip | ASTM A240 |

C. Aluminum Shapes:

- | | | |
|----|-------------------|--------------------------|
| 1. | Structural Shapes | ASTM B308, Alloy 6061-T6 |
|----|-------------------|--------------------------|

- 2. Extruded Pipe ASTM B429, Alloy 6063-T6
- 3. Aluminum Sheet and Plate ASTM B209, Alloy 6061-T6
- D. High Strength Bolts for Steel Members ASTM A325
- C. Steel Washers ASTM F436
- D. Plain Unhardened Steel Washers: ASTM F844
- E. Anchor Bolts: ASTM F1554, Grade 36 standard headed bolts with heavy hex nuts, Grade A washers, hot-dip galvanized, unless otherwise specified.
- F. Stainless Steel Bolts and Nuts: F593 and F594, AISI Type 316
- G. Connection Bolts for Wood Members: ASTM A307, galvanized where specified
- H. Iron Castings: ASTM A48, Class 35
- I. Galvanizing: ASTM A123, Zn w/0.5 percent minimum Ni.
- J. Galvanizing, hardware: ASTM A153, Zn w/0.5 percent minimum Ni.

2.02 POST INSTALLED ANCHORS:

- A. Mechanical Expansion Type Anchors: Anchors shall be qualified per ICC-ES AC193.
 - 1. Products:
 - a. Hilti Corporation, Kwik-Bolt TZ2
 - b. Powers Fasteners, Power Stud SD1+ Stud Anchor
 - c. Simpson Strong Tie, Strong Bolt
 - 2. General:
 - a. Use Zinc or chromate-plated carbon steel where totally embedded, in interior locations with controlled humidity and other protected locations, unless otherwise specified on Contract Drawings.
 - b. Use stainless steel in other locations or when attaching aluminum and stainless steel.
 - c. Do not use expansion anchors in submerged and dynamic load applications.
- B. Drop-In Anchors: Anchors shall be qualified per ICC-ES AC01.
 - 1. Products:
 - a. Hilti Corporation, HDI Drop-In Anchor
 - b. Powers Fasteners, Steel Drop-In
 - c. Simpson Strong-Tie, Drop-In

2. General:
 - a. Use Zinc or chromate-plated carbon steel in interior locations with controlled humidity and other protected locations, unless otherwise specified on Contract Drawings.
 - b. Use stainless steel in other locations or when attaching aluminum and stainless steel.
 - c. Do not use drop-in anchors in corrosive or humid areas or when subjected to dynamic loads.
- C. Sleeve Anchors: Anchors shall be qualified per ICC-ES AC01
1. Products:
 - a. Hilti Corporation, HLC Sleeve Anchor
 - b. Powers Fasteners, Lok-Bolt
 - c. Simpson Strong-Tie, Sleeve-All
 2. General:
 - a. Use Zinc or chromate-plated carbon steel in interior locations with controlled humidity and other protected locations, unless otherwise specified on Contract Drawings.
 - b. Use stainless steel in other locations or when attaching aluminum and stainless steel.
- D. Undercut Anchors:
1. Products:
 - a. Hilti Corporation, HDA Undercut Anchor
 - b. Powers Fasteners, Atomic+ Undercut
 - c. Simpson Strong-Tie, Type Torq-Cut
 2. General:
 - a. Use Zinc or chromate-plated carbon steel in interior locations with controlled humidity and other protected locations, unless otherwise specified on Contract Drawings.
 - b. Use stainless steel in other locations or when attaching aluminum and stainless steel.
 - c. Under cut anchors are not acceptable for use in submerged applications.
- E. Adhesive Anchors:
1. Products:
 - a. Hilti Corporation, HIT-RE 500-V3
 - b. Powers Fasteners, PE1000+ Epoxy Adhesive Anchoring System
 - c. Simpson Strong Tie, SET-XP Epoxy-Tie or Acrylic-Tie
 1. General:
 - a. Adhesive anchors shall be Stainless Steel Type 304.

- b. Epoxy adhesive shall be ANSI/NSF approved for use in contact with potable water.

F. Adhesive Anchors for masonry:

1. Products:

- a. Hilti Corporation, HIT-HY 270
- b. Powers Fasteners, AC100+ Gold
- c. Simpson Strong Tie, SET High Strength Epoxy Tie

2. General:

- a. Epoxy anchors shall be Stainless Steel Type 304.
- b. Epoxy adhesive shall be ANSI/NSF approved for use in contact with potable water.

2.03 ANCHOR CHANNEL INSERTS:

- A. Make anchor channels from channel profiles with “I” anchors shop welded to back of channels. Furnish anchor channels with head bolts, channels, nuts for a complete installation. Material shall be Stainless Steel Type 304.

2.04 WEDGE INSERTS:

A. Manufacturers:

- 1. Gateway Building Products
- 2. Richmond Screw Anchor Company

B. General:

- 1. Malleable iron casting, 3/4-inch (19 mm) minimum size with minimum combined working load capacity of 1,300 pounds (6 kN) in shear and 1,000 pounds (4.5 kN) in tension.
- 2. Stainless Steel bolts and hardware.

2.05 EYE BOLTS:

- A. Provide eyebolts of the welded-eye or forged type, Type 304 stainless steel.
- B. Provide threaded carbon steel lifting eyes that comply with ASTM A489, Type 1 or 2, Style B.
- C. Provide threaded alloy steel eyebolts that comply with ASTM F541 and ASME B18.5, Type 1 2, long/short length.

2.06 GRATING SUPPORT ANGLES AND FRAMING:

- A. Provide aluminum support angles embedded in concrete. Angles shall be 1/4-inch (6 mm) thick, inside depth of support angle shall equal depth of bearing bar, inside length of support angle leg shall equal depth of grating, but not less than 1-3/4] inch (45 mm)). Provide 1 inch by 1/4-inch by 8 inches (25 mm by 6 mm by 200 mm) long bent anchor bars or 3/8-inch (10 mm) diameter by 6 inch (150 mm) headed anchor studs welded to backs of angles at 18 inches (450 mm) on center.

- B. For fiberglass reinforced plastic grating provide supports and framing in accordance with Section 06 60 10.

2.07 STEEL LINTELS:

- A. Provide steel lintels over doors, louvers, grille openings, wall recesses, duct openings, and other openings in masonry walls as shown on Contract Drawings and wherever reinforced concrete or masonry lintels are not provided.
- B. Fabricate lintels from structural shapes as detailed, selected for straightness of section.
- C. Unless otherwise shown, lintels shall have minimum bearing of 8 inches (200 mm) at each side of opening.
- D. Fabricate lintels of multiple sections by welding, grind exposed welds smooth.
- E. Openings less than 4 feet (1,200 mm) wide without lintel scheduled shall have reinforced masonry lintels or double steel angle lintels. Total width of horizontal legs shall be 1 inch (25 mm) less than wall thickness. Weld angles together.
- F. Hot-dipped galvanize after fabrication.

2.08 METAL FRAMES:

- A. Provide door, hatch, and grille frames, and other frames fabricated from structural shapes.
- B. Fabricate frames from rolled steel sections or rolled steel sections and steel plates. Select sections for trueness of web and flange. Straighten members so finished frames are uniform, square, and true throughout length and depth of assembled units.
- C. Connect built-up members of frames by plug welding. Miter or cope and join members with continuous welding beads. Provide temporary spreader bars to prevent springing frames out of shape prior to and during erection.

2.09 STRAP ANCHORS AND STUD ANCHORS:

- A. Provide anchors for frames, curbs, sills, and other metal fabrications anchored into concrete or masonry. Fabricate anchors from strap iron, bent to shape, or of weldable studs, welded to backs of members. Where size and spacing not noted, provide 1 inch by 1/4-inch (25 mm by 6 mm) strap anchors or 3/4-inch (19 mm) diameter studs for concrete and 1-1/2 inch by 1/8-inch (38 mm by 3 mm) strap anchors for masonry. Space masonry anchors to fit jointing of adjacent masonry work at 4 feet (1,200 mm) on center. Space concrete anchors at 3 feet (900 mm) on center.
- B. Where anchors and plates or clips are to be built in for attachment of later Work, provide bolts in plates or clips, welded to back, with threaded ends extended.
- C. For attaching Work to masonry or concrete where anchors or inserts cannot be built in, provide concrete anchors or machine bolts and screws.

2.10 NEOPRENE GASKET:

- A. Provide soft, closed-cell neoprene gasket material suitable for exposure to sewage and sewage gases conforming to ASTM D1056, Type 2, Class C, and Grade 1.
- B. Unless otherwise shown on Contract Drawings, provide neoprene gaskets with a minimum thickness of 1/4-inch (6 mm).
- C. Furnish neoprene gaskets without skin coat.

2.11 STEEL BOLLARDS:

- A. Galvanized steel pipe bollards shall be fabricated to dimensions and details shown in Contract Drawings. Fabricated bollards from 8 inch (200 mm) nominal outside diameter pipe.

2.12 PRESSURE RELIEF VALVES:

A. Wall Type Pressure Relief Valves:

- 1. Manufacturers:
 - a. Clow Valve Co., Type F-1494.
 - b. Neenah Foundry Inc., Type R-5002.
- 2. General:
 - a. Shall be furnished with rubber or neoprene seats and stainless steel or brass pins.
 - b. Valves shall be flanged and gasketed for connection to wall pipe or fittings.

B. Floor Type Pressure Relief Valves:

- 1. Manufacturers:
 - a. Clow Valve Co., Type F-1493.
 - b. Neenah Foundry Inc., Type R-5000.
- 2. General:
 - a. Shall be furnished with lead, rubber or neoprene seats.

C. Provide 4 inch (100 mm) cast-iron or ductile iron pressure relief valves as shown on Contract Drawings.

2.13 FABRICATION:

A. Connections and Workmanship:

- 1. Fabricate details and connection assemblies in accordance with Contract Drawings and Specifications, with projecting corners clipped and filler pieces welded flush.
- 2. Fit work together in fabrication shop and deliver complete or in parts, ready to be set in-place or assembled in field.

3. Provide work true to detail; with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture free from defects impairing strength or durability.
4. Provide clips, lugs, brackets, straps, plates, bolts, nuts, washers, and similar items, as required for fabrication and erection.
5. Provide castings of uniform quality, free from blowholes, porosity, hard spots, shrinkage distortion; smooth and well cleaned by shot blasting.
6. Welding:
 - a. Provide rigid and continuous welds or spot welded as specified and as shown on Contract Drawing. Dress the face of welds flush and smooth. Close fit exposed joints and locate where least conspicuous.
 - b. Weld aluminum work on the unexposed side when possible in order to prevent pitting or discoloration.
 - c. Weld aluminum in compliance with the latest edition of AWS D1.2. Support and clamp component parts of built-up members in proper position for welding.
 - d. Weld shop connections and bolt or field weld connections, unless otherwise specified.
 - e. Grind exposed edges of welds to 1/8-inch (3 mm) minimum radius. Grind burrs, jagged edges, and surface defects smooth.
 - f. Prepare welds and adjacent areas so there is:
 - (1) No undercutting or reverse ridges on weld bead.
 - (2) No weld spatter on or adjacent to weld or other area to be painted or coated.
 - (3) No sharp peaks or ridges along weld bead.
7. Bolting:
 - a. Use bolts of lengths required so bolts do not project more than 1/4-inch (6 mm) beyond face of nut. Do not use washers unless specified. Provide hexagonal head bolts with hexagonal nuts.
 - b. Provide holes required for connection of adjacent or adjoining work wherever noted on Drawings. Locate holes for bolting equipment to supports to tolerance of +/- 1/16-inch (2 mm) of dimensions indicated.

B. Galvanizing:

1. Galvanize after fabrication by hot-dipped process conforming with ASTM A123.
2. Ship and handle in manner to avoid damage to zinc coating.

C. Shop Painting:

1. Do not paint or coat ferrous metal surfaces embedded in concrete.
2. Comply with Section 09 91 10.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Upon receipt of material at job site, inspect all materials for shipping damage. Replace damaged items at no cost to Owner.

- B. Examine supports for size, layout and alignment.
- C. Correct defects considered detrimental to proper installation.

3.02 INSTALLATION:

- A. Provide items such as bolts, shims, blocks, nuts, washers, and wedging pieces to complete installation.
- B. Erect to lines and levels, plumb and true, and in correct relation to adjoining Work. Secure parts using concealed connections when practicable.
- C. Plumb and true vertical members to tolerance of +/- 1/8 inch in 10 feet. Level horizontal members to tolerance of +/- 1/8 inch in 10 feet.
- D. Use steel bolts to connect structural steel members. Use stainless steel bolts to connect structural aluminum members.
- E. Anchor Bolts and Concrete Anchors:
 - 1. Preset anchor bolts using templates. Do not use concrete anchors in place of anchor bolts.
 - 2. After anchor bolts are embedded, protect projecting threads by applying grease and having the nuts installed until the time of installation of equipment or metalwork.
 - 3. Do not install concrete anchors until concrete has reached specified minimum compressive strength.
 - 4. Install concrete anchors in accordance with anchor manufacturer recommendation. Embedment depth of anchor shall be as recommended by the anchor manufacturer, but not less than as shown on Contract Drawings.
 - 5. Locate concrete anchors to clear reinforcing bars in concrete.
- F. Weld headed anchor studs in accordance with manufacturer's recommendations.
- G. Do not place new holes or enlarge unfair holes by use of cutting torch.

3.03 PAINTING, REPAIR, AND PROTECTION:

- A. Paint aluminum in contact with concrete in accordance Section 09 47 00. Under no circumstances shall aluminum contact dissimilar metal.
- B. Between aluminum grating, aluminum stair treads, or aluminum handrail brackets and steel supports, insert 1/4-inch (6 mm) thick neoprene isolator pads, 85 +/- 5 Shore A durometer, sized for full width and length of bracket or support.
- C. Apply an anti-seize compound on all stainless steel fasteners to prevent galling.
- D. Field paint in compliance with Section 09 91 13.
- E. Field repair of damaged galvanized coatings:
 - 1. Clean and repair Zinc coating that has been burned by welding, abraded, or otherwise damaged after installation. Clean damage area by wire brushing and removing all traces of welding flux and loose or cracked zinc coating

2. Coat surfaces using zinc-rich paint.
- F. Field repair of damaged primer.
1. Touch up abrasions in the shop primer immediately after erection. Paint areas left unprimed for welding with primer after welding.
- 3.04 CLOSEOUT ACTIVITIES:
- A. Provide in accordance with Section 01 77 00.

END OF SECTION

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SECTION 05 51 20

ALUMINUM STAIRS AND LADDERS

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. This section describes materials, fabrication, and installation of aluminum stairs and ladders as indicated and in compliance with Contract Documents.

1.02 REFERENCES:

- A. Aluminum Association (AA):

- 1. Aluminum Design Manual—Specifications and Guidelines for Aluminum Structures.

- B. ASTM International (ASTM):

- 1. A276: Standard Specification for Stainless Steel Bars and Shapes.
- 2. B26: Specification for Aluminum-Alloy Sand Castings.
- 3. B209: Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- 4. B211: Specification for Aluminum-Alloy Bars, Rods, Profiles and Tubes.
- 5. B221: Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.
- 6. B247: Specification for Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings and Rolled Ring Forgings.
- 7. B429: Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.

- C. American Welding Society (AWS):

- 1. A2.4: Standard Symbols for Welding, Brazing, and Nondestructive Examination.
- 2. D1.1: Structural Welding Code - Steel.

- D. International Building Code (IBC) 2015.

- E. Occupational Safety and Health Administration (OSHA):

- 1. 29 CFR, Part 1910, Occupational Safety and Health Standards.

1.03 DESIGN CRITERIA:

- A. Stairs shall conform to IBC and OSHA where shown. Ladders shall conform to OSHA.

- B. Stairs shall be designed to withstand a minimum uniform live load of 100 psf (4.8 kPa) or a concentrated live load of 300 pounds (1.3 kN) applied on an area of 4 square inches (2,500 square millimeters) at any point along the element.

- C. Vertical ladders shall be designed to withstand a minimum of two loads of 250 pounds (1.1 kN) each, concentrated between any two consecutive attachments. The number and spacing of additional loads shall be in accordance with the anticipated usage of the ladder. Individual steps or rungs shall be designed to support a load of 250 pounds (1.1 kN) applied at any point.

1.04 SUBMITTALS:

- A. Submit the following shop drawings in accordance with Section 01 33 00.
 - 1. Shop drawings showing clearly the location, size and details of all members
 - 2. Indicate materials, dimensions, connection attachments, anchorage, size and type of fasteners, holes, finishes, and accessories for aluminum stairs and ladders.
 - 3. Reference materials of construction by ASTM designation and grade.
 - 4. Indicate welds including length and size of all shop and field welds by symbols conforming to AWS standards.
 - 5. Letter certifying that stairs and ladders are designed and detailed to meet the requirements of standards, building codes, specifications and design criteria herein described.
- B. Product Data:
 - 1. Manufacturer's catalog sheets on pre-manufactured items.
 - 2. Manufacturer's specifications, load tables, anchor details, and installation details.

1.05 QUALITY ASSURANCE:

- A. Comply with the requirements specified in Section 01 43 00.
- B. Obtain field measurements and elevations prior to preparation of shop drawings and fabrication.
- C. Welding Qualification and Certification:
 - 1. Furnish written welding procedure for all welds in conformance with AWS Structural Welding Code.
 - 2. Use welders, tackers and welding operators certified by test to perform type of work required in conformance with AWS Structural Welding Code. Maintain current test records certified by an independent testing laboratory.
 - 3. Maintain duplicate qualification and certification records at the job site readily available for examination.

1.06 DELIVERY, STORAGE AND HANDLING:

- A. Comply with the requirements specified in Section 01 66 10
- B. Identify and match-mark materials, items and fabrications, for installation and field assembly.
- C. Deliver items to jobsite as complete units, wherever practicable, ready for installation or erection, with anchors, hangers, fasteners and miscellaneous metal items required for installation.
- D. Carefully handle and store materials, protected from weather, corrosion and other damage.
- E. Store off the ground on suitable supports.
- F. Accept material on site. Inspect for damage.
- G. Do not incorporate damaged material in the work.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Aluminum materials and welding electrodes per Section 05 50 00.
- B. Aluminum plates, shapes, pipe and castings shall conform to the following ASTM specifications, alloy and temper designations.
 - 1. Extruded structural shapes, bars and tubes: ASTM B221 Alloy 6061-T6.
 - 2. Extruded structural tube or pipe: ASTM B429 Alloy 6061-T6.
 - 3. Sheet and plate: ASTM B209 Alloy 6061-T6.
 - 4. Die and hand forgings: ASTM B247 Alloy 6061-T6.
 - 5. Castings: ASTM B26.
 - 6. Bolts, washers and nuts: Type 304 stainless steel.
 - 7. Gratings (bearing bars): ASTM B211 Alloy 6061-T6 (connecting bars): ASTM B211 Alloy 6061-T5.
- C. Welding:
 - 1. Provide filler materials appropriate for the alloys and tempers in accordance with the AWS Structural Welding Code.
 - 2. Provide Class 4043 electrodes.
- D. Handrails and Railings per Section 05 52 15.

2.02 FABRICATION:

- A. General:
 - 1. Fabricate true to shape, size and tolerances as indicated and specified.
 - 2. Straighten work bent by shearing or punching.
 - 3. Dress exposed edges and ends of metal smooth, with no sharp edges and with corners slightly rounded.
 - 4. Provide sufficient quantity and size of anchors for the proper fastening of the work.
 - 5. Fabricate details and connection assemblies in accordance with drawings, with projecting corners clipped and filler pieces welded flush.
 - 6. Provide clips, lugs, brackets, straps, plates, bolts, nuts, washers, and similar items, as required for fabrication and erection.
 - 7. Use connections of type and design required by forces to be resisted, and to provide secure fastening.
 - 8. Fit work together in fabrication shop and deliver complete, or in parts, ready to be set in place.
- B. Welding:
 - 1. Grind exposed edges of welds to a 1/8 inch minimum radius. Grind burrs, jagged edges and surface defects smooth.
 - 2. Prepare welds and adjacent areas such that there is no undercutting or reverse ridges on the weld bead and no sharp peaks or ridges along the weld bead.
 - 3. Grind embedded pieces of electrode or wire flush with adjacent surface of weld bead.

C. Bolting:

1. Provide stainless steel stud bolts and nuts with heavy aluminum washers for fastening aluminum material.
2. Provide holes required for the connection of adjacent or adjoining work wherever noted on drawings. Locate holes for bolting to supports to a tolerance of 1/16-inch of exact dimensions indicated.

2.03 ALUMINUM STAIRS:

A. Provide aluminum stairs fabricated from structural aluminum channel stringers, aluminum pipe rails and aluminum treads.

B. Rectangular Bar Grating Treads:

1. Provide stair treads of the same type and bar spacing as grating specified.
2. Provide serrated top surface of bearing bars.
3. Provide minimum 3 inch by 3/16 inch (75 mm by 5 mm) carrier end plates welded to stair treads and punched for bolting to stringers.
4. Provide 1-1/4 inch (30 mm) abrasive nosings.
5. Manufacturers:
 - a. IKG Borden Metal Products Co.; Type B.
 - b. Ohio Gratings, Inc.; Type SG Series.
 - c. McNichols Co.; Type A.

2.04 VERTICAL LADDERS:

A. Fabricate ladders as shown in the contract drawings.

B. Minimum diameter of rungs shall be 3/4-inch (20 mm). The distance between rungs, cleats, and steps shall not exceed 12 inches (305 mm) and shall be uniform throughout the length of the ladder.

C. The minimum clear length of rungs or cleats shall be 16 inches (405 mm).

D. Coat rungs with coarse grain nonskid epoxy coating. Color of coating shall be yellow. Apply nonskid coating per manufacturer's recommendations.

2.05 SAFETY CLIMB FOR VERTICAL LADDERS:

A. Ladder Safety Post

1. Install aluminum ladder safety post on fixed ladders below hatch cover and design with a telescoping tubular section that locks automatically when fully extended. Completely assemble the unit with fasteners for securing to the ladder rungs in accordance with the manufacturer's instructions. Ladder safety post shall be steel, hot-dipped galvanized Model LU-2 as manufactured by the Bilco Company or acceptable equivalent product.

PART 3 - EXECUTION

3.01 GENERAL:

- A. Set and secure in place as indicated. Where bolted connections are used, draw together and draw nuts tightly. Use bolts of lengths required so that they do not project more than 1/4-inch (6 mm) beyond face of nut. Do not use washers unless specified. Provide hexagonal head bolts with hexagonal nuts.
- B. Locate anchors and anchor bolts and build into connecting work.
- C. Install stairs and ladders in accordance with accepted shop drawings.

3.02 STAIRS:

- A. Provide structural aluminum angles, struts, rod hangers, closure plates, and brackets indicated.

3.03 LADDERS:

- A. Anchor uprights to wall with angles or bent plates welded to uprights and anchored to wall. Grind welds smooth where required. Provide assemblies with no sharp or rough surface.
- B. Secure interior ladders to floor slabs with floor flanges.
- C. Provide structural aluminum angles, struts, rod hangers, closure plates, and brackets indicated.

3.04 CORROSION PROTECTION FOR ALUMINUM SURFACES:

- A. Coat aluminum surfaces to be embedded or which will be in contact with concrete or masonry per Section 09 47 00.
- B. Where aluminum surfaces come in contact with dissimilar metals, keep the dissimilar metallic surfaces from direct contact by use of neoprene gaskets or washers.

3.05 CLOSEOUT ACTIVITIES:

- A. Provide in accordance with Section 01 77 00.

END OF SECTION

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SECTION 05 52 15

ALUMINUM HANDRAILS AND RAILINGS

PART 1 GENERAL

1.01 SYSTEM DESCRIPTION

A. Design Requirements:

1. Design railing system to resist load specified in latest edition of Wisconsin Administrative Code and OSHA.

1.02 SUBMITTALS

A. Shop Drawings:

1. Plan showing layout including splices, attachments, and mounting.
2. Identify location and type indicated.
3. Indicate railings in related and dimensional position with scale elevations.

B. Product Data:

1. Manufacturer's literature.
2. Assembly and installation instructions.

C. Test Results (if requested by ENGINEER):

1. Test data showing load, and deflection due to load, in enough detail to prove handrail system satisfies design requirements.
2. Test data on base connections of types required for Project.
3. Engineering calculations that include transfer of forces from base of railing post, through base connection assembly, into supporting structure.

D. Operation and Maintenance (O&M) Data:

1. Manufacturer's recommendations describing procedures for maintaining including cleaning materials, application methods, and precautions as to use of materials which may be detrimental to finish when improperly applied.

E. Submit in accordance with Section 01 33 10.

1.03 QUALITY ASSURANCE

- A. Handrails provided shall be end products of one manufacturer to achieve standardization for appearance, maintenance, and replacement.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, and handle components in manner preventing damage to finished surfaces.
 - 1. Pack tubes and elbows in individual plastic shrink film to protect finish. Do not remove until after installation.
- B. Storage of Materials:
 - 1. Store components in dry, clean location, away from uncured concrete and masonry.
 - 2. Cover with waterproof paper, tarpaulin or polyethylene sheeting.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Thompson Fabricating, LLC.
- B. Alumaguard.
- C. Hollaender Manufacturing Company.
- D. R&B Wagner, Inc.

2.02 MATERIALS

- A. Aluminum alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than strength and durability properties of alloy and temper designated below for each aluminum form required.
 - 1. Extruded Structural Pipe and Tube: ASTM B429, alloy 6063-T6, Schedule 40, 1-1/2 in. IPS (1.90 in. OD, 0.145 in. wall thickness).
 - 2. Plate and Sheet: ASTM B209 (ASTM B209M), alloy 6061-T6.
 - 3. Die and Hand Forgings: ASTM B247 (ASTM B247M), alloy 6061-T6.
- B. Fittings:
 - 1. Fabricate from material similar to railings.
 - 2. Elbows, flanges, sleeves, brackets, and similar items shall be riveted, set screw, bolted, or welded.
 - 3. Connections shall be continuous diameter type for smooth appearance and to permit continuous sliding of hands.
- C. Extensions:
 - 1. Open handrail extensions shall be constructed and secured to vertical posts to comply with code loading requirements.
 - 2. For wall mounted handrails, cantilevered extensions not permitted. Provide handrail wall fastener at end of handrail.

- D. Chains: 3/16 in. minimum stainless steel link chain with spring actuated stainless steel clasp capable of withstanding code required horizontal force (250 lb. minimum).
- E. Toe Plate: 1/4 in. thick by 4 in. high, flat aluminum, alloy 6063-T6, or “S” type aluminum plate, with clamp-on type connection.

2.03 FINISHES

- A. Aluminum Association Finish Designation: AA-M12A41 (Mechanical finish, non-specular, anodic coating, architectural Class I, clear coating 0.7 mil complying with AAMA 607.1 on exposed surfaces.
 - 1. Extruded Components: 0.7 mil anodized.
 - 2. Cast Components: 0.4 mil anodized.

2.04 FASTENINGS

- A. Mechanical Fasteners: Stainless steel.

2.05 FABRICATION

- A. Field-verify dimensions before fabrication.
- B. Form connections and changes in rail direction by using prefabricated fittings or radius bends.
- C. Remove burrs from exposed cut edges.
- D. Form elbow bends and wall returns to uniform radius, free from buckles and twists, with smooth finished surfaces or use prefabricated bends.
- E. Locate intermediate rails between top rail and finish floor as indicated on Drawings.
- F. Space posts not more than 5 ft oc.
- G. Provide base flange for posts.
- H. Fabricate joints which will be exposed to weather to exclude water or provide weep holes where water may accumulate.
- I. Provide removable sections where shown on drawings.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install per manufacturer’s requirements.
- B. Set posts plumb and aligned in each direction to within 1/8 in. in 12 ft.
- C. Set rails horizontal or parallel to rake of steps to within 1/8 in. in 12 ft.

- D. Assemble and install in accordance with manufacturer's written instructions.
- E. Support wall rails on brackets, spaced not more than 5 ft oc and at each end of rail. Cantilevered extensions not allowed.
- F. Install safety chains where shown. Number of chains shall match number of horizontal rails. Chain drape shall not exceed 3 in.
- G. Provide toe board or plate except on stairs and where concrete curb provided. Install with bottom not more than 1/4 in. above walking surface. Match expansion joint location to railing joint location.
- H. Railings shall be continuous, without gaps, for entire length of stair.

3.02 CLEANING

- A. Wash thoroughly using clean water and soap, rinse with clean water.
- B. Do not use acid solution, steel wool or other harsh abrasive.
- C. If stain remains after washing, remove finish, and restore in accordance with manufacturer's recommendations.

3.03 FIELD QUALITY CONTROL

- A. Remove stained or otherwise defective Work and replace with material meeting Specifications.

END OF SECTION

SECTION 05 53 00

METAL GRATING AND ACCESS HATCHES

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. Provide metal grating and access hatches as indicated and in compliance with Contract Documents.
- B. This section includes:
 - 1. Aluminum Bar Grating.
 - 2. Access Hatches.
- C. Furnish all labor, materials, equipment and incidentals necessary to install the products specified.

1.02 REFERENCES:

- A. ASTM International (ASTM):
 - 1. A307: Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
 - 2. A325: Structural Bolts, Steel, Heat Treated 120/105 ksi Minimum Tensile Strength.
 - 3. A1554: Standard Specification for Anchor Bolts, Steel, 36, 55 and 105-ksi Yield Strength
 - 4. B26: Specification for Aluminum-Alloy Sand Castings.
 - 5. B209: Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - 6. B221: Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.
 - 7. B247: Specification for Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings and Rolled Ring Forgings.
- B. American Welding Society (AWS):
 - 1. D1.2: Structural Welding Code - Aluminum.
- C. National Association of Architectural Metal Manufacturers (NAAMM):
 - 1. MBG 531: Metal Bar Grating Manual.
 - 2. MBG 533: Welding Specifications for Fabrication of Steel, Aluminum and Stainless Bar Grating.
- D. Aluminum Association:
 - 1. Aluminum Association Designation System for Aluminum Finishes
 - 2. AAMA 607.1: Voluntary Guide Specification and Inspection Methods for Clear Anodic Finishes for Architectural Aluminum

1.03 DESIGN CRITERIA:

A. Grating

1. Provide grating of minimum depth shown on contract drawings, not exceeding manufacturer's maximum recommended span, and meeting the following load and deflection criteria.
 - a. 100 psf (4.8 kPa) uniform live load or 300 pounds (14.4 kPa) concentrated live load, whichever produces maximum stress].
 - b. L/360 maximum deflection under uniform live load of 100 psf (4.8 kPa).
 - c. 12,000 psi (82.7 MPa) maximum flexural stress.

1.04 SUBMITTALS:

A. Submit the following shop drawings in accordance with Section 01 33 00.

1. Detail shop drawings indicating:
 - a. Dimensions.
 - b. Sectional assembly.
 - c. Location and identification mark.
 - d. Connections and fastening methods.
 - e. Size and location of supporting frames required.
 - f. Materials of construction.
 - g. Installation instructions.
2. Catalog data and design tables showing limits for span length and deflection under load.

1.05 QUALITY ASSURANCE:

- A. Comply with the requirements specified in Section 01 43 00.
- B. Obtain field measurements prior to preparation of shop drawings and fabrication.
- C. Aluminum:
 1. Weld with gas metal arc (GMA) or gas tungsten arc (GTA) processes in accordance with manufacturer's recommendations as accepted and in accordance with recommendations of AWS D1.2.

1.06 DELIVERY STORAGE AND HANDLING:

- A. Comply with the requirements specified in Section 01 66 10.
- B. Store to avoid damage.
- C. Remove material that has become damaged as to be unfit for use.
- D. Identify and match-mark all materials, items, and fabrications for installation and field assembly.

1.07 FIELD MEASUREMENTS:

- A. Verify dimensions and make any field measurements necessary and be fully responsible for accuracy and layout of the work.
- B. Review the Contract Drawings and report any discrepancies to the Engineer for clarification prior to starting fabrication.

PART 2 - PRODUCTS

2.01 ALUMINUM BAR GRATING:

- A. Manufacturers:
 - 1. Basis of Design: McNichols Close Mesh ADA grating model GCM-1-150 or GCM-4-150 or equivalent product as manufactured by one of the following manufacturers:
 - a. IKG Borden Metal Products Co.
 - b. Ohio Gratings, Inc.
- B. Provide aluminum alloy 6063-T6 grating material.
- C. Bearing bar height: 1 1/2".
- D. Provide 3/16-inch (5 mm) thick bearing bars spaced 7/16" or 11/16" center to center with cross bars pressure locked on 4 inch (102 mm) centers.
- E. Fabricate in standard size sections where possible with a maximum panel weight of no more than 80 pounds (0.4 kN).
- F. Apply bearing bar banding at ends of grating sections and at fixture or pipe openings where two or more bearing bars are cut.
- G. Anchor grating to support members using stainless steel clips.
- H. Provide top surface with mill finish.

2.02 FLOOR ACCESS HATCHES (ROOF HATCHES)

- A. Manufacturer:
 - 1. Bilco Company. Model: Ladder Access in custom size as scheduled on Drawings.
- B. Roof hatches shall match existing hatches that are being removed and consist of the following: a 12-inch-high, 11 gauge insulated aluminum curb with integral cap flashing of same material and thickness; an insulated cover with 11 gauge aluminum exterior liner and 18 gauge aluminum interior liner; hinges, compression spring operators, latches, and other associated hardware. All hardware should be stainless steel. Provide fully enclosed curb with custom apron to match existing hatches that are being removed.
 - 1. Hatch to be fully gasketed.

- C. Provide Bilco Ladder-Up safety post Model LU4 designed with a telescoping section that locks automatically when fully extended.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Upon receipt of material at job site, inspect all materials for shipping damage. Damaged items shall be replaced at no cost to Owner.
- B. Examine supports for size, layout and alignment. Surface shall be free of debris.
- C. Correct defects considered detrimental to proper installation.

3.02 PROTECTION:

- A. Protect aluminum from contact with dissimilar metals, concrete, masonry or mortar. Paint aluminum in contact with concrete in accordance Section 09 96 10. Under no circumstances shall aluminum contact concrete or dissimilar metal.
- B. Apply one coat of bituminous paint coating.
- C. Before coating application, clean contact surfaces, remove dirt, grease, oil, foreign substances, followed by immersing in, or wipe thoroughly with, an acceptable solvent. Rinse with clean hot water and dry thoroughly.

3.03 INSTALLATION:

- A. Install and make connections in accordance with accepted submittals and manufacturer's written instructions.
- B. Install grating with direction of bearing bars perpendicular to dominant direction of travel.
- C. Install materials accurately in location and elevation, level and plumb. Field fabricate as necessary for accurate fit.
- D. Coordinate and furnish anchorages, including concrete inserts, sleeves, anchor bolts, and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction.

3.04 CLOSEOUT ACTIVITIES:

- A. Provide in accordance with Section 01 77 00.

END OF SECTION

DIVISION 6
WOOD, PLASTICS, COMPOSITES

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SECTION 06 10 00
ROUGH CARPENTRY

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. Provide materials to perform the rough carpentry work as indicated and in compliance with Contract Documents.

- 1. Section Includes:

- a. Wood blocking, cants, and nailers.

1.02 DEFINITIONS:

- A. Exposed Framing: Framing not concealed by other construction.
- B. Dimension Lumber: Lumber of 2 inches (50 mm) nominal (38 mm actual) or greater but less than 5 inches (125 mm) nominal (114 mm actual) in least dimension.
- C. Timber: Lumber of 5 inches (125 mm) nominal (114 mm actual) or greater in least dimension.
- D. Lumber grading agencies, and the abbreviations used to reference them, include the following:
 - 1. NeLMA: Northeastern Lumber Manufacturers' Association.
 - 2. NLGA: National Lumber Grades Authority.
 - 3. RIS: Redwood Inspection Service.
 - 4. SPIB: The Southern Pine Inspection Bureau.
 - 5. WCLIB: West Coast Lumber Inspection Bureau.
 - 6. WWPA: Western Wood Products Association.

1.03 QUALITY ASSURANCE:

- A. Comply with the requirements specified in Section 01 43 00.
- B. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.04 DELIVERY STORAGE AND HANDLING:

- A. Comply with the requirements specified in Section 01 66 10.

- B. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.01 WOOD PRODUCTS, GENERAL:

- A. Certified Wood: Materials shall be produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship:
 - 1. Miscellaneous lumber.
- B. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
 - 2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
 - 3. Provide dressed lumber, S4S, unless otherwise indicated.
- C. Maximum Moisture Content of Lumber: 15 percent.

2.02 WOOD-PRESERVATIVE-TREATED LUMBER:

- A. Preservative Treatment by Pressure Process: AWWPA U1; Use Category
 - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
 - 1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece.
- D. Application: Treat items indicated on Drawings, and the following:
 - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.

2. Wood sills, sleepers, blocking, and similar concealed members in contact with masonry or concrete.

2.03 MISCELLANEOUS LUMBER:

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Rooftop equipment bases and support curbs.
4. Cants.
5. Furring.
6. Grounds.
7. Utility shelving.

- B. For items of dimension lumber size, provide Construction or No. 2 grade lumber of the following species:

1. Hem-fir (north); NLGA.
2. Mixed southern pine; SPIB.
3. Spruce-pine-fir; NLGA.
4. Hem-fir; WCLIB or WWPA.
5. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
6. Western woods; WCLIB or WWPA.
7. Northern species; NLGA.
8. Eastern softwoods; NeLMA.

2.04 FASTENERS:

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.

- B. Nails, Brads, and Staples: ASTM F1667.

- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).
- F. Bolts: Steel bolts complying with ASTM A307, Grade A (ASTM F568M, Property Class 4.6); with ASTM A563 (ASTM A563M) hex nuts and, where indicated, flat washers.
- G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry assemblies and equal to four times the load imposed when installed in concrete as determined by testing per ASTM E488 conducted by a qualified independent testing and inspecting agency.
- H. Material: Carbon-steel components, zinc plated to comply with ASTM B633, Class Fe/Zn 5.
 - 1. Material: Stainless steel with bolts and nuts complying with ASTM F593 and ASTM F594, Alloy Group 1 or 2 (ASTM F738M and ASTM F836M, Grade A1 or A4).

2.05 METAL FRAMING ANCHORS:

- A. Manufacturers:
 - 1. Cleveland Steel Specialty Co.
 - 2. KC Metals Products, Inc.
 - 3. Phoenix Metal Products, Inc.
 - 4. Simpson Strong-Tie Co., Inc.
 - 5. USP Structural Connectors.
- B. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.
- C. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A653/A653M, G60 (Z180) coating designation.
 - 1. Use for interior locations unless otherwise indicated.
- D. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A653/A653M; structural steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 (Z550) coating designation; and not less than 0.036 inch (0.9 mm) thick.
 - 1. Use for wood-preservative-treated lumber and where indicated.

2.06 MISCELLANEOUS MATERIALS:

- A. Sill-Sealer Gaskets: Glass-fiber-resilient insulation, fabricated in strip form, for use as a sill sealer; 1-inch (25-mm) nominal thickness, compressible to 1/32-inch (0.8 mm); selected from manufacturer's standard widths to suit width of sill members indicated.
- B. Sill-Sealer Gaskets: Closed-cell neoprene foam, 1/4-inch (6.4 mm) thick, selected from manufacturer's standard widths to suit width of sill members indicated.
- C. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch (0.6 mm).
- D. Water-Repellent Preservative: NWWDA-tested and -accepted formulation containing 3-iodo-2-propynyl butyl carbamate, combined with an insecticide containing chlorpyrifos as its active ingredient.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL:

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
- B. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- C. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
 - 1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches (406 mm) o.c.
- D. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- E. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
 - 1. Use inorganic boron for items that are continuously protected from liquid water.
 - 2. Use copper naphthenate for items not continuously protected from liquid water.
- F. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. NES NER-272 for power-driven fasteners.
 2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
 3. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
- G. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.02 WOOD BLOCKING, AND NAILER INSTALLATION:

- A. Install where indicated and where required for screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.
- C. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- D. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches (38 mm) wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.03 CONTRACT CLOSEOUT:

- A. Provide in accordance with Section 01 77 00.

END OF SECTION

DIVISION 7
THERMAL AND MOISTURE PROTECTION

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SECTION 07 21 00
BUILDING INSULATION

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide building insulation as indicated and in compliance with Contract Documents:

1. Section Includes:

- a. Foam-plastic board insulation.
- b. Glass-fiber blanket insulation.

1.02 DEFINITIONS:

A. Thermal Resistivity: Where the thermal resistivity of insulation products is designated by "r values," they represent the reciprocal of thermal conductivity (k values). Thermal conductivity is the rate of heat flow through a homogenous material exactly 1 inch thick. Thermal resistivities are expressed by the temperature difference in degrees F between the two exposed faces required to cause one BTU to flow through one square foot per hour at mean temperatures indicated.

1.03 SUBMITTALS:

A. Submit the following shop drawings in accordance with Section 01 33 00.

1. Product Data: For each type of product indicated.

1.04 QUALITY ASSURANCE:

A. Comply with the requirements specified in Section 01 43 00.

B. Sustainability Standards Certifications.

C. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

D. Fire Performance Characteristics: Provide insulation materials that meet the following:

- 1. Surface Burning Characteristic: ASTM E84.
- 2. Fire Resistance Ratings: ASTM E119.
- 3. Combustion Characteristics: ASTM E136.

- E. Single Source Responsibility for Insulation Products: Obtain each type of building insulation from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.

1.05 DELIVERY STORAGE AND HANDLING:

- A. Comply with the requirements specified in Section 01 66 10.
- B. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- C. Protect foam-plastic board insulation as follows:
 - 1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
 - 2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site before installation time.
 - 3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.01 FOAM-PLASTIC BOARD INSULATION:

- A. Foil-Faced, Polyisocyanurate Board Insulation: ASTM C1289, Type I, Class 1 or Class 2, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84.
 - 1. Manufacturers:
 - a. Atlas Roofing Corporation.
 - b. Dow Chemical Company (The).
 - c. Rmax, Inc.
- B. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

2.02 GLASS-FIBER BLANKET INSULATION

- A. Manufacturers:
 - 1. CertainTeed Corporation.
 - 2. Guardian Building Products, Inc.
 - 3. Johns Manville.

4. Knauf Insulation.
 5. Owens Corning.
- B. Unfaced, Glass-Fiber Blanket Insulation: ASTM C665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E84; passing ASTM E136 for combustion characteristics.
- C. Sustainability Requirements: Provide glass-fiber blanket insulation as follows:
1. Free of Formaldehyde: Insulation manufactured with 100 percent acrylic binders and no formaldehyde.
 2. Low Emitting: Insulation tested according to ASTM D5116 and shown to emit less than 0.05-ppm formaldehyde.

PART 3 - EXECUTION

3.01 PREPARATION:

- A. Clean substrates of substances that are harmful to insulation or vapor retarders, including removing projections capable of puncturing vapor retarders, or that interfere with insulation attachment.

3.02 INSTALLATION, GENERAL:

- A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.03 INSTALLATION OF CAVITY-WALL INSULATION:

- A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches (610 mm) o.c. both ways on inside face, and as recommended by manufacturer. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions. Press units firmly against inside substrates.
1. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Division 04 Section "Unit Masonry."

3.04 PROTECTION:

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

3.05 CONTRACT CLOSEOUT:

- A. Provide in accordance with Section 01 77 00.

END OF SECTION

SECTION 07 53 00

EPDM SINGLE-PLY MEMBRANE ROOFING

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. Provide EPDM single-ply fully adhered membrane roofing as indicated and in compliance with Contract Documents:

1. Section Includes:

- a. Adhered EPDM membrane roofing system.
- b. Vapor retarder.
- c. Roof insulation.

1.02 REFERENCES:

- A. American Society of Civil Engineers (ASCE):

1. 7: Minimum Design Loads for Buildings and Other Structures - Includes Supplement No. 1

- B. ASTM International (ASTM):

1. C67: Standard Test Methods of Sampling and Testing Brick and Structural Clay Tile.
2. C140: Standard Test Methods of Sampling and Testing Concrete Masonry Units and Related Units.
3. C208: Standard Specification for Cellulosic Fiber Insulating Board
4. C552: Standard Specification for Cellular Glass Thermal Insulation.
5. C578: Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
6. C728: Standard Specification for Perlite Thermal Insulation Board
7. C1177/C1177M: Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing
8. C1278/C1278M: Standard Specification for Fiber-Reinforced Gypsum Panel
9. C1289: Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
10. C1396/C1396M: Standard Specification for Gypsum Board
11. D41: Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
12. D312: Standard Specification for Asphalt Used in Roofing
13. D448: Standard Classification for Sizes of Aggregate for Road and Bridge Construction
14. D1079: Standard Terminology Relating to Roofing and Waterproofing
15. D2178: Standard Specification for Asphalt Glass Felt Used in Roofing and Waterproofing
16. D4263: Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
17. D4397: Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications.
18. D4637: Standard Specification for EPDM Sheet Used In Single-Ply Roof Membrane.

19. D6152: Standard Specification for SEBS-Modified Mopping Asphalt Used in Roofing
20. E108: Standard Test Methods for Fire Tests of Roof Coverings
21. E119: Standard Test Methods for Fire Tests of Building Construction and Materials.
22. E1980: Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces

C. Department of Commerce (DOC):

1. PS 2: Performance Standard for Wood-Based Structural-Use Panels.

D. Factory Mutual (FM):

1. 4450: Approval Standard for Class I Insulated Steel Deck Roofs.
2. 4470: Class 1 Roof Covers

E. Single-Ply Roofing Industry (SPRI):

1. RP-4: Wind Design Standard for Single-Ply Roofing Systems

1.03 DEFINITIONS:

- A. Roofing Terminology: See ASTM D1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" for definitions of terms related to roofing work in this Section.

1.04 PERFORMANCE REQUIREMENTS:

- A. General Performance: Installed membrane roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Membrane roofing and base flashings shall remain watertight.
- B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.
- C. Roofing System Design: Provide membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE/SEI 7.
- D. Energy Performance: Provide roofing system that is listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low-slope roof products.
- E. Energy Performance: Provide roofing system with initial solar reflectance not less than 0.70 and emissivity not less than 0.75 when tested according to CRRC-1.

1.05 SUBMITTALS:

- A. Submit the following shop drawings in accordance with Section 01 33 00.
- B. Product Data: For each type of product indicated. Include data substantiating that materials comply with requirements.

- C. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Base flashings and membrane terminations.
 - 2. Tapered insulation, including slopes.
 - 3. Roof plan showing orientation of steel roof deck and orientation of membrane roofing and fastening spacings and patterns for mechanically fastened membrane roofing.
 - 4. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
 - D. Samples for Verification: For the following products, in manufacturer's standard sizes:
 - 1. Sheet roofing, of color specified, including T-shaped side and end lap seam.
 - 2. Roof insulation.
 - 3. Termination bars.
 - E. Qualification Data: For qualified Installer and manufacturer.
 - 1. Installer Certificates: Signed by roofing system manufacturer certifying that Installer is approved, authorized, or licensed by manufacturer to install specified roofing system.
 - 2. For information purposes only, submit manufacturer's printed installation instructions for the entire roof system specified.
 - 3. For firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of five (5) completed projects with project names and addresses, within the past three (3) years.
 - F. Manufacturer Certificate: Signed by roofing manufacturer certifying that membrane roofing system complies with requirements specified in "Performance Requirements" Article.
 - 1. Submit evidence of complying with performance requirements.
 - G. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for components of membrane roofing system.
 - H. Field quality-control reports.
 - I. Maintenance Data: Roofing system in accordance with the maintenance manuals specified in Section 01 78 23.
 - J. Warranty: Sample copy of standard roofing system manufacturer's warranty stating obligations, remedies, limitations, and exclusions of warranty.
 - K. Maintenance Data: For membrane roofing system to include in maintenance manuals.
- 1.06 QUALITY ASSURANCE:
- A. Comply with the requirements specified in Section 01 43 00.
 - B. Manufacturer Qualifications: A qualified manufacturer that is approved for membrane roofing system identical to that used for this Project.

- C. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by membrane roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.
- D. Source Limitations: Obtain components including for membrane roofing system approved by membrane roofing manufacturer.
- E. Exterior Fire-Test Exposure: ASTM E108, Class B; for application and roof slopes indicated, as determined by testing identical membrane roofing materials by a qualified testing agency. Materials shall be identified with appropriate markings of applicable testing agency.
- F. Fire-Resistance Ratings: Where indicated, provide fire-resistance-rated roof assemblies identical to those of assemblies tested for fire resistance per ASTM E119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- G. Preliminary Roofing Conference: Before starting roof deck construction, conduct conference at Project site.
 - 1. Meet with Owner, Engineer or Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
 - 2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
 - 3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Review requirements for deck substrate conditions and finishes, including flatness and fastening.
 - 5. Review structural loading limitations of roof deck during and after roofing.
 - 6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
 - 7. Review governing regulations and requirements for insurance and certificates if applicable.
 - 8. Review temporary protection requirements for roofing system during and after installation.
 - 9. Review roof observation and repair procedures after roofing installation.
- H. Preinstallation Roofing Conference: Conduct conference at Project site.
 - 1. Meet with Owner, Engineer or Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
 - 2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
 - 3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
 - 5. Review structural loading limitations of roof deck during and after roofing.

6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.07 DELIVERY STORAGE AND HANDLING:

- A. Comply with the requirements specified in Section 01 66 10.
- B. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, acceptance or listing agency markings, and directions for storing and mixing with other components.
- C. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
 1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- D. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- E. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.08 PROJECT/SITE CONDITIONS:

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.09 WARRANTY:

- A. Special Warranty: Manufacturer's standard or customized form, without monetary limitation, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period.
 1. Special warranty includes membrane roofing, base flashings, roof insulation, fasteners, cover boards, substrate board, roofing accessories and other components of membrane roofing system.
 2. Warranty Period: 20years from date of Substantial Completion.
- B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering Work of this Section, including all components of membrane roofing system such as membrane roofing, base flashing, roof insulation, fasteners,

cover boards, substrate boards, vapor retarders, roof pavers, and walkway products, for the following warranty period:

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 EPDM MEMBRANE ROOFING:

- A. EPDM: ASTM D4637 Type II, scrim or fabric internally reinforced, uniform, flexible EPDM sheet.
 1. Manufacturers:
 - a. Carlisle SynTec Incorporated.
 - b. Firestone Building Products.
 2. Thickness: 60 mils (1.5 mm), nominal.
 3. Exposed Face Color: Black.

2.02 AUXILIARY MEMBRANE ROOFING MATERIALS:

- A. General: Auxiliary membrane roofing materials recommended by roofing system manufacturer for intended use and compatible with membrane roofing.
 1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
 2. Adhesives and sealants that are not on the exterior side of weather barrier shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
- B. Sheet Flashing: 60-mil- (1.5 mm) thick EPDM, partially cured or cured, according to application.
- C. Protection Sheet: Epichlorohydrin or neoprene non-reinforced flexible sheet, 55- to 60-mil- (1.4 to 1.5 mm) thick, recommended by EPDM manufacturer for resistance to hydrocarbons, non-aromatic solvents, grease, and oil.
- D. Bonding Adhesive: Manufacturer's standard.
- E. Seaming Material: Manufacturer's standard.
- F. Lap Sealant: Manufacturer's standard, single-component sealant.
- G. Water Cutoff Mastic: Manufacturer's standard butyl mastic sealant.
- H. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 x 1/8-inch (25 x 3 mm) thick; with anchors.

- I. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening membrane to substrate, and acceptable to roofing system manufacturer.
 - J. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, reinforced EPDM securement strips, T-joint covers, in-seam sealants, termination reglets, cover strips, and other accessories.
- 2.03 SUBSTRATE BOARDS:
- A. Substrate Board: ASTM C1278/C1278M, cellulosic-fiber-reinforced, water-resistant gypsum substrate, 1/2-inch (13 mm) thick.
 - 1. Products:
 - a. USG Corporation; Securock.
 - B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate panel to roof deck.
- 2.04 VAPOR RETARDER:
- A. Laminated Sheet: Kraft paper, two layers, laminated with asphalt and edge reinforced with woven fiberglass yarn with maximum permeance rating of 0.50 perm (29 ng/Pa x s x sq. m) and with manufacturer's standard adhesive.
- 2.05 ROOF INSULATION:
- A. General: Preformed roof insulation boards manufactured or approved by EPDM membrane roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated[and that produce FM Approvals-approved roof insulation.
 - B. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 1, Grade 2(NTS):
 - C. Composite Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 1, Grade 2 with factory-applied facing board on one major surface, as indicated below by type, and felt or glass-fiber mat facer on the other.
 - 1. Type IV, cellulosic-fiber-insulation-board facer, Grade 2, 1/2-inch (13 mm) thick.
 - 2. Type V, OSB facer, 7/16-inch (11 mm) thick.
 - 3. Type VII, glass mat faced gypsum board facer, 1/4-inch (6 mm) thick.
 - D. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4-inch per 12 inches (1:48) unless otherwise indicated.
 - E. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.
- 2.06 INSULATION ACCESSORIES:
- A. General: Furnish roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with membrane roofing.

- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.
- C. Modified Asphaltic Insulation Adhesive: Insulation manufacturer's recommended modified asphalt, asbestos-free, cold-applied adhesive formulated to attach roof insulation to substrate or to another insulation layer.
- D. Bead-Applied Insulation Adhesive: Insulation manufacturer's recommended bead-applied, low-rise, one- or multicomponent urethane adhesive formulated to attach roof insulation to substrate or to another insulation layer.
- E. Full-Spread Applied Insulation Adhesive: Insulation manufacturer's recommended spray-applied, low-rise, two-component urethane adhesive formulated to attach roof insulation to substrate or to another insulation layer.
- F. Cover Board: DOC PS 2, Exposure 1, OSB, 7/16-inch (11 mm) thick.
- G. Protection Mat: Woven or nonwoven polypropylene, polyolefin, or polyester fabric, water permeable and resistant to UV degradation, type and weight as recommended by roofing system manufacturer for application.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:
 1. Verify that roof openings and penetrations are in place and curbs are set and braced and that roof drain bodies are securely clamped in place.
 2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
 3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Division 05 Section "Steel Decking."
 4. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
 5. Verify that concrete substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D4263.
 6. Verify that concrete curing compounds that will impair adhesion of roofing components to roof deck have been removed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION:

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.

- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.
- C. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.
- D. Install acoustical roof deck rib insulation strips, specified in Division 05 Section "Steel Decking," according to acoustical roof deck manufacturer's written instructions, immediately before installation of overlying construction and to remain dry.

3.03 SUBSTRATE BOARD:

- A. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.

3.04 VAPOR-RETARDER INSTALLATION:

- A. Laminate Sheet: Install laminate-sheet vapor retarder in a single layer over area to receive vapor retarder, side and end lapping each sheet a minimum of 2 inches (50 mm) and 6 inches (150 mm), respectively. Bond vapor retarder to substrate as follows:
 1. Apply adhesive at rate recommended by vapor-retarder manufacturer. Seal laps with adhesive.
 2. Apply ribbons of hot roofing asphalt at spacing, temperature, and rate recommended by vapor-retarder manufacturer. Seal laps with hot roofing asphalt.
- B. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into membrane roofing system.

3.05 INSULATION INSTALLATION:

- A. Coordinate installing membrane roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.
- B. Comply with membrane roofing system and insulation manufacturer's written instructions for installing roof insulation.
- C. Install tapered insulation under area of roofing to conform to slopes indicated.
- D. Install insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2.7 inches (68 mm) or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches (150 mm) in each direction.
 1. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.

- E. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.
- F. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4-inch (6 mm) with insulation.
 - 1. Cut and fit insulation within 1/4-inch (6 mm) of nailers, projections, and penetrations.
- G. Adhered Insulation: Install each layer of insulation and adhere to substrate as follows:
 - 1. Prime surface of concrete deck with asphalt primer at rate of 3/4 gal./100 sq. ft. (0.3 L/sq. m) and allow primer to dry.
 - 2. Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 degrees F (14 degrees C) of equi viscous temperature.
 - 3. Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
 - 4. Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.
- H. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches (150 mm) in each direction. Loosely butt cover boards
 - 1. Fasten cover boards according to requirements in FM Approvals' "RoofNav" for specified Windstorm Resistance Classification.
 - 2. Fasten cover boards to resist uplift pressure at corners, perimeter, and field of roof.

3.06 ADHERED MEMBRANE ROOFING INSTALLATION:

- A. Adhere membrane roofing over area to receive roofing according to membrane roofing system manufacturer's written instructions. Unroll membrane roofing and allow to relax before installing.
- B. Start installation of membrane roofing in presence of membrane roofing system manufacturer's technical personnel.
- C. Accurately align membrane roofing and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- D. Bonding Adhesive: Apply to substrate and underside of membrane roofing at rate required by manufacturer and allow to partially dry before installing membrane roofing. Do not apply to splice area of membrane roofing.
- E. Hot Roofing Asphalt: Apply a solid mopping of hot roofing asphalt to substrate at temperature and rate required by manufacturer and install fabric-backed membrane roofing. Do not apply to splice area of membrane roofing.
- F. Fabric-Backed Membrane Adhesive: Apply to substrate at rate required by manufacturer and install fabric-backed membrane roofing.

- G. In addition to adhering, mechanically fasten membrane roofing securely at terminations, penetrations, and perimeters.
- H. Apply membrane roofing with side laps shingled with slope of roof deck where possible.
- I. Adhesive Seam Installation: Clean both faces of splice areas, apply splicing cement, and firmly roll side and end laps of overlapping membrane roofing according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of membrane roofing terminations.
 - 1. Apply a continuous bead of in-seam sealant before closing splice if required by membrane roofing system manufacturer.
- J. Tape Seam Installation: Clean and prime both faces of splice areas, apply splice tape, and firmly roll side and end laps of overlapping membrane roofing according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of membrane roofing terminations.
- K. Repair tears, voids, and lapped seams in roofing that does not comply with requirements.
- L. Spread sealant or mastic bed over deck drain flange at roof drains and securely seal membrane roofing in place with clamping ring.
- M. Adhere protection sheet over membrane roofing at locations indicated.

3.07 BASE FLASHING INSTALLATION:

- A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
- D. Clean splice areas, apply splicing cement, and firmly roll side and end laps of overlapping sheets to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet flashing terminations.
- E. Terminate and seal top of sheet flashings [.

3.08 FIELD QUALITY CONTROL:

- A. Testing Agency: Engage a qualified independent testing agency to perform inspections.
- B. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.
- C. Repair or remove and replace components of membrane roofing system where inspections indicate that they do not comply with specified requirements.

- D. Additional inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.09 PROTECTING AND CLEANING:

- A. Protect membrane roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Engineer and Owner.
- B. Correct deficiencies in or remove membrane roofing system that does not comply with requirements, repair substrates and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.10 ROOFING INSTALLER'S WARRANTY:

- A. WHEREAS []<Insert name> of []<Insert address>, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:
 - 1. Owner: []<Insert name of Owner>.
 - 2. Address: []<Insert address>.
 - 3. Building Name/Type: []<Insert information>.
 - 4. Address: []<Insert address>.
 - 5. Area of Work: []<Insert information>.
 - 6. Acceptance Date: []<Insert date>.
 - 7. Warranty Period: []<Insert time>.
 - 8. Expiration Date: []<Insert date>.
- B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,
- C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period he will, at his own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.
- D. This Warranty is made subject to the following terms and conditions:
 - 1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:
 - a. Lightning;
 - b. Peak gust wind speed exceeding []<Insert wind speed> mph (minute/second);
 - c. Fire;
 - d. Failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;

- e. Faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
 - f. Vapor condensation on bottom of roofing; and
 - g. Activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.
2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
 3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.
 4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.
 5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.
 6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.
 7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this []<Insert day> day of []<Insert month>, []<Insert year>.

1. Authorized Signature: []<Insert signature>.
2. Name: []<Insert name>.
3. Title: []<Insert title>.

3.11 CLOSEOUT ACTIVITIES:

- A. Provide in accordance with Section 01 77 00.

END OF SECTION

SECTION 07 60 00

SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide sheet wall flashing and trim as indicated and in compliance with Contract Documents.

1. Section Includes:

a. Manufactured Products:

- (1) Manufactured through-wall flashing and counterflashing.
- (2) Manufactured roof edge flashing

1.02 PERFORMANCE REQUIREMENTS:

A. General: Sheet metal flashing and trim assemblies as indicated shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

B. Fabricate and install roof edge flashing and copings capable of resisting the following forces according to recommendations in FMG Loss Prevention Data Sheet 1-49:

1. See structural notes drawing.

C. Thermal Movements: Provide sheet metal flashing and trim that allows for thermal movements from ambient and surface temperature changes.

1. Temperature Change (Range): 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C), material surfaces.

1.03 SUBMITTALS:

A. Submit the following shop drawings in accordance with Section 01 33 00.

B. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.

C. Shop Drawings: Show fabrication and installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work. Include the following:

1. Identification of material, thickness, weight, and finish for each item and location in Project.
2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.

3. Details for joining, supporting, and securing sheet metal flashing and trim, including layout of fasteners, cleats, clips, and other attachments. Include pattern of seams.
4. Details of termination points and assemblies, including fixed points.
5. Details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction.
6. Details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
7. Details of special conditions.
8. Details of connections to adjoining work.

D. Warranty: Sample of special warranty.

E. Maintenance Data: For sheet metal flashing, trim, and accessories to include in maintenance manuals.

1.04 QUALITY ASSURANCE:

A. Comply with the requirements specified in Section 01 43 00.

B. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.

1. Review methods and procedures related to sheet metal flashing and trim.
2. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
3. Review special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect sheet metal flashing.
4. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.05 DELIVERY STORAGE AND HANDLING:

A. Comply with the requirements specified in Section 01 66 10.

B. Deliver sheet metal flashing materials and fabrications undamaged. Protect sheet metal flashing and trim materials and fabrications during transportation and handling.

C. Unload, store, and install sheet metal flashing materials and fabrications in manner to prevent bending, warping, twisting, and surface damage.

D. Stack materials on platforms or pallets, covered with suitable weathertight and ventilated covering. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.

E. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to the extent necessary for the period of sheet metal flashing and trim installation.

1.06 COORDINATION:

- A. Coordinate installation of sheet metal flashing and trim with interfacing and adjoining construction to provide leakproof, secure, and noncorrosive installation.

1.07 PROJECT/SITE CONDITIONS:

- A. Protect exposed finishes against construction damage; remove protection prior to final acceptance.

PART 2 - PRODUCTS

2.01 METAL FASCIA.

- A. Metal fascia shall consist of a 24 gauge steel fascia with a face height of 6 3/4 inches and continuous 22 gauge galvanized steel spring clip. Provide prefabricated mitered corners, splice sections, and all accessories for a complete weathertight installation.
- B. Acceptable products include the following, or equal:
 - 1. Econosnap by W.P. Hickman Company.
 - 2. PAC-LOC-Fascia by Peterson Aluminum Corporation.

2.02 FINISHES

- A. Finish on all products shall be a 1.0 mil DFT two-coat factory-applied 70% Kynar 500.
- B. Fluoropolymer coating over an epoxy prime coat. Colors shall be selected by OWNER.
- C. Exposed fasteners shall be provided with the same finish as the sheet metal products.

2.03 WALL SHEET METAL FABRICATIONS:

- A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch- (2400 mm) long, but not exceeding 12-foot- (3600 mm) long, sections, under copings, at shelf angles, and where indicated. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches (150 mm) beyond each side of wall openings. Form with 2-inch- (50 mm) high, end dams where flashing is discontinuous. Fabricate from the following materials:
 - 1. Stainless Steel: 0.016 inch (0.40 mm) thick.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of the Work.
 - 1. Verify compliance with requirements for installation tolerances of substrates.

2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- B. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
 - C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION, GENERAL:

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
 1. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
 2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
 3. Space cleats not more than 12 inches (300 mm) apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
 4. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
 5. Install sealant tape where indicated.
 6. Torch cutting of sheet metal flashing and trim is not permitted.
 7. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3000 mm) with no joints allowed within 24 inches (600 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with sealant concealed within joints.

3.03 ROOF FLASHING INSTALLATION:

- A. General: Install sheet metal flashing and trim to comply with performance requirement, sheet metal manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
- B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in SMACNA's "Architectural Sheet Metal Manual" and as indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate

3.04 WALL FLASHING INSTALLATION:

- A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.
- B. Through-Wall Flashing: Installation of through-wall flashing is specified in Division 04 Section "Unit Masonry."

3.05 ERECTION TOLERANCES:

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4-inch in 20 feet (6 mm in 6 m) on slope and location lines as indicated and within 1/8-inch (3 mm) offset of adjoining faces and of alignment of matching profiles.
- B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

3.06 CLEANING AND PROTECTION:

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder.
- C. Clean off excess sealants.
- D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of installation, remove unused materials and clean finished surfaces. Maintain in a clean condition during construction.
- E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

3.07 CLOSEOUT ACTIVITIES:

- A. Provide in accordance with Section 01 77 00.

END OF SECTION

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SECTION 07 92 00

JOINT SEALANTS

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide joint sealants as indicated and in compliance with Contract Documents.

1. Section Includes:

a. Urethane joint sealants..

1.02 REFERENCES:

A. ASTM International (ASTM):

1. C834: Standard Specification for Latex Sealing Compounds.
2. C919: Standard Practice for Use of Sealants in Acoustical Applications.
3. C920: Standard Specification for Elastomeric Joint Sealants.
4. C1021: Standard Practice for Laboratories Engaged in Testing of Building Sealants.
5. C1087: Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems
6. C1193: Standard Guide for Use of Joint Sealants.
7. C1247: Standard Test Method for Durability of Sealants Exposed to Continuous Immersion in Liquids.
8. C1248: Standard Test Method for Staining of Porous Substrate by Joint Sealants.
9. C1311: Standard Specification for Solvent Release Sealants.
10. C1330: Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants.
11. C1521: Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints.
12. E90: Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

1.03 PRECONSTRUCTION TESTING:

A. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

1. Use ASTM C1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
2. Submit not fewer than eight pieces of each kind of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.

5. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:

1. Locate test joints where indicated on Project or, if not indicated, as directed by CM.
2. Conduct field tests for each application indicated below:
 - a. Each kind of sealant and joint substrate indicated.
3. Notify CM seven days in advance of dates and times when test joints will be erected.
4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
 - a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.
 - (1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
5. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.04 SUBMITTALS

- A. Submit the following shop drawings in accordance with Section 01 33 00.
- B. Product Data: For each joint-sealant product indicated.
- C. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- D. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- E. Joint-Sealant Schedule: Include the following information:
 1. Joint-sealant application, joint location, and designation.
 2. Joint-sealant manufacturer and product name.
 3. Joint-sealant formulation.

- 4. Joint-sealant color.
 - F. Qualification Data: For qualified Installer.
 - G. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.
 - H. Sealant, Waterproofing, and Restoration Institute (SWRI) Validation Certificate: For each sealant specified to be validated by SWRI's Sealant Validation Program.
 - I. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.
 - J. Preconstruction Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
 - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
 - 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
 - K. Preconstruction Field-Adhesion Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.
 - L. Field-Adhesion Test Reports: For each sealant application tested.
 - M. Warranties: Sample of special warranties.
- 1.05 QUALITY ASSURANCE:
- A. Comply with the requirements specified in Section 01 43 00.
 - B. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
 - C. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.
 - D. Product Testing: Test joint sealants using a qualified testing agency.
 - 1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.
 - 2. Test according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C920 for adhesion and cohesion under cyclic movement, adhesion-in-peel, and indentation hardness.
 - E. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

1.06 PROJECT CONDITIONS:

- A. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
 - 2. When joint substrates are wet.
 - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 - 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.07 WARRANTY:

- A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
 - 1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 - 2. Disintegration of joint substrates from natural causes exceeding design specifications.
 - 3. Mechanical damage caused by individuals, tools, or other outside agents.
 - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL:

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. VOC Content of Interior Sealants: Provide sealants and sealant primers for use inside the weatherproofing system that comply with the following limits for VOC content when calculated according to 40 CFR 59, Part 59, Subpart D (EPA Method 24):
 - 1. Architectural Sealants: 250 g/L.

2. Sealant Primers for Nonporous Substrates: 250 g/L.
 3. Sealant Primers for Porous Substrates: 775 g/L.
- C. Liquid-Applied Joint Sealants: Comply with ASTM C920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C920 classifications for type, grade, class, and uses related to exposure and joint substrates.
 - D. Low-Emitting Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
 - E. Liquid-Applied Joint Sealants: Comply with ASTM C920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C920 classifications for type, grade, class, and uses related to exposure and joint substrates.
 1. Suitability for Immersion in Liquids. Where sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C1247. Liquid used for testing sealants is deionized water, unless otherwise indicated.
 - F. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C1248 and have not stained porous joint substrates indicated for Project.
 - G. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.
 - H. Colors of Exposed Joint Sealants: As selected by Engineer from manufacturer's full range.

2.02 URETHANE JOINT SEALANTS:

- A. Single-Component, Nonsag, Urethane Joint Sealant: ASTM C920, Type S, Grade NS, Class 100/50, for Use NT.
 1. Products:
 - a. Sika Corporation, Construction Products Division; Sikaflex - 15LM.
 - b. Tremco Incorporated; Dymonic FC.
- B. Single-Component, Nonsag, Urethane Joint Sealant: ASTM C920, Type S, Grade NS, Class 50, for Use NT.
 1. Products:
 - a. Pacific Polymers International, Inc.; Elasto-Thane 230 LM Type II.
 - b. Polymeric Systems, Inc.; PSI-901.

- C. Single-Component, Nonsag, Urethane Joint Sealant: ASTM C920, Type S, Grade NS, Class 25, for Use NT.
1. Products:
 - a. Pacific Polymers International, Inc.; Elasto-Thane 230 Type II.
 - b. Pecora Corporation; Dynatrol I-XL.
 - c. Polymeric Systems, Inc.; Flexiprene 1000.
 - d. Sika Corporation, Construction Products Division; Sikaflex - 1a.
 - e. Tremco Incorporated; Dymonic.
- D. Single-Component, Nonsag, Traffic-Grade, Urethane Joint Sealant: ASTM C920. Type S, Grade NS, Class 25, for Use T.
1. Products:
 - a. May National Associates, Inc.; Bondaflex PUR 40 FC.
 - b. Pacific Polymers International, Inc.; Elasto-Thane 230 Type II.
 - c. Sika Corporation, Construction Products Division; Sikaflex - 1a.
 - d. Tremco Incorporated; Vulkem 116.
- E. Single-Component, Pourable, Traffic-Grade, Urethane Joint Sealant: ASTM C920, Type S, Grade P, Class 25, for Use T.
1. Products:
 - a. BASF Building Systems; Sonolastic SL 1.
 - b. Bostik, Inc.; Chem-Calk 950.
 - c. May National Associates, Inc.; Bondaflex PUR 35 SL.
 - d. Pecora Corporation; Urexpan NR-201.
 - e. Polymeric Systems, Inc.; Flexiprene 952.
 - f. Schnee-Morehead, Inc.; Permathane SM7101.
 - g. Sika Corporation. Construction Products Division; Sikaflex - 1CSL.
 - h. Tremco Incorporated; Vulkem 45.
- F. Immersible, Single-Component, Nonsag, Traffic-Grade, Urethane Joint Sealant: ASTM C920, Type S, Grade NS, Class 25, for Uses T and I.
1. Products:
 - a. BASF Building Systems; Sonolastic NP1.
 - b. Sika Corporation, Construction Products Division; Sikaflex - 1a.
 - c. Tremco Incorporated; Vulkem 116.
- G. Immersible, Single-Component, Pourable, Traffic-Grade, Urethane Joint Sealant: ASTM C920, Type S, Grade P, Class 25, for Uses T and I.
1. Products:
 - a. Sika Corporation, Construction Products Division; Sikaflex - 1CSL.
 - b. Tremco Incorporated; Vulkem 45.

2.03 JOINT SEALANT BACKING:

- A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin) Type O (open-cell material) Type B (bicellular material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.04 MISCELLANEOUS MATERIALS:

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION:

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Concrete.
 - b. Masonry.
 3. Remove laitance and form-release agents from concrete.
 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
 - a. Metal
 - b. Glass
 - c. Porcelain enamel
 - d. Glazed surfaces of ceramic masonry
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.03 INSTALLATION OF JOINT SEALANTS:

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 1. Do not leave gaps between ends of sealant backings.
 2. Do not stretch, twist, puncture, or tear sealant backings.
 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 - 1. Remove excess sealant from surfaces adjacent to joints.
 - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - 3. Provide concave joint profile per Figure 8A in ASTM C1193, unless otherwise indicated.
 - 4. Provide flush joint profile where indicated per Figure 8B in ASTM C1193.
 - 5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 8C in ASTM C1193.
 - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.04 FIELD QUALITY CONTROL:

- A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
 - 1. Extent of Testing: Test completed and cured sealant joints as follows:
 - a. Perform 10 tests for the first 1000 feet (300 m) of joint length for each kind of sealant and joint substrate.
 - b. Perform 1 test for each 1000 feet (300 m) of joint length thereafter or 1 test per each floor per elevation.
 - 2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.
 - a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
 - 3. Inspect tested joints and report on the following:
 - a. Whether sealants filled joint cavities and are free of voids.
 - b. Whether sealant dimensions and configurations comply with specified requirements.
 - c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.

4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

B. Evaluation of Field-Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.05 CLEANING:

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.06 PROTECTION:

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.07 CONTRACT CLOSEOUT:

- A. Provide in accordance with Section 01 77 00.

3.08 JOINT-SEALANT SCHEDULE:

- A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces subject to water immersion.

1. Joint Locations:

- a. Joints in pedestrian plazas.
2. Urethane Joint Sealant: Immersible, single component, nonsag, traffic grade
3. Joint-Sealant Color:: As selected by Engineer from manufacturer's full range of colors

- B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces

1. Joint Locations:

- a. Construction joints in cast-in-place concrete.
- b. Joints between plant-precast architectural concrete units.
- c. Control and expansion joints in unit masonry.

- d. Joints in glass unit masonry assemblies.
 - e. Joints between metal panels.
 - f. Joints between different materials listed above.
 - g. Perimeter joints between materials listed above and frames of doors windows and louvers.
 - h. Control and expansion joints in ceilings and other overhead surfaces.
- 2. Urethane Joint Sealant: Single component, nonsag, Class 100/50
- C. Joint-Sealant Application: Interior joints in horizontal traffic surfaces .
- 1. Joint Locations:
 - a. Isolation joints in cast-in-place concrete slabs.
 - 2. Urethane Joint Sealant: Single component, pourable, traffic grade.
 - 3. Joint-Sealant Color:: As selected by Engineer from manufacturer's full range of colors
- D. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.
- 1. Joint Locations:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints of exterior openings where indicated.
 - c. Tile control and expansion joints.
 - d. Vertical joints on exposed surfaces of interior unit masonry concrete walls.
 - e. Joints on underside of plant-precast structural concrete beams and planks.
 - f. Perimeter joints between interior wall surfaces and frames of interior doors and windows.
 - 2. Joint Sealant: Urethane Joint Sealant: Single component, nonsag, Class 100/50
 - 3. Joint-Sealant Color:: As selected by Engineer from manufacturer's full range of colors

END OF SECTION

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DIVISION 8

OPENINGS

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SECTION 08 15 10

FIBERGLASS DOORS AND ALUMINUM FRAMES

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. Provide fiberglass reinforced plastic doors and aluminum frames as indicated and in compliance with Contract Documents.

1.02 SUBMITTALS:

- A. Submit the following shop drawings in accordance with Section 01 33 00.
- B. Product Data: Submit manufacturer's technical product data, substantiating compliance with corrosive environment requirements.
- C. Shop Drawings:
 - 1. Include details of each frame type, elevations of door and reinforcement, conditions at openings, details of construction, location and installation requirements of finish hardware and reinforcements, and details of joints and connections. Show anchorage and accessory items.

1.03 DELIVERY STORAGE AND HANDLING:

- A. Comply with the requirements specified in Section 01 66 10.

1.04 WARRANTY:

- A. Comply with the requirements of Section 01 78 36.
- B. Manufacturer shall unconditionally guarantee fiberglass doors and frames for minimum of 10 yrs against failure due to corrosion from environment.
- C. Warranty: Include coverage against failure due to corrosion.

PART 2 - PRODUCTS

2.01 FIBERGLASS DOORS

- A. Thermally insulated fiberglass doors shall be 1 3/4-inch total thickness with 1 1/2-inch rigid polyurethane core. All doors shall be mortised and reinforced to receive hardware.
- B. Manufacturers:

1. Special-Lite, Inc. SL-17.
 - a. Color: To be selected by OWNER to match existing.

2.02 DOOR FRAMES

- A. Aluminum frames shall be tube type, minimum 0.125-inch thick, 6063-T5 Aluminum alloy. Frames shall be prepared for all door hardware.
 1. Finish: Kynar two-coat finish chosen by OWNER from manufacturer's standard.
- B. Frames shall have a 4-inch head member at 7 foot doors in masonry.
- C. Frame depth to be as shown on drawings.

2.03 HARDWARE

- A. Comply with the requirements specified in Section 08 71 00.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Install doors and frames in accordance with manufacturer's written instructions.
- B. Coordinate with masonry wall construction for anchor placement.
- C. Touch-up minor damaged surfaces caused during installation as recommended by the manufacturer.

3.02 ERECTION TOLERANCES:

- A. Maximum Diagonal Distortion: 1/8 measured with straight edges, crossed corner to corner.

3.03 ADJUSTING:

- A. Adjust door for smooth and balanced door movement.

3.04 CLOSEOUT ACTIVITIES:

- A. Provide in accordance with Section 01 77 00.

END OF SECTION

SECTION 08 45 23

FIBERGLASS-SANDWICH PANEL ASSEMBLIES

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. Provide fiberglass-sandwich panel assemblies as indicated and in compliance with Contract Documents.
 - 1. Section includes aluminum-framed assemblies incorporating fiberglass-sandwich panels as follows:
 - a. Wall assemblies.

1.02 SUBMITTALS:

- A. Submit the following shop drawings in accordance with Section 01 33 00.
- B. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum components of panel assemblies.
- C. Shop Drawings: For panel assemblies. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Include details of provisions for assembly expansion and contraction and for draining moisture within the assembly to the exterior.
 - 2. Preconstruction Testing Shop Drawings: Prepared by a qualified preconstruction testing agency, showing details of laboratory mockup.
 - a. Resubmit Shop Drawings with changes made to details of laboratory mockup to successfully complete preconstruction testing.
- D. Samples for Initial Selection: For units with factory-applied color finishes.
- E. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.
- F. Fabrication Samples: Of each framing system intersection and adjacent panels, made from 12-inch (300 mm) lengths of full-size framing members and showing details of the following:
 - 1. Joinery.
 - 2. Anchorage.
 - 3. Expansion provisions.
 - 4. Fiberglass-sandwich panels.

5. Flashing and drainage.

- G. Delegated-Design Submittal: For panel assemblies indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- H. Qualification Data: For qualified Installer, manufacturer.
- I. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for panel assemblies.
- J. Preconstruction Test Reports: Prepared by a qualified preconstruction testing agency, for panel assemblies.
- K. Field quality-control reports.
- L. Warranties: Sample of special warranties.
- M. Maintenance Data: For panel assemblies to include in maintenance manuals.

1.03 QUALITY ASSURANCE:

- A. Comply with the requirements specified in Section 01 43 00.
- B. Manufacturer Qualifications: For fiberglass-sandwich panels, a qualified manufacturer whose facilities, processes, and products are monitored by an independent, accredited quality-control agency for compliance with applicable requirements in ICC-ES AC04, "Sandwich Panels," or ICC-ES AC177, "Translucent Fiberglass Reinforced Plastic (FRP) Faced Panel Wall, Roof and Skylight Systems".
- C. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of panel assemblies required for this Project.
- D. Testing Agency Qualifications: Qualified according to ASTM E699 for testing indicated.
- E. Product Options: Information on Drawings and in Specifications establishes requirements for panel assemblies' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including testing conducted by an independent testing agency and in-service performance.
 - 1. Do not modify intended aesthetic effects, as judged solely by Engineer. If modifications are proposed, submit comprehensive explanatory data to Engineer for review.
- F. Preinstallation Conference: Conduct conference at Project site.

1.04 DELIVERY STORAGE AND HANDLING:

- A. Comply with the requirements specified in Section 01 66 10.
- B. Handle products in accordance with AAMA MCWM-1 – Curtain Wall Manual.

- C. Protect prefinished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond when exposed to sunlight or weather. Puncture wrappings at ends for ventilation.
- 1.05 PROJECT/SITE CONDITIONS:
- A. Do not install sealants when ambient temperature is less than 40 degrees F (5 degrees C) during and 48 hours after installation.
 - B. Maintain this minimum temperature during and after installation of sealants.
- 1.06 WARRANTY:
- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of panel assemblies that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - c. Water leakage.
 - 2. Warranty Period: Five years from date of Substantial Completion.
 - B. Special Fiberglass-Sandwich-Panel Warranty: Manufacturer's standard form in which manufacturer agrees to replace panels that exhibit defects in materials or workmanship.
 - 1. Defects include, but are not limited to, the following:
 - a. Fiberbloom.
 - b. Delamination of coating, if any, from exterior face sheet.
 - c. Color change exceeding requirements.
 - d. Delamination of panel face sheets from panel cores.
 - 2. Warranty Period: 10 years from date of Substantial Completion.
 - C. Special Aluminum-Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes fail within specified warranty period. Warranty does not include normal weathering.
 - 1. Failures include, but are not limited to, checking, crazing, peeling, chalking, and fading of finishes.
 - 2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. Manufacturers:

1. Kalwall Corporation.
2. Or equal

2.02 PERFORMANCE REQUIREMENTS:

A. General Performance: Fiberglass-sandwich-panel assemblies shall withstand the effects of the following forces without failure due to defective manufacture, fabrication, installation, or other defects in construction:

1. Structural loads.
2. Thermal movements.
3. Movements of supporting structure.
4. Dimensional tolerances of building frame and other adjacent construction.
5. Failure includes, but is not limited to, the following:
 - a. Deflection exceeding specified limits.
 - b. Water leakage.
 - c. Thermal stresses transferred to building structure.
 - d. Noise or vibration created by wind, thermal, or structural movements.
 - e. Loosening or weakening of fasteners, attachments, and other components.

B. Structural Loads:

1. Seismic Loads: As indicated on Drawings
2. Wind Loads: As indicated on Drawings.

C. Deflection Limits:

1. Vertical Panel Assemblies: Limited to 1/180 of clear span for each assembly component.

D. Structural-Test Performance: Provide panel assemblies tested according to ASTM E330, as follows:

1. When tested at positive and negative wind-load design pressures, assemblies do not show evidence of deflection exceeding specified limits.

2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not show evidence of material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
 3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- E. Windborne-Debris-Impact-Resistance Performance: Provide panel assemblies that pass missile-impact and cyclic-pressure tests when tested according to ASTM E1886 and the testing information in ASTM E1996.
1. Large-Missile Test: For glazed openings located within 30 feet (9.1 m) of grade.
 2. Small-Missile Test: For glazed openings located more than 30 feet (9.1 m) above grade.
- F. Water Penetration under Static Pressure: Provide panel assemblies that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 15 lbf/square feet (720 Pa).
- G. Water Penetration under Dynamic Pressure: Provide panel assemblies that do not evidence water leakage through fixed glazing and framing areas when tested according to AAMA 501.1 under dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/square feet (300 Pa).
1. Maximum Water Leakage: No uncontrolled water penetrating aluminum-framed systems or water appearing on systems' normally exposed interior surfaces from sources other than condensation. Water leakage does not include water that is controlled by flashing and gutters and drained to the exterior, or water that cannot damage adjacent materials or finishes.
- H. Energy Performance: Provide panel assemblies with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below and certified and labeled according to NFRC:
1. Thermal Transmittance (U-Factor): Fixed glazing and framing areas shall have U-factor of not more than 0.65 Btu/square foot x h x degrees F (3.69 W/sq. m x K) as determined according to NFRC 100.
 2. Solar-Heat-Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than 0.7 as determined according to NFRC 200.
 3. Air Infiltration: Maximum air leakage through fixed glazing and framing areas of 0.30 cfm/sq. ft. (1.50 L/s per sq. m) of fixed wall area as determined according to ASTM E283 at a minimum static-air-pressure differential of 6.24 lbf/square feet (300 Pa).

2.03 ALUMINUM FRAMING SYSTEMS:

- A. Components: Manufacturer's standard extruded-aluminum members of thickness required and reinforced as required to support imposed loads.

1. Construction: Thermally broken, extruded aluminum.
- B. Aluminum: Alloy and temper recommended in writing by manufacturer for type of use and finish indicated.
1. Sheet and Plate: ASTM B209/B209M.
 2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221/B221M.
 3. Extruded Structural Pipe and Tubes: ASTM B429/B429M.
 4. Structural Profiles: ASTM B308/B308M.
- C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning skylight components.
- D. Fasteners and Accessories: Manufacturer's standard, corrosion-resistant, nonstaining, and nonbleeding fasteners and accessories; compatible with adjacent materials.
1. At closures, retaining caps, or battens, use ASTM A193/A193M, 300 series stainless-steel screws.
 2. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 3. At movement joints, use slip-joint linings, spacers, and sleeves of material and type recommended in writing by manufacturer.
- E. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A123/A123M or ASTM A153/A153M requirements.
- F. Anchor Bolts: ASTM A307, Grade A (ASTM F568M, Property Class 4.6), galvanized steel.
- G. Concealed Flashing: Corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
- H. Exposed Flashing and Closures: Aluminum sheet not less than 0.063 inch (1.60 mm) thick, finished to match framing.
- I. Framing Gaskets: Manufacturer's standard.
- J. Frame-System Sealants: As recommended in writing by manufacturer. Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4 mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
- 2.04 FIBERGLASS-SANDWICH PANELS:
- A. Description: Assembly of uniformly colored, translucent, thermoset, fiberglass-reinforced-polymer face sheets bonded to both sides of a grid core.
1. Self-Ignition Temperature: 650 degrees F (343 degrees C) or more per ASTM D1929.

2. Smoke-Developed Index: 450 or less per ASTM E84, or 75 or less per ASTM D2843.
 3. Flame-Spread Index: Not more than 25 per ASTM E84.
 4. Combustibility Classification: Class CC1 per ASTM D635.
 5. Interior Finish Classification: Class A per ASTM E84.
- B. Panel Thickness: 2-3/4 inches (70 mm).
- C. Panel Strength Characteristics:
1. Maximum Panel Deflection: 3-1/2 inches (89 mm) when a 4 x 12-foot (1200 x 3600 mm) panel is tested according to ASTM E72 at 34 lbf/sq. ft. (1.6 kPa), with a maximum 0.090-inch (2.3 mm) set deflection after five minutes.
 2. Panel Support Strength: Capable of supporting, without failure, a 300-lbf (1334-N) concentrated load when applied to a 3-inch- (75 mm) diameter disk according to ASTM E661.
- D. Grid Core: Mechanically interlocked, extruded-aluminum I-beams, with a minimum flange width of 7/16-inch (11 mm).
1. Extruded Aluminum: ASTM B221/B221M, in alloy and temper recommended in writing by manufacturer.
 2. I-Beam Construction: Thermally broken, extruded aluminum.
 3. Grid Pattern: As indicated on Drawings.
- E. Exterior Face Sheet:
1. Thickness: 0.070 inches (1.78 mm).
 2. Color: Crystal.
 3. Color Change: Not more than 3.0 units Delta E when measured according to ASTM D2244, after outdoor weathering in southern Florida compliant with procedures in ASTM D1435, with panels mounted facing south and as follows:
 - a. Panel Mounting Angle: Not more than **5** degrees from horizontal.
 - b. Exposure Period: 60 months.
 4. Erosion Protection: Manufacturer's standard.
 5. Impact Resistance: No fracture or tear at impact of 230 foot x lbf (312 J) by a 3-1/4-inch- (83 mm) diameter, 5-lb (2.3 kg) freefalling ball according to UL 972 test procedure.
- F. Interior Face Sheet:
1. Thickness: 0.060 inch (1.52 mm).

2. Color: White.

G. Fiberglass-Sandwich-Panel Adhesive: ASTM D2559.

1. Compatible with facing and core materials.

2. Tensile and shear bond strength of aged adhesive ensures permanent adhesion of facings to cores, as evidenced by testing tensile strength according to ASTM C297 and shear bond strength according to ASTM D1002. Use accelerated aging procedures that comply with aging requirements for adhesives with high resistance to moisture in ICC-ES AC05, "Sandwich Panel Adhesives."

2.05 FABRICATION:

A. Frame System Fabrication:

1. Fabricate components before finishing.

2. Fabricate components that, when assembled, have the following characteristics:

a. Profiles that are sharp, straight, and free of defects or deformations.

b. Accurately fitted joints with ends coped or mitered.

c. Internal guttering systems or other means to drain water passing through joints, condensation occurring within components, and moisture migrating within assembly to exterior.

3. Fabricate sill closures with weep holes and for installation as continuous component.

4. Reinforce components as required to receive fastener threads.

B. Panel Fabrication: Factory assemble and seal panels.

1. Laminate face sheets to grid core under a controlled process using heat and pressure to produce straight adhesive bonding lines that cover width of core members and that have sharp edges.

a. White spots indicating lack of bond at intersections of grid-core members are limited in number to four for every 40 square feet (3.7 sq. m) of panel and limited in diameter to 3/64-inch (1.2 mm).

2. Fabricate with grid pattern that is symmetrical about centerlines of each panel.

3. Fabricate panel to allow condensation within panel to escape.

4. Reinforce panel corners.

2.06 ALUMINUM FINISHES:

A. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm, AA-M12C22A32/A34, Class II, 0.010 mm or thicker.

1. Color: Bronze #85

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION:

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints between aluminum components to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion, electrolytic deterioration, and immobilization of moving joints.
6. Seal joints watertight unless otherwise indicated.

B. Metal Protection: Where aluminum components will contact dissimilar materials, protect against galvanic action by painting contact surfaces with corrosion-resistant coating or by installing nonconductive spacers as recommended in writing by manufacturer for this purpose.

C. Install continuous aluminum sill closures with weatherproof expansion joints and locked and sealed corners. Locate weep holes at rafters.

D. Install components to drain water passing through joints, condensation occurring within aluminum members and panels, and moisture migrating within assembly to exterior.

E. Install components plumb and true in alignment with established lines and elevations.

F. Erection Tolerances: Install panel assemblies to comply with the following maximum tolerances:

1. Alignment: Limit offset from true alignment to 1/32-inch (0.8 mm) where surfaces abut in line, edge to edge, at corners, or where a reveal or protruding element separates aligned surfaces by less than 3 inches (75 mm); otherwise, limit offset to 1/8-inch (3.2 mm).
2. Location and Plane: Limit variation from true location and plane to 1/8-inch in 12 feet (3.2 mm in 3700 mm), but no greater than 1/2-inch (13 mm) over total length.

3.03 FIELD QUALITY CONTROL:

- A. Repair or remove work where test results and inspections indicate that it does not comply with specified requirements.
- B. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- C. Prepare test and inspection reports.

3.04 CLOSEOUT ACTIVITIES:

- A. Provide in accordance with Section 01 77 00.

END OF SECTION

SECTION 08 71 00
FINISH HARDWARE

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. Provide finish hardware as indicated and in compliance with Contract Documents.
 - 1. Section Includes:
 - a. Finish hardware for doors as specified and as listed in "Hardware Groups" and required by actual conditions. Mechanical door hardware for the following:
 - (1) Swinging doors.
 - b. Electrified door hardware.
 - c. Screws, special screws, bolts, special bolts, expansion shields, and other devices for proper application of hardware.
- B. General Requirements:
 - 1. Provide items, articles, materials, operations and methods listed, mentioned or scheduled herein or on drawings, in quantities as required to complete project. Provide hardware that functions properly. Prior to furnishing hardware, advise Engineer of items that will not operate properly, are improper for conditions, or will not remain permanently anchored.

1.02 REFERENCES:

- A. American National Standards Institute (ANSI):
 - 1. A117.1: Accessible and Usable Buildings and Facilities.
- B. Builders Hardware Manufacturers Association (BHMA):
 - 1. A156 Series.

1.03 SUBMITTALS:

- A. Submit the following shop drawings in accordance with Section 01 33 00.
- B. Product Data: For each type of product indicated. Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.
- C. Shop Drawings: Details of electrified door hardware, indicating the following:
 - 1. Wiring Diagrams.

2. Other Submittals:

- a. Door Hardware Schedule: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
- b. Keying Schedule: Prepared by or under the supervision of Installer, detailing Owner's final keying instructions for locks.

D. Warranty: Special warranty specified in this Section.

E. Source Limitations: Obtain each type of door hardware from a single manufacturer.

- 1. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.

F. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

G. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.

1.04 DELIVERY STORAGE AND HANDLING:

A. Comply with the requirements specified in Section 01 66 10.

1.05 COORDINATION:

A. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

B. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

C. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.

1.06 WARRANTY:

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

- 1. Failures include, but are not limited to, the following:

- a. Structural failures including excessive deflection, cracking, or breakage.
 - b. Faulty operation of doors and door hardware.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
2. Warranty Period: Three years from date of Substantial Completion, unless otherwise indicated.

PART 2 - PRODUCTS

2.01 SCHEDULED DOOR HARDWARE:

- A. Provide door hardware for each door as scheduled in Part 3 "Door Hardware Schedule" to comply with requirements in this Section. Match existing hardware in the facility to the furthest extent possible. Items listed below may be modified to an equal product by an alternate manufacturer in order to match the existing.

2.02 HINGES:

- A. Hinges: BHMA A156.1. Full mortise, ball bearing, nonferrous, nonrising, loose pin, flat bottom tip, unless otherwise specified. Provide three 4 1/2-inch by 4 1/2-inch butts per door for doors 7 feet or less in height.

1. Manufacturers:

- a. Hager Companies. BB1191.
- b. Stanley Commercial Hardware. FBB 191.

2.03 MECHANICAL LOCKS AND LATCHES:

- A. Cylindrical key-in-lever with 2 3/4-inch backset. Strikes shall be curved lip. Provide removable core brass 6 cylinders.

1. Manufacturers:

- a. Sargent Manufacturing Company. Series 10L.

2.04 ELECTRIC STRIKES:

- A. Electric Strikes: BHMA A156.31. Low profile 1 3/8-inch depth, heavy duty stainless steel construction.

1. Manufacturers:

- a. HES, Inc.; an ASSA ABLOY Group company. 4500C Series.

2.05 KEYING:

A. Keying System: Match Existing System.

1. Master key or grand master key locks to Owner's existing system.

2.06 SURFACE CLOSERS:

A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Provide SRI primer for corrosion resistance.

1. Manufacturers:

- a. LCN Closers. 1460 Series.

2.07 PROTECTION PLATES

A. Fabricate protection plates (kick) 1 1/2 inch less than door width on stop side and not more than 1/2 inch less than door width on pull side, by 6 inch height.

1. Metal Plates: Stainless steel, 0.050 inch (U.S. 18 ga) with countersunk screw holes of intervals of not over 6 inch on all four sides.

- a. Rockwood.

2.08 FINISHES:

A. Provide finishes complying with BHMA A156.18; US 26D or US 32D.

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

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Mounting Heights: Mount door hardware units at heights to comply with governing regulations.

B. Install each door hardware item to comply with manufacturer's written instructions.

1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

3.02 ADJUSTING:

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended.
 - 1. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.

3.03 CLEANING AND PROTECTION:

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.04 CONTRACT CLOSEOUT:

- A. Provide in accordance with Section 01 77 00.

3.05 DOOR HARDWARE SCHEDULE:

- A. See Door Schedule on Drawings for hardware group application:

Group 1

Lockset: Change existing 10G05 to 10G04
Add Electric Strike
All other existing hardware to remain.

Group 2

Lockset: 10U15
Closer: 1460 BF (Regular Arm)
Hinges and Kickplate

END OF SECTION

DIVISION 9

FINISHES

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SECTION 09 29 00
DRYWALL CONSTRUCTION

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. Provide gypsum board and accessories as indicated and in compliance with Contract Documents.
- B. Section Includes:
 - 1. Exterior gypsum board for ceilings and soffits.
 - 2. Moisture resistant gypsum board.
 - 3. Texture finishes.

1.02 SUBMITTALS:

- A. Submit the following shop drawings in accordance with Section 01 33 00.
- B. Product Data: For each type of product.
- C. Samples: For the following products:
 - 1. Trim Accessories: Full-size Sample in 12-inch- (300-mm-) long length for each trim accessory indicated.
 - 2. Textured Finishes: Manufacturer's standard size for each textured finish indicated and on same backing indicated for Work.

1.03 QUALITY ASSURANCE:

- A. Comply with the requirements specified in Section 01 43 00.

1.04 DELIVERY STORAGE AND HANDLING:

- A. Comply with the requirements specified in Section 01 66 10.
- B. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.05 PROJECT/SITE CONDITIONS:

- A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

- C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.01 GYPSUM BOARD, GENERAL:

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.02 INTERIOR GYPSUM BOARD:

- A. Manufacturers:

- 1. CertainTeed Corp.
- 2. Georgia-Pacific Gypsum LLC.
- 3. National Gypsum Company.
- 4. USG Corporation.

- B. Moisture- and Mold-Resistant Gypsum Board: ASTM C1396/C1396M. With moisture- and mold-resistant core and paper surfaces.

- 1. Core: 5/8 inch (15.9 mm), Type X.
- 2. Long Edges: Tapered.
- 3. Mold Resistance: ASTM D3273, score of 10.

2.03 EXTERIOR GYPSUM BOARD FOR CEILINGS AND SOFFITS:

- A. Glass-Mat Gypsum Sheathing Board: ASTM C1177/C1177M, with fiberglass mat laminated to both sides and with manufacturer's standard edges.

- 1. Products:

- a. CertainTeed Corp.; GlasRoc Sheathing.
- b. Georgia-Pacific Gypsum LLC; Dens-Glass Gold.
- c. National Gypsum Company; Gold Bond, e(2)XP.
- d. USG Corporation; Securock Glass Mat Sheathing.

2. Core: 5/8 inch (15.9 mm), Type X.

2.04 TRIM ACCESSORIES:

A. Interior Trim: ASTM C1047.

1. Material: Galvanized or aluminum-coated steel.
2. Shapes:
 - a. Cornerbead.
 - b. Bullnose bead.
 - c. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - d. L-Bead: L-shaped; exposed long flange receives joint compound.
 - e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
 - f. Expansion (control) joint.

B. Exterior Trim: ASTM C1047.

1. Material: Hot-dip galvanized steel sheet, plastic, or rolled zinc.
2. Shapes:
 - a. Cornerbead.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - c. Expansion (Control) Joint: One-piece, rolled zinc with V-shaped slot and removable strip covering slot opening.

C. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.

1. Manufacturers:
 - a. Fry Reglet Corp.
 - b. Gordon, Inc.
 - c. Pittcon Industries.
2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B221 (ASTM B221M), Alloy 6063-T5.
3. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.

2.05 JOINT TREATMENT MATERIALS:

- A. General: Comply with ASTM C475/C475M.
- B. Joint Tape:
 - 1. Interior Gypsum Board: Paper.
 - 2. Exterior Gypsum Soffit Board: Paper.
 - 3. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
- C. Joint Compound:
 - 1. Exterior Gypsum Soffit Board: Use setting-type taping compound and setting-type, sandable topping compound.
 - 2. Glass-Mat Gypsum Sheathing Board: As recommended by sheathing board manufacturer.
 - 3. Water-Resistant Gypsum Backing Board: Use setting-type taping compound and setting-type, sandable topping compound.

2.06 AUXILIARY MATERIALS:

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
- C. Steel Drill Screws: ASTM C1002, unless otherwise indicated.
 - 1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
 - 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

2.07 TEXTURE FINISHES:

- A. Primer: As recommended by textured finish manufacturer.
- B. Non-Aggregate Finish: Pre-mixed, vinyl texture finish for spray application.
 - 1. Products:
 - a. USG Corporation; Wall and Ceiling Spray Texture.
 - 2. Texture: Medium-fine to match adjacent existing gypsum board textured surfaces.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine areas and substrates including welded hollow-metal frames and framing, with Installer present, for compliance with requirements and other conditions affecting performance.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 APPLYING AND FINISHING PANELS, GENERAL:

- A. Comply with ASTM C840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6- to 10-mm-) wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- (6- to 13-mm-) wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

3.03 FINISHING GYPSUM BOARD:

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C840:
 - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 - 2. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
 - a. Primer and its application to surfaces are specified in other Division 09 Sections.
- E. Glass-Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as exposed soffit board.
- F. Glass-Mat Faced Panels: Finish according to manufacturer's written instructions.

3.04 APPLYING TEXTURE FINISHES:

- A. Surface Preparation and Primer: Prepare and apply primer to gypsum panels and other surfaces receiving texture finishes. Apply primer to surfaces that are clean, dry, and smooth.
- B. Texture Finish Application: Mix and apply finish using powered spray equipment, to produce a uniform texture free of starved spots or other evidence of thin application or of application patterns.
- C. Prevent texture finishes from coming into contact with surfaces not indicated to receive texture finish by covering them with masking agents, polyethylene film, or other means. If, despite these precautions, texture finishes contact these surfaces, immediately remove droppings and overspray to prevent damage according to texture-finish manufacturer's written recommendations.

3.05 PROTECTION:

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

3.06 CONTRACT CLOSEOUT:

- A. Provide in accordance with Section 01 77 00.

END OF SECTION

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SECTION 09 67 23

RESINOUS FLOORING

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. Provide resinous flooring as indicated and in compliance with Contract Documents to patch the existing flooring as scheduled.

- 1. Section Includes:

- a. Decorative resinous flooring system.

1.02 DEFINITIONS:

- A. Resinous Flooring: Systems in which topping component, consisting of resinous compounds or resin emulsions combined with selected fine aggregates, is continuously bonded to supporting substrate to produce thin, monolithic wearing surface.
- B. Decorative Epoxy-Resin Flooring: Usually consist of decorative aggregates such as colored quartz, marble, granite, dyed stone, pigmented silica or vinyl flakes in clear epoxy resin matrix.

1.03 SUBMITTALS:

- A. Submit the following shop drawings in accordance with Section 01 33 00.
- B. Product Data: For each type of product indicated. Include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required.
- C. Samples for Verification: For each resinous flooring system required, submit 3 duplicate 6 inches (150 mm) square samples of each color, applied to a rigid backing by Installer for this Project. Engineer to retain one accepted sample.
- D. Product Schedule: For resinous flooring.
- E. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.
- F. Material Certificates: For each resinous flooring component, from manufacturer.
- G. Material Test Reports: For each resinous flooring system.

1.04 REGULATORY REQUIREMENTS:

- A. Conform to applicable code for flame/smoke rating requirements tested in accordance with ASTM E84.

1.05 QUALITY ASSURANCE:

- A. Comply with the requirements specified in Section 01 43 00.
- B. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of flooring systems required for this Project.
 - 1. Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated.
- C. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer. Provide secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from source recommended by manufacturer of primary materials.
- D. Preinstallation Conference: Conduct conference at Project site.

1.06 DELIVERY STORAGE AND HANDLING:

- A. Comply with the requirements specified in Section 01 66 10.
- B. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.
- C. Store materials to comply with manufacturer's written instructions to prevent deterioration from moisture, heat, cold, direct sunlight, or other detrimental effects.
- D. Store materials for three days prior to installation in area of installation to achieve temperature stability.

1.07 PROJECT/SITE CONDITIONS:

- A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.
- B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.
- C. Close spaces to traffic during resinous flooring application and for not less than 24 hours after application unless manufacturer recommends a longer period.

1.08 WARRANTY:

- A. Section 01 77 00 – Contract Closeout: Warranty provisions.
- B. Provide three year warranty under provisions of Section 01 78 39.
- C. Warranty: Include coverage against flooring delamination from substrate and degradation of surface finish.

1.09 EXTRA MATERIALS:

- A. Section 01 77 00 – Contract Closeout: Spare parts and maintenance products.
- B. Provide 2 gallons of flooring material, of each color selected.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Manufacturers:
 - 1. MICOR Company Inc. to match existing.

2.02 DECORATIVE RESINOUS FLOORING

- A. Primer: MICOROX 103 Epoxy Primer.
- B. Decorative Resinous liquids shall be blended silica aggregated in an epoxy resin binder broadcast with colored quartz aggregate and top coated with 100% solids, cycloaliphatic amine cured sealer. Nominal application to be 1/4 inch thick.
- C. Ceramic-coated aggregate shall be used to achieve color. Color to match existing.
- D. Epoxy Sealer: Clear, two component 100% solids epoxy seal coat(s) MICOROX® 1882

2.03 ACCESSORIES:

- A. Primer: Type recommended by manufacturer for substrate and body coats indicated.
- B. Waterproofing Membrane: Type recommended by manufacturer for substrate and primer and body coats indicated.
- C. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.

PART 3 - EXECUTION

3.01 PREPARATION

- A. General: Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry substrate for resinous flooring application.
- B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.
 - 1. Roughen concrete substrates as follows:

- a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
 - b. Comply with ASTM C811 requirements unless manufacturer's written instructions are more stringent.
2. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written instructions.
 3. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.
 - a. Perform anhydrous calcium chloride test, ASTM F1869. Proceed with application of resinous flooring only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft of slab area in 24 hours.
 - b. Perform plastic sheet test, ASTM D4263. Proceed with application only after testing indicates absence of moisture in substrates.
 - c. Perform relative humidity test using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
 4. Alkalinity and Adhesion Testing: Verify that concrete substrates have pH within acceptable range. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.
- C. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.
 - D. Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.
 - E. Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written instructions.
- 3.02 APPLICATION:
- A. General: Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.
 1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
 2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
 3. At substrate expansion and isolation joints, comply with resinous flooring manufacturer's written instructions.
 - B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.

- C. Apply waterproofing membrane, where indicated, in manufacturer's recommended thickness.
 - 1. Apply waterproofing membrane to integral cove base substrates.
 - D. Apply reinforcing membrane to substrate cracks.
 - E. Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions and details including those for taping, mixing, priming, troweling, sanding, and topcoating of cove base. Round internal and external corners.
 - 1. Integral Cove Base: 6 inches high or as needed to match adjacent, existing resinous flooring base.
 - F. Apply self-leveling slurry body coats in thickness indicated for flooring system.
 - 1. Broadcast aggregates at rate recommended by manufacturer and, after resin is cured, remove excess aggregates to provide surface texture indicated.
 - G. Apply troweled or screeded body coats in thickness indicated for flooring system. Hand or power trowel and grout to fill voids. When cured, remove trowel marks and roughness using method recommended by manufacturer.
 - H. Apply grout coat, of type recommended by resinous flooring manufacturer, to fill voids in surface of final body coat and to produce wearing surface indicated.
 - I. Apply topcoats in number indicated for flooring system and at spreading rates recommended in writing by manufacturer.
- 3.03 PROTECTION:
- A. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.
 - B. Clean resinous flooring not more than 4 days before dates scheduled for inspections intended to establish date of Substantial Completion in each Project area. Use cleaning materials and procedures recommended in writing by resinous flooring manufacturer.
- 3.04 CLOSEOUT ACTIVITIES:
- A. Provide in accordance with Section 01 77 00.

END OF SECTION

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SECTION 09 96 10

COATINGS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Coated surfaces to include:

- a. Surfaces described in Room Finish Schedule and notes on Drawings.
- b. Existing surfaces described in Room Finish Schedule and notes on Drawings.

2. Labeling and directional arrows on piping, equipment with valves or electrical connections, valves, and ducts whether coated or not.

3. Do not coat over any code-required labels such as UL and Factory Mutual, or any equipment identification, performance rating, name, or nomenclature plates.

B. Equipment manufacturer is responsible for surface preparation and coatings of equipment, motors, and appurtenances. Equipment to be coated and coating system are identified in equipment Specification section(s).

C. Existing finishes to be removed to accept new finishes shall be disposed of per State of Wisconsin

1.02 DEFINITIONS

A. Definitions as used in Room Schedule and Standard Coating Schedule.

1. Coatings: Heavy duty finishes for use on any surfaces, especially surfaces subject to submerged, high moisture, splash or chemical environment.

B. First Coat: Field prime, factory prime, or shop prime. When only one coat is required, first coat is finish coat.

C. Second or Third Coats: Successive finish coats applied over first coat.

1.03 SUBMITTALS

A. Product Data:

1. Submit manufacturer's literature stating application recommendations and generic makeup of each type of coating scheduled.

2. Substitutions: For coatings not specified, provide substitute manufacturer's literature with specified coating literature for ENGINEER to make proper evaluation.

B. Miscellaneous:

1. Letter of Certification/Shop Painting:

- a. CONTRACTOR has option of shop coating materials and equipment partially or totally.
- b. If CONTRACTOR applies coatings in factory submit following:
 - 1) Coatings used.
 - 2) Manufacturer's written certificate factory applied coating system is identical to, or exceeds, specified requirements.
 - 3) Requirements for touch-up or coating.
 - 4) History of coating performance in same environment.
- c. Submit following for factory-applied first coat.
 - 1) First coat used.
 - 2) CONTRACTOR'S certification factory applied first coat is compatible with field applied finish coats.

2. Certification:

- a. Certification that products supplied comply with volatile organic compounds (VOCs) requirements specified herein or local regulations if more restrictive.

3. Schedules:

- a. Submit schedule of proposed coating systems within 60 calendar days of Award of Contract.
- b. Schedule of proposed coating systems shall identify same information as shown in coating schedule.

C. Submit in accordance with Section 01 33 10.

1.04 QUALITY ASSURANCE

A. Applicator Qualifications:

- 1. Engage an experienced applicator who has successfully completed coating system applications similar in material and extent to those indicated for Project.

B. Single-Source Responsibility:

- 1. Provide coating material produced by same manufacturer for each system. Use only thinners recommended by manufacturer and only within recommended limits.

C. Manufacturer shall supply products that comply with OTC/LADCO controlling use of volatile organic compounds (VOC's) or local regulations if more restrictive..

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver material in original, sealed, unopened packages and containers bearing manufacturer's name. Each container shall have manufacturer's printed label stating type of coating, color of coating, instructions for reducing, and spreading rate.
- B. Protect storage location and maintain temperature ranges recommended by coating manufacturer for most sensitive coating, but not less than 55°F.
- C. Keep storage area neat and clean and replace or repair damage thereto or to its surroundings.
- D. Avoid danger of fire. Deposit cleaning rags and waste materials in metal containers having tight covers or remove from building each night. Provide fire extinguishers of type recommended by coating manufacturer in areas of storage and where finishing is occurring. Allow no smoking or open containers of solvents. Store solvents in approved safety cans. Give special attention to possible hazards in areas of existing buildings.
- E. Empty containers shall have labels canceled and be clearly marked as to use.
- F. Upon Substantial Completion, remaining material will become property of OWNER. Seal material as required for storage, marked as to contents and shelf life, and store where required by OWNER.

1.06 PROJECT/SITE CONDITIONS

- A. Environmental Requirements:
 - 1. Do not apply exterior coating in cold, foggy, damp or rainy weather.
 - 2. Apply no finish in rooms where dust is being generated.
 - 3. Do not apply exterior coating when temperature is lower than 50°F or as required by manufacturer.
 - 4. Maintain interior temperature and relative humidity of space, as recommended by coating manufacturer, 24 hrs before applying and until coating is cured.
- B. Protection:
 - 1. Cover materials and surfaces, including floors, adjoining or below Work with clean drop cloths or canvas.
 - 2. Remove hardware, accessories, plates, lighting fixtures, and similar items or provide protection by masking. Upon completion, replace above items or remove protection and clean.
 - 3. Maintain manufacturer's environmental requirements while coating dries.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Coatings:
 - 1. Sherwin-Williams
 - 2. Tnemec Company, Inc..
 - 3. Or equal.

2.02 MATERIALS

- A. Coatings:
 - 1. Color shall be formed of pigments free of lead, lead compounds or other materials which might be affected by presence of hydrogen sulfide or other gases likely to be present at Project.
 - 2. Coatings shall meet surface burning characteristics as required by code and established by ASTM E84.

2.03 COLORS

- A. Colors shall be selected and approved by OWNER.
- B. Prior to beginning work, ENGINEER will provide color coordinating schedule. System color coding shall comply with Section 40 05 05.
- C. Coat access doors, electrical distribution panels, grilles, and heating units to match color of adjacent wall or ceiling surfaces.
- D. In areas scheduled for finishing, coat exposed piping, conduit, and ducts to match adjacent or near surfaces, except for color coding.
- E. In areas where existing surfaces are coated, coat new exposed piping, conduit, and ducts to match adjacent or near surfaces, except for color coding.
- F. Rooms and spaces may have certain walls coated different color than other walls in same room and ceilings and trim may be different color or colors than walls.
- G. Equipment Colors:
 - 1. Equipment includes equipment, motors, and structural supports, fasteners, and attached portions of electrical conduit.
 - 2. Coat equipment same color as piping equipment serves.

2.04 MIXING AND TINTING

- A. Tint undercoats similar to finish coats.

PART 3 EXECUTION

3.01 EXAMINATION

- A. If surfaces to be finished cannot be put into proper condition for finishing by customary cleaning, sanding, and puttying operations or if surfaces were improperly primed by others, report defects to CONTRACTOR and ENGINEER, in writing, or assume responsibility and correct unsatisfactory finish resulting from improper surfaces. Commencement of Work indicates acceptance of surfaces.
- B. Materials removed and replaced to correct defects due to Work placed on unsuitable surfaces shall be at CONTRACTOR'S expense.
- C. Where surface dryness is questioned, test with dampness indicating instrument. Do not apply coatings over surfaces where moisture content exceeds that permitted in manufacturer's printed instructions.
- D. Provide coats compatible with the surface and prior coats.

3.02 SURFACE PREPARATION AND TOUCH-UP

- A. General:
 - 1. Surfaces, including floors shall be clean, dry, and free of loose dirt, dust, and foreign matter before applying coating.
 - 2. Comply with coating manufacturer's recommendations for surface preparation.
- B. Gypsum board:
 - 1. Cut scratches, cracks, and abrasions in surfaces and openings adjoining trim as required, fill with plaster of paris, spackling or other approved material, bring flush with adjoining surface, and sand smooth and seal before application of priming coat when dry.
 - 2. Give suction spots second coat of primer before applying finish coat.
- C. Ungalvanized Ferrous Metal:
 - 1. General:
 - a. Round or chamfer sharp edges and grind smooth burrs, jagged edges, and surface defects.
 - b. Prepare welds and adjacent areas to remove undercutting or reverse ridges on weld bead, weld spatter on or adjacent to weld or area to be coated, and sharp peaks or ridges along weld bead. Grind embedded pieces of electrode or wire flush with adjacent surface of weld bead.
 - c. Coat surfaces same day prepared. Reprepare surfaces starting to rust before coating.

2. Cleaning Methods:

- a. Workmanship for metal surface preparation as specified shall conform with SSPC specifications as follows:
 - 1) SP-1: Solvent Cleaning
 - 2) SP-2: Hand Tool Cleaning
 - 3) SP-3: Power Tool Cleaning
 - 4) SP-5: White Metal Blast Cleaning
 - 5) SP-6: Commercial Blast Cleaning
 - 6) SP-7: Brush-off Blast Cleaning
 - 7) SP-8: Pickling
 - 8) SP-10: Near-White Blast Cleaning
 - 9) SP-11: Power Tool Cleaning to Bare Metal
 - 10) SP-12: Cleaning of Metals by Waterjetting Prior to Recoating
 - b. Wherever “solvent cleaning,” “hand tool cleaning,” “wire brushing,” or “blast cleaning,” or similar words of equal intent used in Specifications or coating manufacturer’s specifications, they shall be understood to refer to applicable SSPC specifications listed above.
 - c. Use hand tools to clean areas that cannot be cleaned by power tools.
3. Shop Preparation: Equipment, structural steel, metal doors and frames, metal louvers, and similar items may be shop-prepared and first coat applied at CONTRACTOR’S option. Centrifugal wheel blast cleaning is acceptable alternate to shop blast cleaning. Clean and prime in accordance with this section.
 4. Field Touch-Up: Sandblast items and equipment as specified to restore damaged surfaces previously shop or field blasted and first coat applied. Materials, equipment, procedures, and safety equipment for personnel shall conform to SSPC.

D. Galvanized Metal:

1. Touch-up damaged areas with zinc-rich primer.
2. Prepare galvanized metal surfaces to be coated as required for system being applied.

E. Masonry:

1. Remove loose grit and mortar.
2. Remove grease, oil, dirt, salts or other chemicals, loose materials or other foreign matter by solvent, detergent or other suitable cleaning methods.

F. Cast-in-Place Concrete/Precast Concrete:

1. Do not begin surface preparation until 30 days after concrete has been placed.
2. Remove grease, oil, dirt, salts or other chemicals, loose materials or other foreign matter by solvent, detergent or other suitable cleaning methods.
3. Brush-blast all surfaces to be coated to create surface profile similar to medium (60-80) grit sandpaper. Care should be taken not to open up bug holes and voids in concrete by overblasting substrate. All large bug holes and voids created by blasting objective shall be filled with appropriate filler prior to painting surface. Surface must be clean, dry and free

of oil, grease and other contaminants. If brush-off blasting is impractical, acid etch with muriatic acid solution and wash with water or neutralizing agent as required by coating manufacturer. Surface blasting may be done at precast plant or on-site before units are installed.

4. Cleaning Methods: Workmanship shall conform with SSPC specifications as follows:
 - a. SP-13: Surface Preparation of Concrete
 - b. ICRI03732, CSP 1-3

G. Plastic:

1. Solvent clean pipe in accordance with manufacturer's recommendations.
2. Hand sand with medium grit sandpaper to provide tooth for coating system.
3. Large areas may be power sanded or brush-off blasted, provided sufficient controls employed so surface roughened without removing excessive material.

H. Existing Concrete, Concrete Block and Precast Concrete:

1. All previously coated walls and ceilings of concrete and concrete block of existing structures, except as noted, shall be pole-sanded and hand-sanded to remove all old peeling paints as well as roughen-up existing paints.

3.03 APPLICATION

A. General Requirements:

1. Spread evenly and flow on smoothly without runs, lumps or sags.
2. Make edges of coating adjoining other materials or colors sharp and clean without overlapping.
3. Number of coats and film thickness required is same regardless of application method. Do not apply succeeding coats until previous coat has cured as required by manufacturer. Where sanding is required, according to manufacturer's direction, sand between applications to produce smooth, even surface.
4. Finish edges of doors as specified for faces. Apply one coat finish on tops and bottoms of doors after fitting.
5. Term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convactor covers, covers for finned tube radiation, grilles, and similar components are in place. Extend coatings in these areas, as required, to maintain system's integrity and provide desired protection.
 - a. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces.
 - b. Coat back sides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - c. Omit first coat on metal surfaces that have been shop-primed and touch-up painted.
6. Manufacturer Applied Coating Systems:
 - a. Repair abraded areas on factory-finished items in accordance with manufacturer's directions.

- b. Blend repaired areas into original finish.
7. Existing Surfaces:
- a. If finish coat will not produce uniform coverage, provide first coat base over existing Work.
 - b. Where ceilings or walls scheduled for patching or remodeling, coat entire ceiling or wall in that area.
 - c. At altered rooms, wherever new Work adjoins existing Work, finish new Work to match existing.
8. Application Procedures:
- a. Apply coatings by brush, roller, spray, or other applicators according to manufacturer's instructions.

B. Priming and Sealing:

- 1. Refer to Coating Schedule for specific coating material.
- 2. Shop Coating:
 - a. Shop first coat for ferrous metal shall comply with SSPC guidelines, and as specified in Coating Schedules of this Specification.
 - b. Hand or power sand chipped, peeled or abraded first coat and feather edges. Spot coat areas with specified first coat.
 - c. Prior to application of finish coats, clean shop first coat surfaces free of dirt, oil, and grease.
 - d. Prepare and prime holdback areas as required for specified coating system.

3.04 FIELD QUALITY CONTROL

A. Sampling of Materials:

- 1. ENGINEER reserves right to select unopened containers of materials furnished for project and have materials tested at an independent testing laboratory. OWNER will pay for first tests.
- 2. Retests of rejected materials and tests of replacement materials shall be paid for by CONTRACTOR.
- 3. Remainder of contents of containers not required for testing will be returned to CONTRACTOR.

B. Coverage:

- 1. Before beginning Work, finish one complete room, space surface, or item of each color scheme required, showing selected colors, finished texture, material, and workmanship. After approval, sample rooms or items shall serve as standard for similar Work throughout building.
- 2. If coverage is not acceptable to ENGINEER, ENGINEER reserves right to require extra application of paint at no extra cost to OWNER.

3. Work at site where coat of material is applied will be inspected by ENGINEER before application of succeeding specified coat, otherwise no credit for coat applied will be given and CONTRACTOR automatically assumes responsibility to recoat Work in question. Furnish ENGINEER report of particular coat applied and when completed for inspection to comply with above.

3.05 COATINGS SCHEDULE

A. General:

1. Unless otherwise noted, Sherwin-Williams, products are identified in this schedule to establish quality and type desired.
2. Scheduled thickness or coverage rate is as recommended by Sherwin-Williams. If other manufacturers are proposed and accepted, manufacturer's requirements shall be followed, but in no case may thickness or coverage rate be less.
3. DFT = dry film thickness (mils/coat). DFT shown is for spray application. Additional coats may be required if brushed and rolled.
4. sfpg = sq ft/gal (per coat).
5. Examples of surfaces to be coated are not all inclusive.

B. Standard Coating Schedule:

Example Surfaces	Surface Preparation	Sherwin-Williams Meets OTC/LADCO
Concrete Masonry	Masonry, Clean and dry.	S-W Cement-Plex 875 to fill bug holes and voids First Coat - 166 sq ft/gal sprayed and backrolled. S-W Macropoxy 646 Second Coat - 5.0 to 10.0 DFT/ S-W Macropoxy 646 Third Coat - 5.0 to 10.0 DFT/ S-W Macropoxy 646
Structural Members, Pipe Hangers	SP6	First Coat - 4.0 – 6.0 DFT/ S-W Macropoxy 646. Second Coat - 4.0 to 6.0 DFT/ S-W Macropoxy 646 Third Coat - 4.0 to 6.0 DFT/ S-W Macropoxy 646
Factory Primed Miscellaneous Metals and Equipment	Sand to abrade surface followed by SSPC-SP1 with non-hydrocarbon solvent	First Coat - 3.0 – 5.0 mils DFT / S-W Macropoxy 646 . Second Coat (Interior) - 3.0 – 5.0 mils DFT/ S-W Macropoxy 646 epoxy. Second Coat (Exterior) - 3.0 – 4.0 DFT/ S-W Hi-Solids Polyurethane S/G
Pipes, Equipment, Vinyl Coated Pipe Insulation	Lightly Sanded	First Coat - 3.0 - 5.0 DFT/ S-W Macropoxy 646.

Example Surfaces	Surface Preparation	Sherwin-Williams Meets OTC/LADCO
Insulated Ducts and Pipes	As required for insulation surface	First Coat –2.0 to 4.0 DFT/ S-W Pro-Industrial Pro-Cryl Universal Primer Second Coat - 2.0 – 4.0 mils DFT S-W Waterbased Catalyzed Epoxy Eg-Shel
Dissimilar Material Protection	As required by material	First Coat - 4.0 – 6.0 DFT / S-W Macropoxy 646
Vinyl-Coated Pipe and Duct Insulation	Hand Sanded	First Coat - 4.0 to 6.0 DFT / S-W Macropoxy 646
Equipment, Pipes	SP10 NAPF 500-03-04 Abrasive Blast Cleaning For Ductile Iron Pipe NAPF 500-03-05 Abrasive Blast Cleaning for Cast Ductile Iron Pipe	First Coat - 3.0 to 5.0 mils DFT/ S-W Macropoxy 646 PW. Second Coat – 4.0 – 6.0 DFT/ S-W Macropoxy 646 PW Third Coat 5.0 – 7.0 mils DFT/ S-W Macropoxy 646 PW (Note: SherPlate PW, being 100% solids, holds up to more stringent water quality standards common in Canada and Northeastern U.S.)
Concrete and Precast Concrete	ICRI No. 310.2 CSP 3-5	First Coat – 4.0 – 6.0 DFT S-W Corobond 100 Filler – FT910 as required to provide a continuous substrate Second Coat - 5.0 – 10.0 mils DFT S-W Core-Cote HP FF Third Coat - 5.0 – 10.0 mils DFT S-W Cor-Cote HP FF
Gypsum Board		First Coat: 1.0 DFT / S-W ProMar 200 Zero VOC Latex Primer, B28W2600 Second Coat: 2.0 DFT / S-W Pro Industrial Water Based Catalyzed Epoxy Gloss, B73-300 Series Third Coat: 2.0 DFT / S-W Pro Industrial Water Based Catalyzed Epoxy Gloss, B73-300 Series

3.06 SYSTEMS COLOR CODING AND LABELING SCHEDULE

- A. Colors for piping and equipment in piping systems are specified in Section 40 05 05 .

3.07 FINAL TOUCH-UP

- A. Prior to Substantial Completion, examine coated surfaces and retouch or refinish to leave surfaces in condition acceptable to ENGINEER.

3.08 CLEANING

- A. Before Substantial Completion, remove masking, coating, and other material from floors, glass, and other surfaces and remove rubbish and accumulated materials of whatever nature not caused by other trades from premises and leave in clean, orderly condition, with floors broom clean.

END OF SECTION

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DIVISION 22

PLUMBING

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SECTION 22 00 10
PLUMBING SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Domestic Water Piping Systems:
 - a. Domestic cold water piping.
 - b. Domestic hot water piping.
 - c. Domestic recirculating water piping.
 - d. Exterior water piping.

2. Waste Piping Systems:
 - a. Above ground, waste, and vent piping within buildings including vent stacks, horizontal branches, traps, and connections to fixtures and drains.
 - b. Underground building drain piping including mains, branches, traps, connections to fixtures and drains, and connections to stacks terminating at connection to sanitary sewers 10 ft outside inner face of foundation wall.

3. Storm Water Piping System:
 - a. Conductor piping from roof drains and deck drains to storm building drain.
 - b. Storm building drain piping from conductor piping and area drains to concrete splash pad 1 ft outside inner face of foundation wall.

1.02 SUBMITTALS

A. Schedule below identifies information required for each item of material or equipment.

	Unit Type	Submittal Information Item
1.	Valves	1
2.	Hydrants	1
3.	Water heater	1, 2, 3, 5
4.	Sump pumps	1, 2, 3, 4, 5
5.	Fixtures and trim	1, 2
6.	Insulation	1

B. Submittal Information:

1. Product Data: Manufacturer's specifications for units showing dimensions, weights, capacities, ratings, performance characteristics, gauges, color, and finished of materials, and installation instructions.

2. Product Data: Motors; for poly-phase motors 5 hp and larger, submit in accordance with requirements of Section 26 05 90. For single-phase motors and poly-phase motors less than 5 hp, submit NEMA design types, construction, installation class, NEMA frame size, horsepower, voltage and amp draw characteristics, and service factor.
3. Shop Drawings, Assembly Drawings: Show unit dimensions, rough-in elevations, construction details, and field connection details.
4. Shop Drawings, Wiring Diagrams: Manufacturer's electrical requirements for power supply wiring to units.
5. Shop Drawings, Wiring Diagrams: Manufacturer's ladder type for interlock and control wiring. Differentiate between portions of wiring factory-installed and portions to be field installed.
6. Operating and Maintenance (O&M) Data:
 - a. Maintenance instructions including lubrication instructions, filter replacement, motor and drive replacement, and spare parts lists.
 - b. Include O&M data, product data, and Shop Drawings in single-bound manuals.

C. Submit Items 1 through 5 in accordance with Section 01 33 10.

D. Submit Item 6 in accordance with Sections 01 33 10.

E. Information submitted by CONTRACTOR, but not designated to be submitted will be returned without action by ENGINEER.

1.04 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of plumbing systems products of types, materials, and sizes required, whose products have been in satisfactory use in similar service.

B. Plumbing Code Compliance: Comply with applicable portions of building codes pertaining to plumbing materials, construction, and installation of products.

1. Wisconsin Administrative Code:

a. SPS 382 - Design, Construction, Installation, Supervision, and Inspection of Plumbing.

C. PDI Compliance: Comply with applicable PDI standards pertaining to products and installation of soil and waste piping systems.

PART 2 PRODUCTS

2.01 GENERAL

A. Where more than one type is indicated, selection is CONTRACTOR'S option or compliance with governing regulations.

B. Size system drain piping as shown or, if not shown, as required to properly drain piping systems, including valves and equipment.

- C. Manufacturer's equipment used as basis of design for project is name indicated in Specifications for particular type of equipment or application contained in these Contract Documents. If no manufacturer listed, basis of design is industry standard indicated.

2.02 WATER SUPPLY SYSTEM

- A. Tube Size 2-1/2 in. and smaller, buried:

1. Copper Tube: ASTM B88, Type K.
2. Fittings: Brass flared connections.
3. Valves: Class 150 bronze.

- B. Tube Size 2-1/2 in. and smaller, interior:

1. Copper Tube: ASTM B88, Type L.
2. Fittings: Wrought copper solder joint.
3. Valves: Class 125 bronze gate, ball or globe valve.

2.03 SOIL, VENT AND STORM SYSTEMS PIPING

- B. Pipe Size 10 in. and smaller, above ground only:

1. Cast Iron: CISPI 301 hubless soil pipe and fittings.
2. Service weight.

- C. Pipe Sizes 3 in. and smaller, above ground only:

1. Steel Pipe: ASTM A153/A153M, galvanized, Schedule 40.
2. Fittings: Class 125 galvanized cast iron threaded or cast iron threaded drainage.

- D. Pipe Sizes 4 in. and smaller:

1. Poly Vinyl Chloride (PVC) plastic pipe.
2. Pipe Weight: Type DWV.
3. Fittings: PVC plastic, Type DWV, socket type, solvent cement joints.

- E. Pipe Sizes 4 in. and smaller:

1. Acrylonitrile-Butadiene-Styrene (ABS) plastic tube.
2. Pipe Weight: Type DWV.
3. Fittings: ABS plastic, Type DWV, socket type, solvent cement joints.

- F. Pipe Size 2 in. and smaller, acid resistant:

1. Polypropylene (PP) plastic pipe.
2. Fittings: PP plastic, Type DWV, heat fusion joint.

2.04 SUMP PUMP PIPING

A. Pipe Size 1-1/4 in.:

1. Steel Pipe: ASTM A53/A53M, galvanized, Schedule 40.
2. Fittings: Class 125 galvanized cast iron threaded drainage.

2.05 DRAINAGE AND VENT PIPING PRODUCTS

A. Floor Cleanout:

1. Manufacturers:
 - a. J.R. Smith, Series 4020.
 - b. Zurn.
 - c. Or equal.
2. Cast iron body, round adjustable, scoriated secured nickel bronze top, straight thread gasket seal closure plug.

B. Wall Cleanouts:

1. Manufacturers:
 - a. J.R. Smith, Figure 4422.
 - b. Zurn.
 - c. Or equal.
2. Cast iron body adaptable to pipe with cast bronze or brass cleanout plug.

C. Flashing Flanges:

1. Products recommended by manufacturer for use in service indicated.
2. Include clamping device.

D. Hub Drains:

1. Manufacturers:
 - a. J.R. Smith, Figure 2010-A.
 - b. Zurn.
 - c. Or equal.
2. Vandal proof cast iron floor drains, in sizes indicated, with 8 in. polished bronze strainer and flashing collar.
3. Screw anchors matching strainer finish.

F. Roof Drain:

1. Manufacturers:
 - a. J.R. Smith, Figure 1010.
 - b. Zurn.
 - c. Or equal.
2. Cast iron body, combined flashing clamp and gravel stop, under deck clamp, aluminum dome, in size indicated.

2.06 VALVES AND ACCESSORIES

A. Ball Valves 3/4 in. and smaller:

1. Manufacturers:
 - a. Nibco, Figure T-585-Y.
 - b. Wolverine Brass.
 - c. Or equal.
2. Bronze body, screwed, brass or stainless steel ball, full port, Teflon seat rings, 125 psi WP steam.

B. Ball Valves 1 in. through 2 in.

1. Manufacturers:
 - a. Nibco, Figure T-580-Y.
 - b. Wolverine Brass.
 - c. Or equal.
2. Bronze body, screwed, brass or stainless steel ball, conventional port, Teflon seat rings.
 - a. Nibco Figure T-580-Y.
 - b. Wolverine Brass.
 - c. Or equal.

C. Swing Check Valve:

1. Manufacturers:
 - a. Jenkins, Figure 92-A.
 - b. Nibco.
 - c. Or equal.
2. Bronze, regrinding, screwed, 40° to 45° seating angle.
 - a. Jenkins Figure 92-A.

- b. Nibco.
- c. Or equal.

D. Wall Hydrants:

- 1. Manufacturers:
 - a. Woodford, Model 25.
 - b. Zurn.
 - c. Or equal.
- 2. 3/4 in. brass body, molded, nitrile valve, vacuum breaker with 3/4 in. male hose thread.

E. Hose Bibbs:

- 1. Manufacturers:
 - a. Woodford, Model 24.
 - b. Nibco.
 - c. Or equal.
- 2. 3/4 in. brass body, nickel plated, Teflon packing, vacuum breaker with 3/4-in. male hose thread.
- 3. 1-1/2-in. cast brass, 200 lb WOG, 1-1/2-in. female NPT inlet, male outlet hose thread, cap with chain, Elkhart brass Model 88, or equal. 50 ft linen 1-1/2 in. hose with semi-automatic hose rack Elkhart brass Model 5-41-R, or equal. 1-1/2 in. straight bore nozzle combination, nozzle with ball shutoff Elkhart brass Model LB-275-TB, or equal.

F. Backflow Preventer:

- 1. Manufacturers:
 - a. Watts, No. 9D.
 - b. Febco.
 - c. Or equal.
- 2. 3/4 in. bronze construction, stainless steel internal parts, continuous pressure with intermediate atmospheric vent.

G. Backflow Preventer:

- 1. Manufacturers:
 - a. Watts No. 909.
 - b. Or equal.
- 2. Reduced pressure principle, cast iron epoxy coated body, bronze seats, bronze relief valve with stainless steel trim.

2.08 FIXTURES

A. General:

1. Provide factory fabricated fixtures of size, type, rating, and capacity indicated.
2. Where not indicated, provide proper selection, as determined by CONTRACTOR, to comply with installation requirements.
3. Provide sizes and types matching piping and equipment connections.

B. Sump Pump:

1. Manufacturers:
 - a. Liberty Pumps, Model 231
 - b. Weil.
 - c. Or equal.
2. Cast iron housing and volute, aluminum impeller, 10 ft of head, 1,920 gal/hr, 4-pole, 115v, 1 ph, with 8 ft power cord.
3. Provide properly sized steel sump cover.

C. Instantaneous Water Heater:

1. HAWS Model TWBS.EW, instantaneous water heater, up to 6 GPM, 480 VAC/3 phase/20 kW, with included hot shutoff valve, bypass valve, 45-90 psi required.

D. Emergency Eyewash Station:

1. Global Industries Model No. 708381, Bradley or equal twin eyewash heads with face-spray ring. Bowl and spray ring shall be stainless steel construction. Heads shall be covered with ABS plastic. Eyewash shall be equipped with push type ball valve that stays open until manually closed, mounted on 1-1/4 in., painted galvanized pipe pedestal with 9 in. floor flange. Install with a shut-off valve on the supply line for servicing.

2.09 INSULATION

A. Fibrous Glass Insulation:

1. Manufacturers:
 - a. Owens-Corning.
 - b. Manville.
 - c. Or equal.
2. 1 in. thick, 3.5 lb density with laminated white vapor barrier jacket.
3. Ratings not exceeding flame spread of 25 and smoke developed of 50 (Test Method ASTM E84).

B. Flexible Unicellular Pipe Insulation (Below Grade):

1. Manufacturers:
 - a. Manville.
 - b. Rubatex.
 - c. Or equal.
2. ASTM C534, Type I, density 4.5 to 8.5 pcf.
3. Maximum ASTM C96 permeability = 0.3 perm-in.
4. Maximum $k = 0.30 \text{ Btu-in./hr-sq ft-}^\circ \text{F}$, at 75° F to 200° F (95° C), with PVC jacket and fittings sealed at joints.

PART 3 EXECUTION

3.01 GENERAL

- A. Trench, backfill, and compact in accordance with Section 31 23 33.
- B. Install pipe hangers, supports, and anchors in accordance with Section 22 05 29.
- C. Install wall pipes, sleeves, and seals in accordance with Section 22 05 29.
- D. Install valves in accordance with Section 22 05 23.

3.02 PIPING INSTALLATION

- A. General:
 1. Install pipe, tube, and fittings in accordance with recognized industry practices achieving permanently leakproof piping systems, capable of performing each indicated service without piping failure.
 2. Install each run with minimum joints and couplings, but with adequate and accessible unions for disassembly and maintenance or replacement of valves and equipment.
 3. Reduce sizes (where indicated) by use of reducing fittings.
 4. Align piping accurately at connections, within 1/16 in. misalignment tolerance.
 5. Comply with ASME B31.9 - Building Service Piping.
- B. Pipe Locations:
 1. Locate piping runs, except as otherwise indicated, vertically and horizontally (pitched to drain), and avoid diagonal runs wherever possible.
 2. Orient horizontal runs parallel with walls and column lines.
 3. Locate runs, as shown or described by diagrams, details, and notations or, if not otherwise indicated, run piping in shortest route which does not obstruct usable space or block access for servicing building and equipment.
 4. Hold piping close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building; limit clearance to 1/2 in. where furring is shown for enclosure to concealment of piping, but allow for insulation thickness, if any.
 5. Where possible, locate insulated piping for 1.0 in. clearance outside insulation.

6. Wherever possible in finished and occupied spaces, conceal piping from view by locating in column enclosures, hollow wall construction or above suspended ceilings; do not encase horizontal runs in solid partitions, except as indicated.

C. Electrical Equipment Spaces:

1. Do not run piping through transformer vaults and other electrical or electronic equipment spaces and enclosures unless unavoidable.
2. Install drip pan under piping that must be run through electrical spaces.

D. Expansion Compensation:

1. Install piping including mains, branches, and runouts with sufficient offsets to allow for free expansion and contraction and sufficient to prevent leaks and overstressing of piping system.

F. Installation of Soil and Vent Piping:

1. Install horizontal piping on constant grade, avoiding pockets. Minimum grade of 1/8 in./ft for mains and 1/4 in./ft for branches.
2. Cleanouts:
 - a. Install cleanout plugs at each 90° change in direction in suspended horizontal piping.
 - b. Where not otherwise indicated, install cleanouts at 50 ft intervals in piping 3 in. and smaller, and 100 ft intervals in piping 4 in. and larger.
 - c. Install floor and wall cleanouts at locations indicated.
3. Flashing Flanges:
 - a. Install flashing flange and clamping device with each cleanout passing through waterproof membrane.
4. Testing:
 - a. Test soil and vent piping system in accordance with requirements of Plumbing Code.

3.03 FIXTURES

A. Plumbing Fixtures:

1. Install in accordance with manufacturer's written instructions and as called for and required by codes.
2. Verify locations and coordinate with architectural designs and other devices and equipment, as approved by ENGINEER before roughing-in connections.
3. Operation of fixtures shall be tested for proper operation and adjusted for field connections and service use, as required.

B. Sump Pump:

1. Install in accordance with manufacturer's written instructions, provide discharge with union and check valves.

3.04 PIPE INSULATION

- A. Install in accordance with manufacturer's written instructions, install after testing and acceptance of piping system, and insulate each continuous run of piping with full-length units. Do not use cut pieces or scraps abutting each other, maintain integrity of vapor barrier jacket on pipe insulation.
- B. Cover valves, fittings, and similar items in each piping system with equivalent thickness and composition of insulation, install factory molded or precut on job fabricated units.
- C. Install insulation on domestic hot, cold, and storm water piping and roof drain bowl.
- D. Replace damaged insulation which cannot be repaired.

3.05 CLEANING AND STERILIZATION

- A. Clean and sterilize domestic water piping system as required by health authorities having jurisdiction and in accordance with Section 33 13 00 and Plumbing Code.
- B. Plate count must be less than 10 spc/ml.

3.06 TESTING PIPING SYSTEMS

- A. Test piping system in accordance with Section 22 08 10 and Plumbing Code.

END OF SECTION

DIVISION 23

HEATING, VENTILATING AND AIR CONDITIONING

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SECTION 23 00 10
HEATING AND VENTILATING SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Heating:
 - a. Gas-fired unit heater.
2. Ventilation:
 - a. Exhaust fan with gravity ventilator hood.
 - b. Damper.
 - c. Ductwork and grilles.
 - d. Fan coil unit.
3. Controls:
 - a. Thermostats.
 - b. Damper operators.

B. Refer to Division 16 sections for following work; not work of this section.

1. Power supply wiring from power source to power connection on equipment. Include starters, disconnects, and required electrical devices, except where specified as furnished or factory-installed, by manufacturer.
2. Interlock wiring between equipment and field-installed control devices.

C. Provide following electrical work as work of this section, complying with requirements of Division 16 sections:

1. Control wiring between field-installed controls, indicating devices, and ventilators.

1.02 SUBMITTALS

A. Schedule below identifies information required for each item of material or equipment:

Schedule:

Unit Type	Submittal Information Item
Unit Heaters	1, 2, 3, 4, 5
Grilles	1
Dampers	1
Exhaust Fans	1, 2, 3, 5, 6

Unit Type	Submittal Information Item
Gravity Ventilator Hoods	1

B. Submittal Information:

1. Product Data: Submit manufacturer's technical product data including rated capacities of selected model clearly indicated, performance characteristics, weights, furnished specialties and accessories, and installation and startup instructions. Provide characteristic fan curves, gauges, color, and finish of materials.
2. Shop Drawings: Submit manufacturer's assembly type drawings indicating dimensions, weight loadings, required clearances, and method of assembly of components.
3. Shop Drawings, Wiring Diagrams: Manufacturer's electrical requirements for power supply wiring to terminal units.
4. Shop Drawings, Wiring Diagrams: Manufacturer's ladder type for interlock and control wiring. Differentiate between portions of wiring that are factory-installed and portions to be field installed.
5. Motors: For polyphase motors 5 hp and larger, submit in accordance with requirements of Section 26 05 90. For single phase, definite purpose, special purpose and polyphase motors less than 5 hp, submit NEMA design types, construction, insulation class, NEMA frame size, horsepower, voltage and amp draw characteristics, and service factor for each common application.
6. Operating and Maintenance (O&M) Data:
 - a. Maintenance instructions including lubrication instructions, filter replacement, motor and drive replacement, and spare parts lists.
 - b. Include O&M data, product data, and Shop Drawings in single bound manuals.

C. Submit in accordance with Section 01 33 10.

D. Information submitted by CONTRACTOR, but not designated to be submitted will be returned without action by ENGINEER.

1.03 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture products of types, materials, and sizes required, whose products have been in satisfactory use in similar service.

B. Code Compliance: Comply with applicable portions of building codes pertaining to plumbing materials, construction, and installation of products.

1. Wisconsin Administrative Code:
 - a. SPS 363 - Energy Conservation.
 - b. SPS 364 - Heating, Ventilating and Air Conditioning.

PART 2 PRODUCTS

2.01 GENERAL

- A. Where more than 1 type is indicated, selection is CONTRACTOR'S option or compliance with governing regulations.
- B. Manufacturer's equipment used as basis of design for this project is name indicated in specification for particular type of equipment or application contained in Contract Documents. If no manufacturer is listed, basis of design is industry standard indicated.

2.02 GAS-FIRED UNIT HEATER

- A. Manufacturers:
 - 1. Modine.
- B. General:
 - 1. Except as otherwise indicated, provide manufacturer's standard electric propeller unit heater materials and components as indicated by published product information, designed and constructed as recommended by manufacturer, and as required for complete installation.
- C. Heating Elements:
 - 1. Provide elements of indicated duty and rated for indicated capacity, consisting of resistance elements in steel sheath with extended fins, or in spiral sheath.
- D. Casing:
 - 1. General:
 - a. Provide casing braced and reinforced to provide required stiffness and containing heating element supports.
 - d. Fabricate from 22 ga aluminized steel.
- E. Air Deflectors:
 - 1. Provide manufacturer's standard air deflectors of following types:
 - a. Adjustable air-deflector blades.
- F. Motors:
 - 1. Comply with Section 26 05 90 except as provided in this Section.
 - 2. Provide totally enclosed shaded pole or permanent split capacitor motors, Class B insulation, resiliently mounted, tap wound with built-in thermal overload protection, sleeve bearings or permanently lubricated ball bearings.

3. Internal Wiring: Provide high temperature, heat resistant wiring in flexible metal conduit from terminal junction box to electrical devices. Provide fuses in motor and control circuit wiring.
4. Devices:
 - a. Thermally activated fan switch to keep fan motor operating until residual heat dissipated.
 - b. Disconnect switch.
 - c. Automatic reset, high limit cut-out switch located in discharge air stream.
 - d. Magnetic contactor.
 - e. Transformer.
 - f. Manual Summer-Off-Winter switch.
 - g. Wall-mounted thermostat.

G. Fans:

1. Provide aluminum blower fans, balanced statically and dynamically of indicated capacity suitable for standard or spark proof application.

2.03 DAMPERS

A. Manufacturers:

1. Ruskin, CD-50.
2. Or equal.

B. Provide automatic control dampers as indicated with damper frames not less than formed 13 ga galvanized steel. Provide mounting holes for enclosed duct mounting. Provide damper blades no less than formed 16 ga galvanized steel with maximum blade width of 8 in. Equip dampers with motors, with proper rating for each application.

1. Secure blades to 1/2 in. diameter, zinc plated axles using zinc plated hardware. Seal off against spring stainless steel blade bearings. Provide blade bearings of nylon and thrust bearings at each end of every blade. Construct blade linkage hardware of zinc plated steel and brass. Submit leakage and flow characteristics, plus size schedule for controlled dampers.
2. Operating Temperature Range: From -20°F to 200°F (-29°C to 93°C).
3. For standard applications as indicated, provide parallel or opposed blade design (as selected by manufacturer's sizing techniques) with optional closed cell neoprene edging.
4. For low leakage applications as indicated, provide parallel or opposed blade design (as selected by manufacturer's sizing techniques) with inflatable seal blade edging or replaceable rubber seals, rated for leakage at less than 10 cfm/sq ft of damper area at differential pressure of 4 in. wg when damper being held by torque of 50 in./lbs.

C. Damper Motors: Provide 115 volt, single-phase electric damper motors sized to operate dampers with sufficient reserve power to provide smooth 2-position action.

1. Provide permanent split capacitor or shaded pole type motors with gear trains completely oil immersed and sealed. Equip spring return motors with integral spiral spring mechanism. Furnish entire spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches or feedback potentiometer.

2. Equip motors for outdoor locations and outside air intakes with 0-ring gaskets designed to make motors completely weatherproof, and internal heaters permitting normal operation at -40°F.

2.04 EXHAUST FAN

A. Manufacturers:

1. Greenheck Fan Co.
2. Or equal.

B. Provide centrifugal roof type, ceiling mounted, power ventilators of type, size, and capacity shown on Drawings, and specified herein.

C. Type: Centrifugal fan, direct driven as scheduled. Provide hangars to securely mount fan to ceiling.

D. Electrical: Provide factory-wired disconnect switch at motor in fan housing. Provide fusible type for polyphase motors. Provide conduit chase within unit for electrical connection.

1. Motors:

- a. Single Phase: Open, drip-proof machine, definite purpose, permanent split capacitor induction type, belt or direct driven as scheduled. Provide internal overload protection.

E. Color: Standard aluminum.

F. Room Thermostat: Provide line voltage, reverse-acting 56°F to 94°F temperature range, Fan-Off-Auto subbase.

2.05 GRAVITY VENTILATOR HOOD

A. Manufacturers:

1. Greenheck Fan Co.
2. Or equal.

B. General:

1. Comply with loading and strength requirements as indicated where units support other work. Coordinate dimensions with rough-in sheets or Shop Drawings of equipment to be supported.
2. Fabricate of structural quality sheet steel (ASTM A570/A570M, Grade as required) which has been prepared for painting and factory-primed and painted with 2 mil thickness of baked-on synthetic enamel after fabrication.
3. Fabricate with welded or sealed mechanical corner joints.
4. Except as otherwise indicated or required for strength, fabricate units of minimum 14 ga (0.0747 in.) metal.

- C. Sloping Roofs: Where slope of roof deck exceeds 1/4 in. per ft, fabricate units with height tapered to match slope to result in level installation of tops of units.

2.06 DUCTWORK

A. Exposed Ductwork Materials:

- 1. Where ductwork indicated to be exposed to view in occupied spaces, provide materials free from visual imperfections including pitting, seam marks, roller marks, oil canning, stains and discolorations, and other imperfections, including those which would impair painting.

B. Sheet Metal:

- 1. Except as otherwise indicated, fabricate ductwork from galvanized sheet steel.
- 2. ASTM A653/A653M, lock-forming quality, with ASTM A525, G90 zinc coating; mill phosphatized for exposed locations.

PART 3 EXECUTION

3.01 INSTALLATION OF GAS-FIRED UNIT HEATER

- A. Install gas-fired unit heater and thermostat as indicated and in accordance with recognized industry practices, to ensure heating terminal equipment fulfills requirements. Comply with applicable installation requirements of NFPA 70 and NECA'S "Standard of Installation."
- B. Coordinate with electrical work including wiring/cabling work, as necessary to interface installation of heating terminals with other work.
- C. Clean dust and debris from each heating terminal as installed to ensure cleanliness.
- D. Comb out damaged fins where bent or crushed before covering elements with enclosures.
- E. Touch up scratched or marred heating terminal enclosure surfaces to match original finishes.
- F. Provide equipment grounding connections, sufficiently tight to ensure permanent and effective ground for heating terminals as indicated.
- G. Upon completion of installation of heating terminals and after building circuitry energized, test heating terminals to demonstrate capability and compliance with requirements. Where possible, field correct malfunctioning units then retest to demonstrate compliance.
- H. Controls: Controls shall be integral with unit heater. Provide wiring between heater and wall mounted thermostat in accordance with Division 16.

3.02 INSTALLATION OF LOUVER AND DAMPER

- A. Examine areas and conditions under which air inlets are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

- B. Install air inlets in accordance with manufacturer's written instructions and recognized industry practices to ensure products serve intended functions. Install ducts pitched to drain to outside or provide supplemental drain piping.
- C. Coordinate with other work, including necessary interface to install air inlets with other work.
- D. Provide wiring to interlock damper motor with exhaust fan.

3.03 INSTALLATION OF EXHAUST FAN

- A. Except as otherwise indicated or specified, install ventilator in accordance with manufacturer's installation instructions and recognized industry practices to ensure ventilator serve intended function.
- B. Coordinate ventilator work with work of walls and ceilings necessary for proper interfacing.
- C. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted and reverse acting thermostat. Furnish copy of manufacturer's wiring diagram submittal to electrical installer.
 - 1. Verify electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division 16 sections. Verify proper rotation direction of fan wheels. Do not proceed with equipment startup until wiring installation is acceptable to equipment installer.
 - 2. Install thermostat on subbase. For single-phase motors, wire in series with unit disconnect in motor power circuit. For polyphase motors, wire into starter control circuit in series with automatic side of starter Hand-Off-Auto switch.
- D. Remove shipping bolts and temporary supports within ventilator. Adjust dampers for free operation.
- E. After installation of ventilators has been completed, test ventilator to demonstrate proper operation of units at performance requirements specified. When possible, field correct malfunctioning units, then retest to demonstrate compliance. Replace units which cannot be satisfactorily corrected.
- F. Controls: Wire thermostat, exhaust fan and motor operated dampers to operate as follows:
 - 1. "Off" Position - Fan motor off and dampers closed.
 - 2. "Hand" Position - Exhaust fan motor operates continuously and dampers open.
 - 3. "Auto" Position - When space temperature rises above thermostat setpoint (85°F, field adjustable) fan motor is energized and dampers open. When space temperature falls 2°F below setpoint, reverse procedure.

3.04 INSTALLATION OF GRAVITY VENTILATOR HOOD

- A. Comply with manufacturer's instructions and recommendations. Coordinate with installation of roof deck and other substrates to receive accessory units, roofing and flashing as required to ensure that each element of work performs properly, and that combined elements are waterproof and weathertight. Anchor units securely to supporting structural substrates, adequate to withstand lateral and thermal stresses as well as inward and outward loading pressures.
 - 1. Except as otherwise indicated install roof accessory items in accordance with construction details of "NRCA Roofing and Waterproofing Manual".
- B. Flange Seals: Except as otherwise indicated, set flanges of accessory units in thick bed of roofing cement, to form seal.
- C. Clean exposed metal and plastic surfaces in accordance with manufacturer's instructions. Touch up damaged metal coatings.

3.05 INSTALLATION OF DUCTWORK

- A. Assemble and install ductwork in accordance with recognized industry practices to achieve airtight (maximum 5% leakage) and noiseless (no objectionable noise) systems, capable of performing indicated service. Install each run with minimum of joints.
- B. Provide ductwork with inside dimensions equal to sizes indicated on Drawings.
- C. Align ductwork accurately at connections, within 1/8 in. misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with threaded rods, angles, and anchors of type holding ducts true-to-shape and preventing buckling. Strap hangers are not acceptable.
- D. After installation, seal ductwork to seal class recommended and method prescribed in SMACNA "HVAC Duct Standards Sealants."
- E. Install concrete inserts for support of ductwork in coordination with formwork.

END OF SECTION

DIVISION 33

UTILITIES

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SECTION 33 13 00

DISINFECTION OF BUILDING PROCESS WATER PIPES

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Section Includes:

1. Disinfection of water pipes in the Pump Station in accordance with AWWA C651.

1.02 REFERENCES:

A. American Water Works Association (AWWA):

1. C651: Disinfecting Water Mains.

B. Wisconsin Administrative Code, NR810 – Requirements for the operation and maintenance of public water systems.

C. Wisconsin Administrative Code, NR811 – Requirements for operation and design of community water systems.

1.03 SEQUENCING:

A. Basic procedure for disinfecting water mains:

1. Inspecting materials to be used to ensure their integrity.
2. Preventing contaminating materials from entering the water main during storage, construction, or repair and noting potential contamination at the construction site.
3. Removing, by flushing or other means, those materials that may have entered the water main.
4. Chlorinating any residual contamination that may remain, and flushing the chlorinated water from the main.
5. Protecting the existing distribution system from backflow caused by hydrostatic pressure test and disinfection procedures.
6. Documenting that an adequate level of chlorine contacted each pipe to provide disinfection.
7. Determining the bacteriological quality by laboratory test after disinfection.
8. Final connection of the accepted new water main to the active distribution system.

1.04 SUBMITTALS:

A. Submit the following in accordance with Section 01 33 00.

1. Supervisor qualifications.
2. Equipment list.
3. Proposed methods of disinfection.

1.05 QUALITY ASSURANCE:

- A. Comply with the requirements specified in Section 01 43 00.
- B. Regulatory Requirements:
 - 1. Disinfection work shall be acceptable to Owner and Wisconsin Department of Natural Resources. If requirements of this section are in conflict with requirements of regulatory agencies, the latter shall govern.
- C. Source Quality Assurance:
 - 1. Perform Work in connection with disinfection under direction of experienced supervisor.
 - 2. Use equipment in proper working condition and adequate for specified Work.
- D. Prior to starting disinfection work, furnish detailed outline of proposed sequence of operation, manner of filling and flushing units, source and quality of water to be used, and disposal of wasted water.
- E. Perform work in connection with disinfection under direction of experienced supervisor.
- F. Use equipment in proper working condition and adequate for specified work.

1.06 DELIVERY STORAGE AND HANDLING:

- A. Comply with the requirements specified in Section 01 61 00.

PART 2 - PRODUCTS

2.01 OWNER-SUPPLIED PRODUCTS:

- A. The Owner will provide potable water for the first disinfection effort. Submit request for use of water from waterlines of Owner 48 hours in advance. If bacteriological testing shows that the first disinfection effort was not successful, the Contractor will be charged, at the Owner's current rates, the cost of additional water for subsequent disinfection efforts.

2.02 MATERIALS:

- A. Water: Use potable water for cleaning and disinfection.
- B. Chlorine: Provide in accordance with AWWA C652.
 - 1. Liquid Chlorine: Inject with a solution feed chlorinator and a water booster pump. Follow the instructions of the chlorinator manufacturer.
 - 2. Calcium Hypochlorite (Dry): Dissolve in water to a known concentration in a drum and pump into the pipeline at a metered rate. Tablet form calcium hypochlorite may be used only for water mains up to 12 inches in diameter and less than 2,500 feet in length.
 - 3. Sodium Hypochlorite (Solution): Further dilute in water to desired concentration and pump into the pipeline at a metered rate.

2.03 EQUIPMENT:

- A. Submit list of equipment used for disinfecting work.

2.04 ACCESSORIES:

- A. Chlorine Residual Test Kit: For measuring chlorine concentration, supply and use a medium range, drop count, DPD drop dilution method kit per AWWA C651, Appendix A.1. Maintain kits in good working order available for immediate test of residuals at point of sampling.

PART 3 - EXECUTION

3.01 PREPARATION:

- A. Isolate new work being disinfected from system to avoid possibility of contaminating materials entering distribution system.
- B. Method of disinfection for water containment devices and piping systems shall conform to AWWA C651.

3.02 CHLORINE PREPARATION:

A. Liquid Chlorine:

1. Apply chlorine gas-water solution by means of solution feed chlorinating device or, if accepted by Engineer, dry gas may be fed directly through proper devices for regulating rate of flow and providing effective diffusion of gas into water within unit being treated.
2. Provide chlorinating devices for feeding solutions of chlorine gas that prevent backflow of water into chlorine cylinder.

B. Calcium Hypochlorite:

1. Prepare granular calcium hypochlorite as water mixture before introduction into unit. Make dry powder into paste and thin to approximately 1 percent chlorine solution.
2. To prepare chlorine solution, add 1 pound of calcium hypochlorite (65 to 70 percent available chlorine to 7-1/2 gallons of water).

3.03 PIPELINE PREPARATION:

- A. After pressure and leakage tests complete, flush units thoroughly to remove foreign material.
- B. Release entrapped air at high points and fill units with disinfecting agent and water to allow disinfecting agent to come in contact with interior surfaces.
- C. If complete venting cannot be accomplished through available outlets, provide necessary corporation cocks and vent piping.

3.04 PIPE DISINFECTING METHODS:

A. Continuous Feed Method:

1. Introduce potable water into the pipeline at a constant measured rate. Feed the chlorine solution into the same water at a measured rate. Proportion the two rates so that the chlorine concentration in the pipeline is maintained at a minimum concentration of 50 mg/L. Check the concentration at points downstream during the filling to ascertain that sufficient chlorine is being added.

B. Slug Method:

1. Introduce the water in the pipeline at a constant measured rate. At the start of the test section, feed the chlorine solution into the pipeline at a measured rate so that the chlorine concentration created in the pipeline is 100 mg/L. Feed the chlorine for a sufficient period to develop a solid column or "slug" of chlorinated water that will, as it passes along the line, expose all interior surfaces to a concentration of at least 100 mg/L for at least 3 hours.

C. Disinfection of Valves, Blind Flanges, and Appurtenances:

1. During the period that the chlorine solution or slug is in the section of pipeline, open and close valves to obtain a chlorine residual at hydrants and other pipeline appurtenances. Swab exposed faces of valves and blind flanges prior to bolting flanges in place with a 1 percent sodium hypochlorite solution.

D. Disinfection of Connections to Existing Pipelines

1. Disinfect isolation valves, pipe, and appurtenances in accordance with AWWA C651, Section 4.7. Flush with potable water until discolored water, mud, and debris are eliminated. Swab interior of pipe and fittings with a 1 percent sodium hypochlorite solution. After disinfection, flush with potable water again until water is free of chlorine odor.

E. Confirmation of Residual:

1. After the chlorine solution applied by the continuous feed method has been retained in the pipeline for 24 hours, confirm that a chlorine residual of 10 mg/L minimum exists along the pipeline by sampling at air valves and other points of access.
2. With the slug method, confirm by sampling as the slug passes each access point and as it leaves the pipeline that the chlorine concentration in the slug is at least 50 mg/L.

3.05 FINAL FLUSHING AND TEST:

A. Following chlorination, flush unit or system until replacement water in system is proven to be comparable in quality to water which will enter unit or system.

B. Above acceptable condition of water delivered by each unit or system shall continue for at least 2 days, as demonstrated by laboratory examination of samples. Laboratory tests shall show chlorine residual, after final flushing, of less than 1 mg/L (ppm).

- C. Repetition of Flushing and Testing:
 - 1. If initial treatment results in unsatisfactory bacterial test, repeat disinfection until satisfactory results obtained.
 - D. Prevent entry of contaminated water into previously disinfected units or systems.
 - E. Flushing water shall have no chlorine residual when discharging to surface water.
- 3.06 BACTERIOLOGIC TESTS:
- A. Collect two sets of samples per AWWA C651, Section 5.1, deliver to a certified laboratory within six hours of obtaining the samples, and obtain a bacteriologic quality test to demonstrate the absence of coliform organisms in each separate section of the pipeline and in each structure after chlorination and refilling. Collect at least one set of samples from every pipe line and water storage tank, plus one set from the end of the line and at least one set from each branch. At each connection to an existing pipeline, take two additional samples.
 - B. Repetition of Procedure: If the initial chlorination fails to produce required residuals and bacteriologic tests, repeat the chlorination and retesting until satisfactory results are obtained.
 - C. Test Facility Removal: After satisfactory disinfection, disinfect and replace air valves, restore the pipe coating, and complete the pipeline where temporary disinfection or test facilities were installed.
- 3.07 FIELD QUALITY CONTROL:
- A. Owner will obtain samples for and submit to laboratory for analysis before reservoir placed in service.
 - B. If safe samples not obtained using above procedure, Contractor shall add additional chlorine in amounts necessary to obtain safe samples.
- 3.08 CLOSEOUT ACTIVITIES:
- A. Provide in accordance with Section 01 77 00.

END OF SECTION

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SECTION 33 13 11

DISINFECTION OF WATER TANKS

PART 1 - GENERAL

1.01 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Disinfection work shall comply with Wisconsin DNR Code NR 811. Requirements of this section in conflict with requirements of authority for disinfection, authority shall govern.

B. Source Quality Assurance:

1. Perform Work in connection with disinfection under direction of experienced supervisor.
2. Use equipment in proper working condition and adequate for specified Work.

PART 2 - PRODUCTS

2.01 CHLORINE

- ###### A. Provide chlorine in accordance with requirements of AWWA C652.

PART 3 - EXECUTION

3.01 CLEANING

A. Before disinfecting, clean the tank as follows:

1. Remove debris and material not part of structural or operating facilities of tank.
2. Clean using high pressure water jet or other equally effective means to remove dirt and foreign material.
3. Remove water, dirt, and foreign material and dispose.

- ###### B. Cleaning shall not commence until paint has cured, but in no instance, sooner than 7 days after the final coating has been applied.

3.02 DISINFECTING TANKS

- ###### A. Disinfect in accordance with AWWA C652, Method 2.

3.03 FIELD QUALITY ASSURANCE

- A. Collect samples and analyze the samples for total coliform bacteria before reservoir placed in service. CONTRACTOR's laboratory subcontractor shall be certified in the State of Wisconsin for total coliform bacteria analysis.
- B. If safe samples not obtained using above procedure, CONTRACTOR shall, at his expense, add additional chlorine in amounts necessary to obtain safe samples.
- C. Costs of water for rechlorination of tank if first attempt does not test safely shall be paid by CONTRACTOR.
- D. Measure amount of chlorine in waste water and prevent water with measurable total chlorine residual from being discharge to surface water.
- E. Any water discharged must be dechlorinated and meet the utility NPDES permit requirements.

END OF SECTION

DIVISION 40
PROCESS INTEGRATION

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SECTION 40 23 13.01

PROCESS VALVES AND APPURTENANCES

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. Provide and test valves and appurtenances as indicated and specified.
 - 1. Provide sizes and capacities as indicated or specified.

1.02 SUBMITTALS:

- A. Submit the following in accordance with Section 01 33 00:
 - 1. Data, regarding valve characteristics and performance including Cv.
 - 2. Shop drawing data for accessory items.
 - 3. Manufacturer's literature as needed to supplement certified data.
 - 4. Operating and maintenance instructions and parts lists.
 - 5. Listing of reference installations as specified with contact names and telephone numbers.
 - 6. Valve shop test results.
 - 7. Qualifications of field service technician.
 - 8. Shop and Field inspections reports.
 - 9. List of recommended spare parts other than those specified.
 - 10. Recommendations for short and long term storage.
 - 11. Special tools.
 - 12. Shop and field testing procedures and equipment to be used.
 - 13. Number of service technician days provided and per diem field service rate.
 - 14. Manufacturer's product data and specifications for shop painting.
 - 15. Provide a layout drawing, plan and section showing orientation of plug, gate, check, ball valves and actuators and nearest obstructions for each valve.
 - 16. Manufacturer's product data and specifications for shop painting.
 - 17. Provide a listing of the materials recommended for each service specified and indicated. Provide documentation showing compatibility with process fluid and service specified and indicated.
 - 18. Material Certification:
 - a. Provide certification from the equipment manufacturer that the materials of construction specified are recommended and suitable for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated including an installation list of a minimum of five installations in operation for a minimum of 5 years. Provide proposed materials at no additional cost to the Owner.
 - b. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated.

- B. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations and clarifications from the specified requirements.
 - 1. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.
 - 2. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specification and justification are resubmitted with the entire package.

1.03 SPARE PARTS:

- A. Comply with requirements specified in Section 01 61 00.

1.04 QUALITY ASSURANCE:

- A. Comply with the requirements specified in Section 01 43 00.
- B. Provide enclosures for the area classifications specified and indicated.
- C. Contractor responsible for verifying outside diameter of pipe to be tapped.
- D. Services of Manufacturer's Representative as stated in Section 01 43 00 and specified herein.
- E. Manufacturer of valve shall have a minimum of five operating installations with in the same service as specified operating for not less than 5 years.
- F. If equipment proposed is heavier, taller, different laying length or requires more operating space than specified and indicated; provide all structural, architectural, mechanical, electrical and plumbing revisions at no additional cost to the Owner.
 - 1. If equipment is heavier than specified, the Contractor shall provide all hoisting equipment sized to maintain the minimum safety factor between the specified maximum equipment weight and the lifting capacity of the hoisting equipment indicated and specified.

1.05 DELIVERY, STORAGE AND HANDLING:

- A. Comply with the requirements specified in Section 01 61 00 and as specified.

PART 2 - MATERIALS

2.01 RESILIENT SEAT GATE VALVES 3-INCH (80 MM) AND LARGER:

- A. Resilient Seat Gate Valves:
 - 1. Manufacturers-OS&Y Type Valves:
 - a. American.
 - b. Mueller.

- c. Clow.
 - d. M&H
 - e. Or approved equal
2. Manufacturers-NRS Type Valves:
- a. American.
 - b. Mueller.
 - c. Clow.
 - d. M&H
 - e. Or approved equal

B. General:

1. Provide valves that conform to NSF Standard 61.
2. Non-potable water service: Provide resilient seat gate valves for all sizes indicated. If resilient seat valves are not available provide solid wedge gate valves.
3. Potable water service: Provide resilient seat gate valves for all sizes indicated. If resilient seat valves are not available provide double revolving disc gate valves.
4. Provide metallic seated valves conforming to AWWA C500 except as herein modified. (Valves larger than 48-inch, size shall comply with the intent of AWWA C500.)
5. Provide resilient seated valves conforming to AWWA C509 except as modified herein.

C. Materials:

1. Body and Bonnet: ASTM A536 ductile iron.
2. Wedge: ASTM A536 ductile iron encapsulated with EPDM.
3. Provide all other materials as specified in AWWA C500 and C509.

Working water pressure:

Valve Size		Pressure Rating	
inch	mm	psi	bar
3 to 16	80 to 400	250	17
18 & Larger	450 & Larger	150	10

4. Buried Valves: Mechanical joint or push-on joint ends, non-rising stem valves with operating nut in lieu of hand wheel. Provide gate boxes, steel extension stems or universal-joint operating rods with 2-inch square operating nuts at upper end with coupling connected to valve stem to bring to operating nut to within 6 inches of ground surface.
5. Provide counterclockwise rotation to open valves.
6. Provide handwheels with arrow and word "open" to indicate open direction.
7. Provide geared operators for all valves 16-inch and larger. Gearing shall be steel with enclosed cases.
 - a. Provide spur gears for buried valves with stems vertical
 - b. Provide bevel gears where required by position of valve.
 - c. Provide buried valves with totally enclosed gear cases to enclose both the gears and valve stuffing box and provide gasketed Type 316 stainless steel removable cover plates with Type 316 stainless steel fasteners to allow access to the stuffing box.
8. Provide conventional packing in OS&Y valves.

9. Provide conventional packing or double O rings in non-rising stem valves.
 10. Valves capable of being repacked or O ring replaceable while under pressure.
 11. Provide Type 316 stainless steel bolts and bronze nuts for stuffing box follower.
 12. Provide bypass valves for valves 16-inch and larger where required for opening under pressure with a maximum 40-lb rim pull at the valve pressure rating.
- D. Provide all gate valves with all internal and external wetted parts coated with a fusion bonded epoxy in accordance with ANSI/AWWA C550.

2.02 BUTTERFLY VALVES – LIQUID SERVICE (AWWA):

A. Manufacturers:

1. Pratt 2FII by Plant and Flanged
2. Pratt Triton XR-70 by Plant and Flanged
3. DeZurik BAW
4. No substitutes

B. Provide valves that conform to NSF Standard 61.

C. Provide valves conforming to AWWA Standard C504 for Rubber Seated Butterfly Valves except as modified herein.

D. Valve Bearings: Self-lubricating, nonmetallic material to effectively isolate the disc-shaft assembly from the valve body. Cast or ductile iron thrust or journal bearing surfaces are NOT acceptable.

E. Class 150B valves except as specified or indicated.

F. Valve Body: ASTM A126 Class B cast iron or ductile iron.

1. Exposed service: Flanged or grooved joint short body valve.
2. Buried service: Mechanical joint body.
3. Wafer, lug wafer or tapped wafer valves may be used only as specified or indicated.

G. Valve Seats:

1. Potable Water Service: Molded new natural rubber or synthetic rubber.
2. Wastewater or Sludge Service: Molded neoprene, Buna-N or other synthetic elastomer resistant to oil and grease.
3. Provide seat mounted on disc or in body.
4. Provide seats offset from shaft and field replaceable for all valves 24-inch and larger.
5. Provide seats mounted on disc, mechanically fastened to disc with Type 316 stainless steel hex head screws. Provide rubber seat reinforced with stainless steel retaining ring. Seats vulcanized or bonded to the disc are not acceptable.

H. Mating surfaces for valves with seat on disc: Type 316 stainless steel.

1. Provide mating surface mechanically retained in body and sealed with O-ring.

I. For valves with seats mounted on body provide the seats clamped or mechanically secured with Type 316 stainless steel fasteners.

- J. Mating surfaces for valve with seat in body: Type 316 stainless steel or plasma applied nickel-chromium material containing 80 percent nickel, 20 percent chrome.
- K. Plated or sprayed on mating surface material not acceptable.
- L. Seat Placement:
 - 1. If seat on disc provide disc of ASTM A126 Class B cast iron or ductile iron.
 - 2. If seat in body, provide disc of ASTM A126 Class B cast iron, ductile iron or Type 316 stainless steel. Type 316 Stainless steel edge on cast or ductile-iron discs secured with Type 316 stainless steel threaded fasteners, heat shrunk on disc, a welded-on overlay, or a plasma applied nickel-chrome material.
- M. Shaft: Type 316 stainless steel. Either one piece extending completely through disc or stub shafts inserted into valve disc stubs.
- N. Shaft seal of the split-V type or O-ring type. Seal replaceable without disassembly of valve.
- O. Manual Operators:
 - 1. Operator capable of valve operation at rated pressure with a maximum 80 lb pull on actuator. Operator to be self-locking.
 - 2. Valves 8-inch and smaller, provide lever operator, 18-inch maximum length.
 - 3. Valves 10-inch and larger, or where chain wheels are required, provide traveling nut operator. Provide position indicator.
 - 4. Chainwheels: Provide where required as specified herein.
- P. Buried valves: Provide gear operator with operating nut and valve box as shown. Gear operator to be totally enclosed with gasketed Type 316 stainless steel covers with Type 316 stainless steel fasteners for access to valve packing.

2.03 BALL VALVES – GENERAL SERVICE:

- A. Manufacturers:
 - 1. Jamesbury
 - 2. KF
 - 3. Inline
 - 4. Kitz
- B. Valves 1/2-inch thru 4-inch
 - 1. Materials:
 - a. Body and End Cap: Three piece, ASTM A351 Grade CF8M.
 - b. Body Seal: PTFE.
 - c. Seat: RTFE.
 - d. Ball: Type 316 stainless steel.
 - e. Stem: Type 316 stainless steel.

2. Pressure Rating:
 - a. 1/2-inch thru 2-inch: 1000 psi at 100 degree F
 - b. 2-1/2-inch thru 4-inch: 800 psi at 100 degree F
3. Ends:
 - a. 2-inch and Smaller: Screwed or flanged.
 - b. 3-inch and larger: Flanged.

C. Valves 4-inch thru 12-inch.

1. Materials:
 - a. Body and Adaptor: Two piece, ASTM A351 Grade CF8M.
 - b. Seat: TFE.
 - c. Ball: Type 316 stainless steel.
 - d. Stem: Type 316 stainless steel.
2. Pressure Rating: ANSI Class 150.
3. Ends: Flanged.

D. Actuators:

1. Manual:
 - a. 4-inch and Smaller: Lever.
 - b. 6-inch and Larger: Gear operator.
 - c. Provide chainwheels where required as specified herein.

2.04 BALL VALVES - NON-METALLIC:

A. Manufacturers:

1. Spears
2. ASAHI
3. NIBCO/Chemtrol
4. Hayward

B. Materials:

1. Body: Material as specified or indicated.
 - a. PVC: ASTM D-1784, Type 1, Grade 1, Class 12454B.
 - b. CPVC: ASTM D-1784, Type 4, Grade 1 with hydrostatic design stress of 1600 psi at 73.4 degree F.
 - c. Polypropylene: ASTM D-2146, Type 1 with tensile strength of 4977 psi at 77 degree F.
 - d. PVDF: Minimum tensile strength of 5000 to 7000 psi at 77 degree F.
2. Ball: Same material as valve body.

3. Seats: Teflon, concave design to absorb expansion.
 - a. Triangular seat design is not acceptable.
 - b. Provide viton or EPDM back up cushions to absorb expansion.
 4. Seals: Viton, all Viton shall contain a minimum of 55 percent viton.
 5. Provide vented ball valves for sodium hypochlorite and caustic services.
- C. Ends: Type as specified or indicated:
1. Provide ends flanged in accordance with ANSI B16.1 150 pounds standard drilling.
 2. True union design with integral union nuts on both ends of valve.
 - a. Threads between union nuts and valve body: Provide Buttress threads to protect against pipeline expansion and water hammer stresses.
- D. Machine the following to final tolerances:
1. Exterior of ball
 2. Interior of socket and threaded connections
 3. Teflon seat recesses
 4. Stem
 5. Neck I.D.
 6. Both end connectors
 7. Both carriers
- E. Valve Port:
1. 2-inch and smaller valves: full port.
 2. 3-inch and 4-inch valves: maximum of one pipe size reduction.
 3. 6-inch valves: venturi design.
- F. Valve Ratings:
1. PVC: 150 psi at 120 degree. F.
 2. CPVC: 85 psi at 175 degree F.
 3. Polypropylene: 85 psi at 175 degree F.
 4. PVDF: 85 psi at 210 degree F.
 5. All valves rated for 29.92 inch mercury vacuum.
- G. Physical Properties:
1. Tensile stress, psi; per ASTM D638 Test Method:
 - a. PVC: 7800
 - b. CPVC: 9200
 - c. PP: 5000
 - d. PVDF: 7800
 2. Flexural Stress, psi; per ASTM D790 Test Method:
 - a. PVC: 15650

- b. CPVC: 17060
 - c. PP: 9240
 - d. PVDF: 14930
3. Compressive Strength, psi; per ASTM D695 Test Method:
- a. PVC: 14220
 - b. CPVC: 15650
 - c. PP: 9950
 - d. PVDF: 14220
4. Hardness, Rockwell R, per ASTM D785 Test Method:
- a. PVC: 115
 - b. CPVC: 118
 - c. PP: 95
 - d. PVDF: 110
5. Water Absorption, percent, 24 hour., 1/8-inch thickness, per ASTM D570 Test Method:
- a. PVC: 0.07 percent
 - b. CPVC: 0.15 percent
 - c. PP: 0.01 percent
 - d. PVDF: 0.03 percent

H. Operators:

- 1. Lever, with retaining screw.
- 2. Electric Motor Actuators:
 - a. Provide 120V (220V) single phase actuators.
 - b. Enclosure:
 - (1) NEMA 7 explosion proof for classified areas
 - (2) NEMA 4 or 4X for non-classified areas.

2.05 BALL VALVES – AWWA – METAL SEATED:

A. Manufacturers:

- 1. Golden Anderson.
- 2. Pratt.
- 3. Val-Matic.

B. Type: AWWA Ball Valves:

- 1. Provide the main valve with a full, circular, unobstructed waterway.
 - a. Trunnion mounted.
 - b. Metal-to-metal seated in complete conformance with the requirements of AWWA C507, latest revision.

2. Pressure Class 150/250 and consist of a main valve assembly and a motor actuator, completely assembled, tested and ready for field installation and wiring.

C. Body:

1. Provide valves with valve body consisting of four components: two end pieces, through bolted and O-ring sealed against two center sections bolted together and O-ring sealed.
2. Material: Ductile iron ASTM A536 Grade 65-45-12.
3. Provide the end pieces with ANSI B16.1 Class 150/250 flanges with a true, 100 percent full circular port opening equal to the nominal size of the valve.
4. Provide the two center sections with integrally cast bronze bushed trunnions.
 - a. Provide one center section for rigid mounting and support of the valve operating mechanism without the need for additional support.
 - b. Provide the other section for a mounting pad to support the weight of the valve.
 - c. Provide a minimum shell thickness of all four sections in accordance with Table 3 of AWWA C507, latest edition.

D. Body Seat:

1. Provide a single fixed seat of Alloy 400 Monel located on the pump side end piece and retained in the end piece only by a mechanical means.
2. Provide a spherically generated the seating surface on an eccentric seating axis eliminating seat contact during rotation.

E. Operators:

1. Manually Valve:
 - a. Provide totally enclosed gear operators in a permanently lubrication, watertight and dustproof enclosure, with adjustable open and closed stops and ball position indicator.
 - b. Provide chainwheels where required as specified herein.

2.06 SWING CHECK VALVES – NON METALLIC:

A. Manufacturers:

1. Spears.
2. ASahi/America, Inc.
3. NIBCO/Chemtrol Inc.
4. Hayward Industrial Plastics.

B. Materials:

1. Body and Disc: PVC, ASTM D-1784, Type 1, Grade 1.
2. Seats and Seals: EPDM.

C. Fabrication:

1. Solid thermoplastic construction with no metal to media contact.
2. Single disc design.

3. Provide integral top entry to valve body.
4. Machine finish all seat surfaces.
5. Provide outside level and weight.

D. Pressure Rating at 30 to 120 degree F (-1 to 38 degree C):

1. 3/4-inch thru 2.5-inch: 100 psi.
2. 3-inch thru 6-inch: 75 psi.
3. 8-inch: 45 psi.

E. Ends: Flanged, 150 pounds (PN10) rating.

2.07 TILTING DISC CHECK VALVES:

A. Manufacturers:

1. Val-Matic.
2. Crispin.
3. Pratt.

B. Materials:

1. Body: Cast Iron ASTM A48 Class 30.
2. Disc:
 - a. Valves 24-inch and smaller: Cast Iron ASTM A48 Class 30 or solid, one piece CDA #C83600 bronze disc with no attached disc ring.
3. Seat Ring: Cast Aluminum Bronze ASTM B271 Alloy 954; BHN 150 or CDA #C83600 bronze.
4. Disc Ring: Cast Aluminum Bronze ASTM B271 Alloy 955; BHN 190 or CDA #C83600 bronze.
5. Pivot Pin: Aluminum Bronze ASTM B505, Alloy 955; BHN 195 or Type 303 stainless steel.
6. Pivot Pin Bushing: Aluminum Bronze ASTM B505 Alloy 954; BHN 170.

C. Body:

1. Two piece construction bolted together at the seat with the seat at approximately a 55 degree angle.
2. Inlet body section to contain seat ring and outlet body section to contain two pivot trunnions about which the disc rotates.
3. Provide an inspection port each body half. Locate inspection port in inlet body section on bottom of valve and on top of valve on outlet section.
4. Area through valve must equal to full pipe area.
 - a. Area through seat must equal 1.4 times the area through the inlet and outlet.
5. Provide an indicator to visually show valve disc position at all times.
6. Ends: Flanged, faced and drilled in accordance with 125 pound ANSI B16.1.

2.08 BALL CHECK VALVES -NON-METALLIC:

A. Manufacturers:

1. Spears.
2. ASAHI.
3. NIBCO/Chemtrol.
4. Hayward.

B. Materials:

1. Body: Material as specified or indicated.
 - a. PVC: ASTM D-1784, Type 1, Grade 1, Class 12454B.
 - b. CPVC: ASTM D-1784, Type 4, Grade 1 with hydrostatic design stress of 1600 psi at 73.4 degree F (23 degree C).
 - c. Polypropylene: ASTM D-2146, Type 1 with tensile strength of 4977 psi at 77 degree F (25 degree C).
 - d. PVDF: Minimum tensile strength of 5000 to 7000 psi at 77 degree F (25 degree C).
2. Ball: Same material as valve body.
3. Seats: Teflon, concave design to absorb expansion.
 - a. Triangular seat design is not acceptable.
 - b. Provide Viton or EPDM back up cushions to absorb expansion.
4. Seals: Viton, all Viton to contain a minimum of 55 percent Viton.

C. Ends: Type as specified or indicated.

1. Provide ends flanged in accordance with ANSI B16.1 150 pound (PN10) standard drilling.
2. True union design with integral union nuts on both ends of valve.
 - a. Provide O-rings suitable for the service specified and indicated.
 - b. Threads between union nuts and valve body: Deep molded square ACME threads to protect against pipeline expansion and water hammer stresses.

2.09 SOLENOID VALVES – NON METALLIC:

A. Manufacturers:

1. Hayward Industrial products.

B. Type:

1. Size: 1/4-inch to 1-inch.
2. Globe type.
3. 2-way.
4. Energize to open.
5. Operating Pressure Differential: 120 psi.

C. Materials:

1. Body: CPVC.
2. End Connectors: CPVC.
3. Seals and O-rings: EPDM.
4. Seal Cartridge: CPVC.
5. Union Nut and Bonnet Nut: CPVC.

D. Coil: Class F.

E. Electrical: 120 V, 1 phase, 60 Hz (220 V, 1 phase, 50 Hz).

F. Ends: True Union or Flanged as indicated.

G. Enclosure: NEMA 4X for locations in non-classified areas and NEMA 7 for use in classified areas.

2.10 AIR RELEASE VALVES – CLEAN WATER SERVICE:

A. Manufacturers:

1. Val-Matic.
2. Crispin.
3. ARI.

B. Valves: Provide air release valves of the automatic float operated type designed to release accumulated air from a piping system while the system is in operation and under pressure.

C. Provide valves manufactured and tested in accordance with AWWA C512.

D. Provide valves used in potable water service certified to ANSI/NSF 61 Drinking Water System Components - Health Effects.

E. Valve manufacturer must have a quality management system that is certified to ISO 9001:2000 by an accredited, certifying body.

F. Provide valves with the cover bolted to the valve body and sealed with a flat gasket.

G. Provide replaceable resilient seats.

H. Provide drop tight shut off to the full valve pressure rating.

I. Provide floats guaranteed against failure including pressure surges.

J. Mechanical linkage to provide sufficient mechanical advantage so that the valve will open under full operating pressure.

1. Simple lever designs: Provide valves consisting of a single pivot arm and a resilient orifice button.
2. Compound lever designs: Provide valves consisting of two levers and an adjustable threaded resilient orifice button.

- K. Provide valve body with threaded NPT inlets and outlets.
 - 1. Inlet Connection: Provide hexagonal for a wrench connection.
 - 2. Working Pressure: 150 psi.
 - 3. Provide valves with two additional NPT connections with ball valves as specified herein, one connection with a plug and one with a hose coupling for the gauges, testing, and draining.
 - 4. Provide a vacuum check on the outlet to prevent air from re-entering the system during negative pressure conditions.

- L. Provide valves with an inflow preventer to prevent the introduction of contaminated water through the air valve outlet.
 - 1. Provide the inflow preventer to allow the admittance and exhausting of air while preventing contaminated water from entering during normal operating conditions.
 - a. Provide the inflow preventer flow tested by an independent testing lab approved by the American Society of Sanitary Engineers.

- M. Materials:
 - 1. Valve Body, Cover and Baffle:
 - a. ASTM A126 Class B cast iron for working pressures up to 300 psig.
 - b. ASTM A536 Grade 65-45-12 Cast Ductile Iron. For working pressures 300 psig and greater.
 - c. ASTM A216 Grade WCB cast steel.
 - d. ASTM A351 Grade CF8M stainless steel.
 - e. ASTM B584 Alloy C83600 cast bronze.
 - 2. Floats, Orifice and linkage: Type 316 stainless steel, non-metallic components are not acceptable.
 - 3. Orifice Button: Viton for simple lever valves and Buna-N for compound lever designs.
 - 4. Hardware: Type 316 stainless steel.
 - 5. Screened Hood: Type 316 stainless steel.

- N. Testing:
 - 1. Test valves at 1.5 times the rated working pressure.

2.11 AIR/VACUUM RELIEF VALVES:

- A. Manufacturers:
 - 1. Val-Matic
 - 2. Crispin.
- B. Vacuum Valve: Provide fully automatic, center guided, spring loaded disc designed to admit large quantities of air during the draining of the pipe or if a negative pressure occurs.

- C. Spring: Designed for a minimum of 100,000 cycles without failure and provide a seat cracking pressure of 0.25 psi and to fully open the valve at a pressure differential of 2 psi. Spring Material: Type 302 stainless steel.
- D. Provide valve with a bolted cover and bottom inlet.
- E. Provide a through flow area equal to the nominal size of the valve.
- F. Provide seat with machine registered fits to the body to insure proper alignment of the guide shaft and operation of the seat.
- G. Provide Type 316 stainless steel bird screen on the inlet.
- H. Floats: Type 316 stainless steel with Type 316 stainless steel guide shaft, bushing and fasteners. Float shall be center guided. A resilient bumper shall be provided to cushion the float during sudden opening.
- I. Valve Seats: ASTM A351 Grade CF8M stainless steel.
- J. Seals: Type 316 stainless steel and Buna-N.
- K. Valves shall be rated for ANSI Class 150 constructed of ASTM A536 Grade 65-45-12 ductile iron.
- L. Provide ANSI Class 150 flanged bottom connection.
 - 1. Provide size as indicated.

2.12 CHAINWHEEL OPERATORS – STAINLESS STEEL (DUCTILE IRON):

- A. Provide chainwheels with chain and chain guides. For all valves with handwheels or gear operators higher than 6.5 feet above operating floor level.
- B. Provide chain that reaches to within 3 feet of the operating floor level.
- C. For valves with gear operator mount with chainwheel in the vertical position.
- D. Provide secondary safety restraint system.
- E. Manufacturer:
 - 1. Trumbull.
- F. Materials:
 - 1. Chainwheels: Pocket type wheel, Type 316 stainless steel.
 - 2. Chain: Type 316 stainless steel straight link machine chain.
 - 3. Hardware and Attachments: Type 316 stainless steel.
 - 4. Safety Restraint Cables and Hardware: Type 316 stainless steel.

G. Materials:

1. Chainwheels: Sprocket type wheel, ductile iron.
2. Chain: Galvanized steel connecting link chain.
3. Hardware and Attachments: Galvanized steel.
4. Safety Restraint Cables and Hardware: Type 316 stainless steel.

2.13 POSITION INDICATORS:

A. Manufacturer:

1. Trumbull Industries.

B. Provide position indicators installed on all multi-turn valves and quarter turn valves with gear boxes 3 inch and larger.

1. Type: Planetary gear design.

C. Materials:

1. Provide the sun gear, planet gear, ring gears and scale plate constructed of Delrin.
2. Housings of carbon steel or aluminum are not acceptable.
3. Hardware and Fasteners: Type 316 stainless steel.

D. Position Indicator Design Features:

1. Provide the position indication to show the position of the valve, from fully open to fully closed, identified at ground level.
2. Movement of the indicating arrow must be visible through a window covering a minimum of 300 degrees of the circumference of the indicator.
3. Size of the characters and numerals: minimum 3/16-inch (5 mm).
4. Provide the top scale plate with markings representing the number of turns, contain the word "CLOSED", and a directional arrow.
5. Provide permanently recessed, embossed or engraved markings in the scale plate. The use of adhesive labels is not acceptable.
6. Provide the "OPEN" line marked on a transparent polycarbonate window, field adjusted for the number of turns of each valve size.
7. Provide the position of the adjustable "OPEN" window secured to the top surface of the scale plate by the outside diameter of three Type 316 stainless button head cap screws.
8. Provide all adapters to secure the position indicator, for installation in either a valve box, floor box or wall bracket as indicated and required.
9. Provide the position indicator and adapter with matching flat sides to prevent rotation of the indicator during operation.

E. Exposed and Submerged Valves:

1. Provide a Type 316 stainless steel extension stem connected to a 2 inch square nut on the valve and extend up through the position indicator, terminating in a 2 inch square nut, operable by a standard waterworks tee-handle wrench.

2.14 SHOP PAINTING:

- A. Coat internal and external ferrous surfaces of valve with NSF Certified Epoxy in accordance with ANSI/NSF Std. 61, and in conformance to AWWA D102 Inside System No. 1 for all valves not specified to have a fusion bonded epoxy coating.
- B. Process Valve Color: Red.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Prior to installation, protect stored valves and appurtenances from damage due to exposure to sunlight, heat, dirt, debris, freezing and thawing, vandalism, etc.
- B. Clean all debris, dirt, gravel, etc, from inside of piping before placing valves in place.
- C. Erect and support valves in respective positions free from distortion and strain on appurtenances during handling and installation. Inspect material for defects in workmanship and material. Clean out debris and foreign material from valve openings and seats, test operating mechanisms to check functioning, and check nuts and bolts for tightness. Repair, valves and other equipment which do not operate easily or are otherwise defective at no additional cost to the Owner.
- D. Set plumb and support valves in conformance with instructions of manufacturer. Shim valves mounted on face of concrete vertically and grout in place. Install valves in control piping for access.
- E. Provide bolted split sleeve coupling or flexible type grooved coupling on downstream side of buried valves to assist in valve removal.
- F. Where indicated provide Type 316 stainless steel stem extension to operating floor elevation as shown and provide the bevel gear operator with a fabricated steel floorstand and handwheel.

3.02 GATE VALVES:

- A. Install gate valve stem as shown or with stems between vertical and 45 degrees above the horizontal. Valves installed with stems below horizontal are not acceptable.

3.03 CHECK VALVES:

- A. Install swing check valves horizontally in pipelines unless otherwise indicated.

3.04 FIELD TESTING:

- A. Pressure test valves with pipeline pressure testing.
- B. Test functions of each valve.
- C. Make all adjustments necessary to place valves in specified working order at time of above tests.

- D. Remove all replace valves and appurtenances at no additional cost to the Owner with equipment that will meet all requirements specified and indicated if unable to demonstrate to the satisfaction of the Engineer that valves will perform the service specified, indicated and as submitted and accepted.
- 3.05 FIELD TOUCH-UP PAINTING:
- A. After installation and accepted testing by the Engineer, apply touch-up paint to all scratched, abraided and damaged shop painted surfaces. Coating type and color shall match shop painting.
- 3.06 CONTRACT CLOSEOUT:
- A. Provide in accordance with Section 01 77 00.

END OF SECTION

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SECTION 40 23 19.01

PIPE SUPPORTS

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. Design, and provide a complete system of pipe supports with inserts, bolts, nuts, restraining and hanger rods, washers, miscellaneous steel, sliding Teflon plates, and accessories as indicated and specified. The term pipe support includes hangers, guides, restraints, anchors and saddles.
- B. Provide all support systems and the design of all support systems for all piping as specified herein. The Contractor shall provide pipe support locations, configurations and details through accepted shop drawing submittals stamped by a Registered Professional Engineer as specified herein.
- C. The Contractor shall be responsible for the proper design, fabrication, location, shop drawings and installation of all pipe supports in accordance with the specified requirements.
- D. Pipe support locations and types for piping 1/2-inch and larger shall be determined by the Contractor using the guidelines for support spacing specified herein and other criteria contained in this pipe support specification. Guidelines for pipe supports may need to be adjusted based upon field coordination, field routing, or other considerations outlined herein such as structural load limits. The Contractor may revise the pipe support locations and details through accepted shop drawing submittals stamped by a Registered Professional Engineer as specified herein. The Contractor is responsible for the proper design, installation and fabrication of all pipe supports in accordance with the specified requirements. For pipe supports 1/2-inch and larger pipe support shop drawings together with a marked up piping drawing showing support number, location and typical type shall be submitted by the Contractor for acceptance.
 - 1. The Contractor shall be responsible for coordinating all pipe support designs for all trades to ensure compliance with all of the requirements of this specification, including but not limited to the total limitations specified herein.
- E. Design and provide all temporary pipe supports required during installation and testing.

1.02 SUBMITTALS:

- A. Submit the following in accordance with Section 01 33 00:
 - 1. Pipe support drawings specified herein and including data for accessory items for acceptance prior to fabrication. The Contractor shall submit pipe support coordination drawings including all piping and pipe supports for all trades.
 - a. Detailed drawing of the device with dimensions.
 - b. A table of applied forces and moments.
 - c. A complete bill of materials.
 - d. A unique identification and revision level.

- e. Stamp of a Registered Professional Engineer, registered in the state where this project is being constructed, experienced in pipe support design and pipe stress analysis as specified herein.
 - f. Detailed connections to existing structure.
 - g. Indicate all welds, both shop and field, by Standard Units of Measurement as specified in AWS D1.1.
2. Welding Procedure: Submit description required to illustrate each welding procedure to be performed in the specified work.
 3. Welding Equipment: Submit descriptive data for welding equipment, including type, voltage and amperage.
 4. Qualification for Welders: Provide certification that welders to be employed in work have satisfactorily passed AWS or ASME qualification tests. If recertification of welders is required, retesting is the Contractor's responsibility at no additional cost to the Owner.
 5. Pipe support manufacturers' qualifications as specified herein.
 - a. List of at least five (5) successful pipe support projects and current addresses and telephone numbers of persons in charge of representing the owner or the owner of those construction projects during the time of pipe support design, fabrication and installation.
 - b. Qualification of manufacturers' Registered Professional Engineer, registered in the state where this project is being constructed, who stamps and seals shop drawings and designs.
 6. Coordination drawings for pipe supports shall include as a minimum the following information.
 - a. Coordination drawings shall include all pipe supports covered by specifications.
 - b. These coordination drawings will be used by the Contractor to ensure that the pipe supports do not obstruct access, access for equipment operation or removal including all mechanical and electrical equipment, panels, valves, gauges, and instrumentation.
 - c. The Contractor shall be responsible for including and coordinating the work of all subcontractors into the coordination drawings.
 - d. Prepare reproducible coordination drawings, indicating equipment, piping, valves, expansion joints, ductwork, conduit, cable trays, junction boxes, lighting fixtures, sleeves, inserts, embedments, supports, hangers and appurtenances at not less than 1/4-inch scale. Drawings shall show beams, columns, ceiling heights, wall, floors, partitions and structural features as indicated on the contract drawings. Individual pipes and conduit 2-in. or less in diameter that will be field routed need not be shown on coordination drawings.
 - e. Coordination drawings shall include large-scale details as well as cross and longitudinal sections required to fully delineate all conditions. Particular attention shall be given to the location, size, and clearance dimensions of equipment items, shafts, operators and necessary maintenance access.
 - f. Make all minor changes in duct, pipe or conduit routings that do not affect the intended function, but items may not be resized or exposed items relocated without the approval of the Owner. No changes shall be made in any wall locations, ceiling heights, door swings or locations, window or other openings or other features affecting the function or aesthetic effect of the building. If conflicts or interferences cannot be resolved, the Owner shall be notified. Any problems of coordination that

- require architectural or structural changes of design shall be submitted to the Owner for resolution.
- g. After the reproducible drawings have been coordinated and all changes have been made, the drawings shall be signed by the Contractor and all subcontractors indicating that all work on that drawing has been coordinated with all associated vendors and subcontractors and all conflicts have been resolved.
 - h. Relocation of any duct, pipe, conduit or other material that has been installed without proper coordination among all trades shall be performed at no additional cost to the Owner.
- 7. Written notification of any deviations from the requirements of this specification.
 - 8. Support documentation and justification as specified.
 - 9. Certificates of Design signed by a Registered Professional Engineer for all pipe supports.
 - 10. Manufacturer's product data and specifications for shop painting.

B. Material Certification:

- 1. Provide certification from the manufacturer that the materials of construction specified are recommended and suitable for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated including an installation list of a minimum of five (5) installations in operation for a minimum of five (5) years. Provide proposed materials at no additional cost to the Owner.
- 2. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated.

C. A copy of the contract mechanical process, and structural drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with "No changes required" or provide a statement that no changes are required.

- 1. Failure to include all drawings or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.
- 2. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.
 - a. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.
 - b. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specifications and justifications are submitted in a complete package.

1.03 QUALITY ASSURANCE:

- A. Provide in accordance with Section 01 43 00 and as specified.
- B. Provide manufacturer's certification in writing, that materials meet or exceed minimum requirements as specified.
- C. Welder Qualifications:
 - 1. Quality and certify welding procedures, welders, and operators in accordance with ANSI B31.1, paragraph 127.5 for shop and project site welding of piping work.
- D. Pipe supports: All supports and parts shall conform to the latest requirements of the Code for Pressure Piping ASME/ANSI B31.1 and Manufactures Standardization Society (MSS) Standard Practice SP-58, SP-69, SP-89 and SP-90 except as supplemented or modified by the requirements of this specification.
- E. Structural Concrete: Conform to the requirements of Section 03 30 00. Concrete strength: 4,000 PSI unless noted otherwise.
- F. Conform to the requirements of the latest edition of the AISC Manual of Steel Construction for miscellaneous and supplementary steel. Tube steels are ASTM A500 Grade B, structural shapes A36, plates A-572 or equal. Stainless steel structural members shall conform to ASTM requirement Type 316L.
- G. Pipe Support Manufacturer Qualifications:
 - 1. Must possess a written quality assurance program.
 - 2. Have a minimum of 5 years experience in the design and fabrication of pipe supports.
 - 3. Have completed the design and fabrication of at least 5 successful pipe support projects of equal size, complexity, and systems as this project within the past 10 years.
 - 4. Retains the services of a Registered Professional Engineer, registered in the state where this project is being constructed, with a minimum of ten years experience in the design of piping systems and pipe supports.
 - 5. Manufacturers' Standardization Society (MSS) Member.
 - 6. Have a field service technician on staff with at least 5 years experience in resolving field installation, interference and interface problems associated with the design, installation and manufacture of pipe supporting components.
- H. Hanger inspections shall be performed in accordance with MSS-SP-89 and ASME B31.1.

1.04 DELIVERY, STORAGE AND HANDLING:

- A. Comply with the requirements specified in Section 01 61 00.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Provide materials used in pipe supports, which are compatible with the pipes to which they are attached. Provide Type 316L stainless steel supports for all stainless steel piping. Copper plated pipe supports are not acceptable.
- B. Allowable materials: As indicated in ANSI B31.1 Appendix A and MSS-SP-58 Table 2.
- C. Provide Type 316L stainless steel for pipe supports, hangers, guides, restraints, and anchors that are exterior or interior submerged, in potentially wetted areas in wet wells, channels, screening and grit removal areas and in chemically corrosive atmospheres.
- D. Provide only new material. Previously used and/or scrap material is not acceptable.
- E. Provide tube steels that are ASTM A500 Grade B, Structural shapes A-36, plates A-572 or equal.
- F. Provide sliding Teflon plates. The sliding surfaces shall be a nominal 3/8-inches glass filled Teflon bonded to stainless steel backup plate with a 10 gauge minimum thickness. The bearing pad upper and lower units shall be as follows: Conslide Type CSA elements as manufactured by Con-Serv. Inc., Balco TFE Slide Bearing Plates 10N-cs as manufactured by Balco Inc., or Dynalon Slide Bearings as manufactured by JVI, Inc. or acceptable equivalent product.
 - 1. The blended TFE material used for this bearing shall be composed of virgin (unreprocessed) TFE resin tested per ASTM D1457 and reinforcing agents milled glass fibers. This structural material shall have the following representative mechanical and physical properties:
 - 2. Tensile strength - 2,000 psi
 - 3. Elongation – 225 percent
 - 4. Specific Gravity - 2.17 to 2.22
 - 5. The coefficient of friction shall average 0.06 under compressive load of 2,000 psi.
 - 6. The compressive creep shall be a minimum of 2 percent at 2,000 psi and 70 degrees F.
 - 7. The elements shall be flat, clean and prepared for installation in the structure. Slots and holes shall be fabricated in the bearing manufacturer's plant.
- G. Concrete anchor bolts - Hilti Kwik-Bolt II Stud Anchors, Rawl Bolt, Phillips Wedge Anchors, or equal.

2.02 DESIGN, LOCATION, AND TYPE OF PIPE SUPPORTS:

- A. Design and provide pipe supports for piping 1/2-inch and larger to include the following loads:
 - 1. Gravity Force: This force includes the weight of pipe, pipe contents (hydro load), valves, in-line equipment, insulation and any other weight imposed on the piping and/or pipe support.
 - 2. Thermal Expansion Force: This force is developed by the restraint of free end displacement of the piping due to thermal growth.
 - 3. Hydrostatic/Dynamic Forces: These forces are developed due to the internal pressure (positive and negative) during operation of the piping system. These forces include the

- forces due to water hammer, pressure pulses due to rapid valve closure, fluid discharge resulting from pump startup, operation of positive displacement pumps, etc.
4. Wind Loadings: Wind loadings.
- B. Provide supports, guides, anchors, flexible couplings and expansion joints in accordance with the coupling and joint manufacturers' specifications and requirements.
 - C. For all pump suction and discharge nozzles provide an anchor located between the pump nozzles and the nearest expansion joint or non-rigid coupling.
 - D. Where possible, provide pipe supports, which are the manufacturers' standard products.
 1. Provide pipe supports with individual means of adjustment for alignment.
 2. Provide pipe supports complete with appurtenances including locking and adjusting nuts.
 3. Hanger rods shall be subjected to tension only.
 4. Where lateral or axial pipe movement occurs, provide hangers for the necessary swing without exceeding 4 degrees. Provide base supports designed using pipe slides. The bearing surfaces: 0.06 coefficient of friction or less.
 5. Provide concrete inserts capable of supporting the design loads.
 6. Metal framing systems will be acceptable to support piping 2 inch and smaller.
 7. Provide insulated piping supported using rigid load bearing insulation (baton board type) with 16 gauge shields to fit between the insulation and the support. Shields to encompass a minimum 1/3 of the pipe circumference and be 12 inch in length.
 8. Provide load-bearing insulation capable of supporting the load, as a minimum on the bottom 60 degrees of the pipe support. Cope insulation and adjust to avoid interference of steel structures.
 9. Provide supplementary steel as needed.
 10. Do not support pipes from other pipe, conduits or metal stairs.
 11. Chain, strap, T-bar, perforated bar and/or wire hangers are not acceptable.
 12. Contact between piping and dissimilar metals such as hangers, building structural work or equipment subject to galvanic action is not acceptable.
 13. All pipe supports located in fluid flow shall be supplied with double nutting.
 - E. Provide thrust anchors to resist thrust where required. Wall pipes may be used as thrust anchors if so designed. Welded attachments shall be of material comparable to that of the piping, and designed in accordance with governing codes.
 - F. Provide expansion joints where indicated and where required based on Contractor's design of the pipe support system. Indicate expansion joints on submittal drawings.
 - G. For piping 2-inch and smaller provide manufacturer's standard supports and standard spacing guidelines
 - H. Pipe supports connected to structural framing and slabs are subject to the following limitations:
 1. Less than 100 lb horizontal load per support.
 2. Vertical loads not to exceed an average of 50 P.S.F. for slabs, with a maximum vertical load per hanger of 500 lbs.
 3. For a maximum of one pipe support per foot of slab width perpendicular to the span.
 4. Vertical loads not to exceed 1,000 lbs. per column or 500 lbs. per support at walls.

5. Piping not supported from floors by metal framing must meet the limitations as specified above.
 - I. All outside above ground supports shall be Type 316L stainless steel as specified herein.
 - J. Provide pipe supports that do not overload or over stress the piping, equipment, or structure that they are supporting or to which they are attached. Allowable pipe stress to be within ANSI B31.1 code allowable.
 - K. The Contractor shall provide the services of a field service technician (preferably from the pipe support manufacturer) to field coordinate the locations of supports and resolve interferences and conflicts encountered during installation.
- 2.03 FABRICATION:
- A. Provide pipe supports formed in accordance with paragraph 5.1 of MSS-SP-58.
 - B. Providing welding in accordance with Structural Welding Code.
 - C. Provide dimensional tolerances as specified in MSS-SP-89.
 - D. Provide threading and tapping in accordance with MSS-SP-89.
- 2.04 SHOP PAINTING:
- A. Primer and Finish Paint: Shop apply to all exterior ferrous surfaces, high solids epoxy in accordance with Section 09 96 10.
 - B. Ferrous surfaces which are not to be painted shall be given a shop applied coat of grease or rust resistant coating.
 - C. Provide additional shop paint coating for touch-up to all surfaces after installation and testing is completed and equipment accepted.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Install items in accordance with manufacturers' printed instructions and as indicated and specified herein.
- B. Perform welding in accordance with Structural Welding Code:
 1. Visually inspect welding while the operators are making the welds and again after the work is completed in accordance with AWS D1.1 Section 6.0. After the welding is completed, hand or power wire brush welds, and clean them before the Qualified Inspector makes the check inspection. The Qualified Inspector shall inspect welds with magnifiers under light for surface cracking, porosity, and slag inclusions; excessive roughness; unfilled craters; gas pockets; undercuts; overlaps; size and insufficient throat and concavity. The Qualified Inspector shall inspect the preparation of groove welds for throat opening and for snug positioning for back-up bars.

2. Nondestructive evaluation of welds connecting structural steel members subjected to critical stresses: Perform in accordance with the weld quality and standards of acceptance in AWS D1.1.
 3. Magnetic Particle Inspection: Perform in accordance with ASTM E709.
 4. Liquid Penetrant Inspection: Perform in accordance with ASTM E165.
 5. For weld areas containing defects exceeding the standards of acceptance in accordance with AWS D1.1, Section 3.7. Provide additional testing of the repaired area at no additional cost to the Owner.
 6. Test Locations: As selected by the Owner.
 7. Correct any deficiencies detected as directed by the Engineer at no additional cost to the Owner.
- C. Proceed with the installation of the pipe supports only after required building structural work has been completed and concrete support structure has reached its 28-day compressive strength as specified in Section 03 30 00.
- D. Install pipe supports to comply with MSS-SP-89. Group parallel runs of horizontal piping to be supported together on trapeze type hangers.
- E. Install pipe supports to provide indicated pipe slopes. Do not exceed maximum pipe deflection allowed by ANSI B31.1.
- F. For exposed continuous pipe runs, install pipe supports of same type and style as installed for adjacent similar piping.
- G. Install pipe supports to allow controlled movement of piping systems. Permit freedom of movement between pipe anchors, and facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- H. Piping to be free to move when it expands or contracts except where fixed anchors are indicated or required by the Contractor's pipe support systems. Where hanger rod swing length cannot be provided or where pipe movement based on expansion of 1 inch/100 feet, for each 100 degrees F change in temperature exceed 1/2-inch, provide sliding supports.
- I. Prevent contact between dissimilar metals. Where concrete or metal support is used, place 1/8-inch thick Teflon, neoprene rubber, or plastic strip under piping at point of bearing. Cut to fit entire area of contact between pipe and pipe support.
- J. Prevent electrolysis in support of copper tubing by use of pipe supports which are plastic coated. Electrician's tape is not an acceptable isolation method.
- K. Apply an anti-seize compound to nuts and bolts on all pipe supports.
- L. Locate reinforcing steel in concrete structure with x-ray prior to drilling for embedment plates and anchor bolts. Avoid contact or interference with reinforcing steel.
- 3.02 INSTALLATION OF BUILDING ATTACHMENTS:
- A. Support piping from structural framing, unless otherwise indicated.

B. Concrete Inserts:

1. Use existing embedded concrete items whenever possible.
2. Use expansion anchors only when existing embedded attachment points are not available or unsuitable. Attach to hardened concrete or completed masonry.

3.03 THRUST ANCHORS AND GUIDES:

A. Thrust Anchors:

1. Center thrust anchors between expansion joints and between elbows and expansion joints for suspended piping. Anchors must hold pipe rigid to force expansion and contraction movement to take place at expansion joints and/or elbows and to preclude separation of joints.
2. Restraining rod size and number shall be as indicated and adhere to manufacturers recommendations as a minimum.

B. Pipe guides: Provide adjacent to sliding expansion joints in accordance with recommendations of the National Association of Expansion Joint Manufacturers and the specific joint manufacturer.

3.04 PIPE SUPPORTS:

- A. Where piping of various sizes is to be supported together, space supports for the largest pipe size and install intermediate supports for smaller diameter pipes.
- B. Provide minimum of two pipe supports for each pipe piece.
- C. Where pipe connects to equipment, support pipe independently from the equipment. Do not use equipment to support piping.
- D. Provide pipe supports so that there is no interference with maintenance or removal of equipment.
- E. Unless otherwise indicated or authorized by the Engineer, place piping running parallel to walls approximately 1-1/2 inch out from face of wall and at least 3 in. below ceiling.
- F. Pedestal pipe supports: adjustable with stanchion, saddle, and anchoring flange. Provide grout between baseplate and floor.
- G. Piping supports for vertical piping passing through floor sleeves: use hot dipped galvanized steel riser clamps.
- H. Support piping to prevent strain on valves, fittings, and equipment. Provide pipe supports at changes in direction or elevation, adjacent to flexible couplings, adjacent to non-rigid joints, and where otherwise indicated. Do not install pipe supports in equipment access areas or bridge crane runs.
- I. Stacked horizontal runs of piping along walls may be supported by metal framing system attached to concrete insert channels.
- J. Do not support piping from other piping.

- K. Designs generally accepted as exemplifying good engineering practice, using stock or production parts, shall be utilized whenever possible.
 - L. Whenever possible, pipe attachments for horizontal piping shall be pipe clamps.
 - M. All rigid rod hangers shall provide a means of vertical adjustment after erection.
 - N. Where the piping system is subjected to shock loads, such as disturbances due to pump discharge or thrust due to actuation of safety valves, hanger design shall include provisions for rigid restraints or shock absorbing devices.
 - O. Hanger rods shall be subject to tensile loading only. At hanger locations where lateral or axial movement is anticipated suitable linkage shall be provided to permit rod swing.
 - P. Hanger spacing shall not exceed the spacing listed below:
 - 1. In the case of concentrated loads the supports shall be placed as close as possible to the load to reduce the bending stress.
 - 2. Where changes in direction of the piping system occur between supports, the total length between supports shall be kept to less than three-fourths of the full span. When practical, a support shall be placed immediately adjacent to any change in direction of the piping system.
 - Q. Where practical, riser piping shall be supported independently of the connected horizontal piping. Pipe support attachments to the riser piping shall be riser clamp shear lugs. Welded attachments shall be of material comparable to that of the piping, and designed in accordance with governing codes. If friction is relied upon to support riser piping proper justification and documentation shall be submitted to ensure that enough friction force is provided to resist the applied loading.
 - R. Hanger components shall not be used for purposes other than for which they were designed. They shall not be used for rigging and erection purposes.
 - S. All threads shall be UNC unless otherwise specified.
 - T. TFE slide bearing plates with steel backup plates shall be stitch weld attachments to the structure. A 1/8-inch fillet weld, 1/2-inch long every 3 inches on center each side of an element shall be used unless otherwise indicated or specified by the manufacturers' written recommendations. Bearing elements with slots or holes shall be stitch welded in place for location. The TFE surfaces of the bearings shall be maintained clean and free from grit, dirt or grease.
- 3.05 INSULATED PIPING:
- A. Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed allowable pipe stresses.
 - B. Where vapor barriers are indicated on water piping, install coated protective shields.

3.06 CONTRACT CLOSEOUT:

- A. Provide in accordance with Section 01 77 00.

END OF SECTION

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SECTION 40 23 19.04

DUCTILE IRON PIPE AND FITTINGS

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. Provide and test ductile iron pipe, fittings and appurtenances as specified.
- B. Options:
 - 1. For buried exterior pipelines provide push-on joint pipe.
 - a. Provide restrained push-on pipe as specified
 - b. Provide either restrained push-on joint fittings as specified and indicated or provide mechanical joint fittings with restraint system as specified herein
 - 2. For piping exposed as in buildings and galleries, provide flanged or rigid-joint, grooved-coupled pipe and fittings.
 - 3. Cast iron pipe and fittings are not acceptable.

1.02 SUBMITTALS:

- A. Submit the following in accordance with Section 01 33 00:
 - 1. Pipe manufacturer's technical specification and product data.
 - 2. Certified shop and erection drawings. Contractor shall submit electronic files of the piping layout including the following.
 - a. Pipe layouts in full detail.
 - b. Location of hangers and supports.
 - c. Location and type of anchors.
 - d. Location of couplings and expansion joints.
 - e. 1/2-inch = 1 foot-0 inch scale details of all wall penetrations and special fittings.
 - f. Schedules of pipe, fittings, special castings, couplings, expansion joints and other appurtenances.
 - 3. Certificates: Sworn certificates in duplicate showing compliance with material used and shop tests performed.
 - 4. Catalog cuts and technical data for expansion joints, couplings, gaskets, pipe supports and other accessories.
 - 5. Brochures and technical data on coatings and linings and proposed method of application.
 - 6. Manufacturer's descriptive literature and technical data on insulation and proposed method of installation.
- B. Material Certification:
 - 1. Provide certification from the pipe and fittings manufacturer that the materials of construction specified are recommended and designed for the service conditions specified

- and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and designed for the service conditions specified and indicated including an installation list of a minimum of five installations in operation for a minimum of 5 years. Provide proposed materials at no additional cost to the Owner.
2. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and designed for the service conditions specified and indicated.
- C. A copy of the contract mechanical process, civil and structural drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with “No changes required” or provide a statement that no changes are required.
1. Failure to include all drawings or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.
 2. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.
 - a. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.
 - b. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specifications and justifications are submitted in a complete package.

1.03 QUALITY ASSURANCE:

- A. Provide in accordance with Section 01 43 00 and as specified.
- B. Provide manufacturer's certification in writing, that materials meet or exceed minimum requirements as specified.
- C. Inspect and test at foundry according to applicable standard specifications.
- D. Owner reserves right to inspect and test by independent service at manufacturer’s plant or elsewhere at his own expense.
- E. Visually inspect before installation.
- F. Job Conditions:
 1. Coordinate dimensions and drillings of flanges with flanges for valves, pumps and equipment to be installed in the piping systems.

1.04 DELIVERY, STORAGE AND HANDLING:

- A. Comply with the requirements specified in Section 01 61 00.

- B. During loading, transportation and unloading, prevent damage to pipes and fittings. Load and unload each pipe under control at all times. Under no circumstances will a dropped pipe be used unless inspected and accepted by Engineer. Place skids or blocks under each pipe in the shop and securely wedge pipe during transportation.

PART 2 - PRODUCTS

2.01 PIPE:

A. Ductile Iron:

1. Design conforming to AWWA A21.50.
2. Manufacture conforming to AWWA A21.15 or AWWA A21.51.
3. Thickness class, unless otherwise indicated or specified:
 - a. Minimum Thickness Class 52.
 - b. Minimum thickness Class 53 for use with threaded flanges.
 - c. Minimum thickness Class 53 for use with flanged pipe.
 - d. Minimum thickness for use with grooved couplings conforming to AWWA C606.
4. Pressure Class, unless otherwise indicated or specified:
 - a. Minimum Pressure Class, 4-inches thru 12-inches: 350
 - b. 14 inches thru 64 inches: 250
 - c. Minimum thickness for use with grooved couplings conforming to AWWA C606.

2.02 PIPE FOR USE WITH COUPLINGS:

- A. As specified above except ends shall be plain.
- B. With bolted split sleeve couplings, ends cast or machined at right angles to axis.
- C. With grooved type coupling:
 1. Ductile-Iron of thickness class specified above.
 2. Grooved End dimensions conforming to AWWA C606 for flexible or rigid joints to suit joint requirements.

2.03 FLEXIBLE JOINT PIPE:

- A. Provide joints with maximum deflection 15 degrees in any direction from pipe axis. Joint design to prevent pulling apart, and to remain watertight at any deflection angle within specified range.
- B. Provide boltless type with rubber gaskets.
- C. Pipe barrel thickness: According to manufacturer's standard but not less than AN Standard for pipe of corresponding class.

- D. Machine joint contact surfaces spherical, without depressions or chatter marks, or rough tool cuts.
 - 1. Smooth by grinding, and buffing.
 - 2. Machining accuracy: Finished pipes interchangeable without loss of watertightness or flexibility.
 - 3. Protect spherical spigot and plain ends of cut lengths by fastened wood lagging.

2.04 FITTINGS:

- A. Provide fittings conforming to AWWA A21.10 or AWWA A21.53, at least Class 150 and match piping class.
- B. Provide all bell push-on or mechanical-joint fittings unless otherwise indicated or specified.
- C. Face and drill flanged fittings conforming to AWWA A21.10 except special drilling or tapping for correct alignment and bolting.
- D. If flanged fittings are not available under AWWA A21.10 provide fittings conforming to ASME B16.1 in 125 pound pressure class.
- E. Provide standard base fittings where indicated.
- F. Provide grooved-end fittings ductile-iron conforming to AWWA A21.10 for center-to-face dimensions.
 - 1. End preparation for grooved-ends conforming to AWWA C606 for flexible or rigid joints as required by type of joint.
- G. Fittings shall be domestic manufacturers (USA).

2.05 NONSTANDARD FITTINGS:

- A. Acceptable design.
- B. Same diameter and thickness as standard fittings.
- C. Manufactured to meet requirements of same specifications as standard fittings except for laying length and types of ends.

2.06 WALL CASTINGS:

- A. Provide size and type indicated.
- B. Wall Castings: Conform to requirements of AWWA A21.10 or fabricate of Class 53 ductile iron pipe with screwed on flanges and welded on waterstop.
- C. Provide water stop centered in wall. Weld water stops on in factory under controlled conditions to ensure adequate strength to permit waterstop to absorb thrust up to the pressure rating of the pipe.

WALL CASTINGS WITH ANNEALED DUCTILE IRON WATER STOPS

Pipe Size	Waterstop thickness, in
4"-12"	0.50
14"-24"	0.75
30"-36"	1.00
42"-48"	1.25

WALL CASTINGS WITH FABRICATED STEEL WATER STOPS

Pipe Size	Waterstop thickness, in
4"-16"	0.25
18"-24"	0.38
30"-36"	0.50
42"-48"	0.75
54"-64"	1.00

- D. On flanged wall castings, provide space between the wall and flange to permit mounting the nuts on the flange bolts.
 - E. Flanged wall castings located with the flange flush with the wall are not acceptable.
 - F. Locate push-on joint wall castings with space between the bell and the wall to insert the follower bolts.
 - G. As an option, fabricated wall pipe of Schedule 40 Type 316L stainless steel may be substituted for wall castings specified above. Provide with waterstops of above dimensions and welded continuously on both sides of stop. Flanges of Type 316 stainless steel. Bolts for connection to buried pipe Type 316 stainless steel. Provide flange insulation gaskets, sleeves and washers for all flanges.
- 2.07 ADAPTERS:
- A. Furnish and install for joining pipe of different types, unless solid sleeves indicated.
 - 1. Provide ends conforming to above specifications for the correct type of joint, to receive adjoining pipe.
 - 2. Joining two classes of pipe may be of lighter class provided annular space in bell-and-spigot type joints sufficient for jointing.
- 2.08 JOINTS:
- A. Provide push-on joint and mechanical joint pipe with necessary accessories, conforming to AWWA A21.11.
 - 1. Provide gasket composition designed for exposure to liquid within pipe.
 - 2. Provide mechanical joint gaskets with copper tips to provide electrical continuity.
 - 3. Provide serrated brass wedges for push-on joints to provide electrical continuity; two per joint for pipe 12-inch and smaller and four per joint for larger pipe.

- B. Provide pipe flanges and accessories conforming to AWWA A21.15.
 - 1. Provide flat faced flanges.
 - 2. Provide 1/8-inch thick, full faced gaskets designed for exposure to liquid within pipe.
- C. Provide restrained joint on pipe and fittings where indicated. Provide restrained joint which is:
 - 1. Boltless
 - 2. Capable of being deflected after assembly
 - 3. Designs using set screws or requiring field welding are not acceptable.
 - 4. Manufacturers:
 - a. American Cast Iron Pipe Co. Flex-Ring.
 - b. U.S. Pipe TR FLEX.
 - c. Clow Super-Lock.

2.09 MECHANICAL JOINT FITTINGS – RESTRAINT SYSTEM:

- A. Provide restraint devices for pipe consisting of multiple gripping wedges incorporated into a follower gland meeting requirements of AWWA A21.10.
 - 1. Mechanical joint restraint shall require conventional tools and installation procedures per AWWA C600, retaining full mechanical joint deflection during assembly and allowing joint deflection after assembly.
 - 2. Provide actuation of the gripping wedges ensured with torque limiting twist off nuts.
 - 3. Provide restraint devices Listed by Underwriters Laboratories (3-inch through 24-inch size) and Designed by Factory Mutual (3-inch through 12-inch size).
 - 4. Gland body, wedges and wedge actuating components must be domestic manufacture (USA).
- B. Working Pressure Rating:
 - 1. 16-inch and Smaller: 350 psi.
 - 2. 18-inch and Larger: 250 psi.
 - 3. Minimum safety factor of 2 to 1.
- C. Materials:
 - 1. Gland body, wedges and wedge actuating components: Grade 65-45-12 ductile iron in accordance with ASTM A536.
 - 2. Ductile iron gripping wedges: Heat treated, 370 to 470 BHN.
 - 3. Provide three test bars incrementally poured per production shift as per Underwriter's Laboratory (U.L.) specifications and ASTM A536. Testing for tensile, yield and elongation in accordance with ASTM E8.
 - 4. Provide chemical and nodularity tests performed as recommended by the Ductile Iron Society, on a per ladle basis.
 - 5. Provide an identification number consisting of year, day, plant and shift (YYDDD)(plant designation)(Shift number) cast into each gland body.
 - 6. Record all physical and chemical test results such that they can be accessed via the identification number on the casting. Provide the Material Traceability Records (MTRs) available, in hard copy.

7. Provide coating for restraint devices consisting of the following:
 - a. Process all wedge assemblies and related parts through a phosphate wash, rinse and drying operation prior to coating application.
 - b. Coating: A minimum of two coats of liquid thermoset epoxy coating with heat cure to follow each coat.
 - c. Surface pretreat all casting bodies with a phosphate wash, rinse and sealer before drying. The coating shall be electrostatically applied and heat cured. Coating: Polyester based powder to provide corrosion, impact and UV resistance.
 - d. Coating system: MEGA-BOND by EBAA Iron, Inc.

D. Manufacturer:

1. EBAA Iron MegaLug Series 1100

2.10 FLANGE ADAPTORS:

A. Provide restrained flange adaptors for pipe consisting of multiple individual gripping wedges incorporated into a follower gland meeting requirements of AWWA A21.10.

1. Provide actuation of the gripping wedges ensured with torque limiting twist off nuts.
2. Provide restraint devices Listed by Underwriters Laboratories (3-inch through 12 inch size) and Designed by Factory Mutual (4-inch through 12-inch size).
3. Gland body, wedges and wedge actuating components must be domestic manufacture (USA).

B. Joint Deflection capability:

1. 3-inch thru 8-inch: 5 degrees
2. 10-inch and 12-inch: 3 degrees
3. 14-inch and 16-inch: 2 degrees

C. Provide flange adaptor to maintain seal with and 0.6 inch gap between end of pipe and mating flange

D. Working Pressure Rating:

1. 16-inch and Smaller: 350 psi.
2. Minimum safety factor of 2 to 1.

E. Materials:

1. Gland body, wedges and wedge actuating components: Grade 65-45-12 ductile iron in accordance with ASTM A536.
2. Ductile iron gripping wedges: Heat treated, 370 to 470 BHN.
3. Provide three test bars incrementally poured per production shift as per Underwriter's Laboratory (U.L.) specifications and ASTM A536. Testing for tensile, yield and elongation in accordance with ASTM E8.
4. Provide chemical and nodularity tests performed as recommended by the Ductile Iron Society, on a per ladle basis.
5. Provide an identification number consisting of year, day, plant and shift (YYDDD)(plant designation)(Shift number) cast into each gland body.

6. Record all physical and chemical test results such that they can be accessed via the identification number on the casting. Provide the Material Traceability Records (MTRs) available, in hard copy.
7. Provide coating for restraint devices consisting of the following:
 - a. Process all wedge assemblies and related parts through a phosphate wash, rinse and drying operation prior to coating application.
 - b. Coating: A minimum of two coats of liquid thermoset epoxy coating with heat cure to follow each coat.
 - c. Surface pretreat all casting bodies with a phosphate wash, rinse and sealer before drying. The coating shall be electrostatically applied and heat cured. Coating: Polyester based powder to provide corrosion, impact and UV resistance.
 - d. Coating system: MEGA-BOND by EBAA Iron, Inc.

F. Manufacturer:

1. EBAA Iron MegaFlange Series 2100

2.11 FLEXIBLE CONNECTIONS:

A. Use as specified or indicated:

1. Bolted split sleeve couplings
2. Grooved couplings
3. Expansion joints

2.12 BOLTED SPLIT SLEEVE COUPLINGS:

- A. Provide in accordance with Section 40 23 19.04.
- B. Pressure rating at least equal to that of related pipeline.
- C. Provide with gaskets of composition designed for exposure to liquid within pipe.
- D. Provide gaskets with copper tips for electrical continuity through joints.

2.13 GROOVED COUPLINGS:

- A. Conform to AWWA C606.
- B. Minimum pipe wall thickness specified under "Pipe For Use With Couplings."
- C. Where grooved couplings are indicated to provide for expansion or flexibility, cut pipe grooves to provide necessary expansion or flexibility.
- D. Where grooved couplings are used instead of flanged joints, joint to be of rigid type with pipe grooves cut to bring pipe ends together. Beam strength of joint shall be equal to or greater than that of flanged joint.

2.14 EXPANSION JOINTS:

- A. Pressure rating at least equal to that of related pipeline.

2.15 FILLING RINGS:

- A. Provide where necessary.
- B. Materials, workmanship, facing, and drilling, conforming to 125-pound. ANSI (PN 10).
- C. Suitable length with nonparallel faces and corresponding drilling, if necessary, for correct assembly of adjoining piping or equipment.

2.16 CONNECTIONS – TAPPED:

- A. Provide service saddles for all taps for lines 24-inch and smaller.
 - 1. Body: Ductile iron ASTM A395 or Bronze.
 - 2. Straps and Hardware: Type 316 stainless steel.
- B. For 30-inch and larger provide watertight joint with adequate strength against pullout. Use only tapered thread taps.
 - 1. Maximum size of taps in pipe or fittings without bosses not to exceed that listed in table of Appendix to AWWA A21.51 based on: 2 full threads.
 - 2. Where size of connection exceeds that given above for pipe, provide boss on pipe barrel or use tapping saddle. Make tap in flat part of intersection of run and branch of tee or cross, or connect by means of tapped tee, branch fitting and tapped plug or reducing flange, or tapping tee and tapping valve, or permitted.
 - 3. Provide taps and piping for gauges and pressure sensing instruments in accordance with ANSI/HI standards so that there are no erroneous readings.

2.17 PIPE COATING:

- A. Outside of pipe and fittings within structures: Clean and apply one shop coat with a 3 to 5 mil DFT of moisture cured urethane.
- B. Outside surfaces of castings to be encased in concrete: No coating.
- C. Machined surfaces cleaned and coated with rust-preventative compound at shop.
- D. Outside of buried pipe and fittings: Standard bituminous coating conforming to AN Standard.

2.18 CEMENT LINING:

- A. Inside of pipe and fittings: Provide double thickness cement lining and Tnemec 431 bituminous seal coat conforming to AWWA A21.4.

2.19 GASKETS, BOLTS, AND NUTS:

- A. Provide ring or full face synthetic rubber gaskets for flanged joints and neoprene faced phenolic for insulating gaskets in accordance with AWWA A21.11 and ASME B16.21.
 - 1. 1/8 inch thick.

- B. Make flanged joints with:
 - 1. Bolts.
 - 2. Bolt studs with nut on each end.
 - 3. Studs with nuts where flange is tapped.
 - 4. Plastic bolt sleeves and washers for insulating joints.
- C. Number and size of bolts conform to same ANS as flanges.
- D. Provide bolts and nuts, except as specified or indicated, Grade B, ASTM A307.
- E. Provide bolt studs and studs of same quality as machine bolts.
- F. Provide Type 316 stainless steel bolts, washers and nuts in the following areas:
 - 1. Submerged
 - 2. Wet Wells
 - 3. Chemical Area
 - 4. Piping exposed to weather

2.20 ELECTRICAL CONDUCTORS:

- A. Provide 1/16-inch by 3/4-inch copper strip conductors for joints indicated to have electrical continuity.
- B. Weld terminal strips to bell-ends and spigot ends of pipe in the foundry. Provide jumper strips and silicon bronze bolts and nuts to complete the connections.
- C. If field cutting of pipe is necessary, weld terminal strip to cut spigot end using thermit weld or other designed process.

PART 3 - EXECUTION

3.01 HANDLING AND CUTTING:

- A. Mark pipe and fittings "Rejected" and remove from site when cracked or has received a severe blow.
- B. If permitted, cut on sound barrel at a point at least 12 inch from visible limit of crack, at Contractor's expense.
- C. Machine cut with milling type cutters, knives, or saws. Snap cutters, torch, or hammer and chisel NOT ALLOWED. Examine for possible cracks.
- D. Chamfer cut ends if used for push-on joints.
- E. Do not cut glass lined pipes.

3.02 INSTALLATION:

- A. Visually inspect before installation.

- B. Ensure pipelines parallel to building walls wherever possible. Install piping to accurate lines and grades. Where temporary supports are used, ensure rigidity to prevent shifting or distortion of pipe. Provide for expansion where necessary.
- C. Pitch piping toward low points. Provide for draining low points.
- D. Before assembly, remove dirt and chips from inside pipe and fittings.
- E. Piping Support: Provide in accordance with Section 40 23 19.01.
- F. Pipe and Fittings:
 - 1. Remove and replace defective pieces.
 - 2. Clear of all debris and dirt before installing and keep clean until accepted.
 - 3. Lay accurately to lines and grades indicated or required. Provide accurate alignment, both horizontally and vertically.
 - 4. Provide firm bearing along entire length of buried pipelines.
 - 5. Do not allow deflection of alignment at joints to exceed permissible deflection as specified below:

PIPE DEFLECTION ALLOWANCES

Maximum permissible deflection, in.*		
Size of pipe, in	Push-on joint	Mechanical joint
4	19	31
6	19	27
8	19	20
10	19	20
12	19	20
14	11	13-1/2
16	11	13-1/2

* Maximum permissible deflection for 20-foot lengths; for other lengths in proportion of such lengths to 20 feet.

- a. For push-on joint or similar pipe, clean bell of excess tar or other obstruction and wipe out before inserting next pipe spigot. Shove new pipe into place until properly seated and hold securely until joint completed.
 - b. Set castings to be encased in concrete accurately with bolt holes, if any, carefully aligned. Clean off rust and scale before setting.
- G. Temporary Plugs: When pipe laying not in progress, close open ends of pipe with temporary watertight plugs. If water in trench, do not remove plug until danger of water entering pipe passed.
- H. Appurtenances: Set valves, fittings and appurtenances as indicated.

3.03 JOINTS AND COUPLINGS:

A. Push-on Joints:

1. Insert gasket into groove bell. Apply thin film of nontoxic gasket lubricant over inner surface of gasket in contact with spigot end.
2. Insert chamfered end into gasket. Force pipe past it until it seats against socket bottom.

B. Bolted Joints:

1. Remove rust-preventive coatings from machined surfaces.
2. Clean pipe ends, sockets, sleeves, housings, and gaskets and smooth all burrs and other defects.
3. Use torque wrench to tighten to correct range of torque not to exceed values specified below:

TORQUE RANGE VALUES

Nominal pipe size, in	Bolt diameter, in	Range of torque, ft-lb
3	5/8	40-60
4-24, incl.	3/4	75-90

C. Flanged Joint:

1. Make up tight.
2. Do not put strain on nozzles, valves, and other equipment.

D. Mechanical Joints:

1. Wire brush surfaces in contact with gasket and clean gasket.
2. Lubricate gasket, bell, and spigot with soapy water.
3. Slip gland and gasket over spigot, and insert spigot into bell until seated.
4. Seat gasket and press gland firmly against gasket.
5. After bolts inserted and nuts made finger-tight, tighten diametrically opposite nuts progressively and uniformly around joint by torque wrench. Torque bolts to values specified above.

E. Flexible Joints:

1. Clean and dry before assembly.
2. Place gaskets, rings, glands and followers in position in back of spigot ball.
3. Coat ball and socket with thin film of lubricant conforming to joint manufacturer's standards.
4. Insert ball and seat in socket. Seat gasket against ball.
5. Boltless joints:
 - a. Assemble retainer rings and glands conforming to manufacturer's standard.
 - b. Lock in place with lead strips.

F. Grooved Couplings:

1. Clean grooves and other parts.

2. Coat ends of pipe and outside of gasket with soft soap or silicone and slip gasket over one pipe end.
3. Bring pipes to correct position and center gasket over pipe ends with lips against pipe.
4. Place housing sections, insert bolts and tighten nuts until housing sections in metal-to-metal contact.
5. After assembly and inspection and before backfilling, coat exterior surfaces of buried couplings, including bolts and nuts, with heavy-bodied bituminous mastic.

G. Tapped Connection:

1. Drill and tap normal to longitudinal axis.
2. Drilled by skilled mechanics using proper tools.
3. Use only tapered threads.

H. Electrical Conductors:

1. Install pipes so terminal strips are aligned.
2. Install jumper strips and tighten bolts.

3.04 FIELD TESTING:

A. Clean of all dirt, dust, oil, grease and other foreign material, before conducting pressure and leakage tests.

B. Pressure and Leakage Tests:

1. Conduct combined pressure and leakage test:
 - a. Initially on pipeline between first two valves, maximum length 1/4 mile, and within three days of completion.
 - b. Afterwards on completed sections of maximum length 1/2 mile.
 - c. Isolated sections upon completion.
2. Conduct combined pressure and leakage test in pipelines.
3. Furnish and install temporary testing plugs or caps; pressure pumps, pipe connections, meters, gages, equipment, and labor.
4. Test when desired and comply with specifications.
5. Test pipelines in excavation or embedded in concrete before backfill or placing of concrete and test exposed piping before field painting.
6. Fill section of pipe with water and expel air. If hydrants or blowoffs are not available at high points for releasing air, make necessary taps and plug after test completion.
7. Maintain section full of water for 24 hours before conducting combined pressure and leakage test.
8. Conduct pressure and leakage test consisting of first raising water pressure (based on elevation of lowest point of section under test and corrected to gage location) to pressure in psi numerically equal to pipe pressure rating, but not more than 150 psi.
9. Maintain pressure and make leakage test by metering water flow into pipe. Acceptable results:
 - a. Average leakage during test: less than 10 gallons per inch of diameter per 24 hours per mile.

- b. No visible leakage in joints.
 - 10. If unable to achieve and maintain specified pressure for one hour with no additional pumping, section fails test.
 - 11. If section fails pressure and leakage test, locate, uncover, and repair or replace defective pipe, fitting, or joint, at no additional expense and without time extension. Conduct additional tests and repairs until section passes test.
 - 12. Modify test procedure only if permitted by Engineer.
- 3.05 FIELD PAINTING:
- A. Provide in accordance with Section 09 96 10.
- 3.06 DISINFECTING AND FLUSHING:
- A. Provide in accordance with Section 33 13 00.
- 3.07 CONTRACT CLOSEOUT:
- A. Provide in accordance with Section 01 77 00.

END OF SECTION

SECTION 40 23 19.05

PROCESS PIPING AND APPURTENANCES

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. Provide and test process piping and appurtenances as indicated and specified.

1.02 SUBMITTALS:

- A. Submit the following in accordance with Section 01 33 00:

1. Submit manufacturer's certificates of conformance.
2. Submit certified copies of test reports.
3. Piping layouts in full detail.
4. Location of pipe hangers and supports.
5. Large scale details of wall penetrations and fabricated fittings.
6. Schedules of all pipe, fittings, special castings, flexible connectors, adapters, couplings, expansion joints, and other appurtenances.
7. Reports as required for welding certifications per ASME B31.1 Paragraph 127.6.
8. Catalog cuts of joints, couplings, harnesses, expansion joints, gaskets, fasteners and other accessories.

- B. Grooved joint couplings and fittings: Provide product submittals with products specifically identified by the manufacturer's style or series designation.

1. Brochures and technical data on coatings and linings and proposed method for application and repair.
2. Manufacturer's descriptive literature and technical data on insulation and proposed method of installation.
3. Shop drawing data for accessory items.
4. Manufacturer's literature as needed to supplement certified data.
5. Operating and maintenance instructions and parts lists.
6. Schematic control and power wiring diagrams.
7. Shop and Field inspections reports.
8. List of recommended spare parts other than those specified.
9. Recommendations for short and long term storage.
10. Special tools.
11. Shop and field testing procedures and equipment to be used.
12. Provide a listing of the materials recommended for each service specified and indicated. Provide documentation showing compatibility with process fluid and service specified and as indicated.
13. The most recent ISO 9000 series certification or quality system plan.
14. Material Certification:
 - a. Provide certification from the piping and equipment manufacturers that the materials of construction specified are recommended and suitable for the service conditions specified and as indicated. If materials other than those specified are

proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified. And indicated including an installation list of a minimum of five installations in operation for a minimum of 5 years. Provide proposed materials at no additional cost to the Authority.

- b. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated.

C. A copy of the contract mechanical process, civil, structural, electrical and instrumentation drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with “No changes required”.

1. Failure to include all drawings applicable to the equipment specified in this section will result in submittal return without review.

D. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations and clarifications from the specified requirements.

1. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.
2. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specification and justification are resubmitted with the entire package.

1.03 QUALITY ASSURANCE:

A. Welder Qualifications:

1. Qualify and certify welding procedures, welders, and operators in accordance with ANSI B31.1, for shop and project site welding of piping work.
2. Qualification for welders: Welding shall be performed by welders holding current certification for the welding procedures in use.
3. Visually inspect welding while the operators are making the welds and again after the work is completed. After the welding is completed, hand or power wire brush welds and clean them before the inspector makes the check inspection. Inspect welds for defects exceeding tolerances allowed by code under which the weld was made. Repair all defects exceeding tolerance.

B. Provide all grooved joint couplings, fittings, valves, and specialties to be the products of a single manufacturer. Grooving tools used must be of the same manufacturer as the grooved components.

1. Provide all castings used for coupling housings, fittings, and valve bodies date stamped for quality assurance and traceability.

C. Job Conditions:

1. Coordinate dimensions and drillings of flanges with flanges for valves, pumps, and other equipment to be installed in piping system.

1.04 DELIVERY, STORAGE AND HANDLING:

- A. Provide in accordance with Section 01 61 00.
- B. During loading, transportation and unloading, prevent damage to pipes and coatings. Load and unload each pipe under control at all times. Under no circumstances will a dropped pipe be used unless inspected and accepted by Engineer. Place skids or blocks under each pipe in the shop and securely wedge pipe during transportation to protect pipe, lining, and coating.

PART 2 - PRODUCTS

2.01 DUCTILE IRON PIPE AND FITTINGS:

- A. Provide in accordance with Section 40 23 19.04.

2.02 CPVC PIPE AND FITTINGS:

- A. Schedule 80.
- B. Material: Type IV, Grade I Chlorinated Polyvinyl Chloride (CPVC) compound with a Cell Classification of 23447 per ASTM D1784.
- C. Provide pipe and fittings manufactured in compliance to ASTM F441 meeting the Quality Assurance test requirements of this standard with regard to material, workmanship, burst pressure, flattening, and extrusion quality.
- D. Provide pipe and fittings produced in the USA using domestic materials, by an ISO 9002 certified manufacturer, and shall be stored indoors after production, at the manufacturing site, until shipped from factory.
- E. Provide pipe and fittings with the National Sanitation Foundation (NSF) seal of approval for potable water applications.
- F. Joining:
 1. Solvent cementing process.
 2. Use only Weld-On 724 for all sodium hypochlorite services.
 3. Provide flanges at valves pumps and equipment only or as indicated and specified.
 4. Threaded connections are not acceptable.
 5. Provide Type 316 stainless steel flange bolting and hardware for all piping systems except sodium hypochlorite use titanium.

2.03 PVC PIPE AND FITTINGS:

- A. Schedule 80
- B. Material: Type I, Grade I Polyvinyl Chloride (PVC) compound with a Cell Classification of 12454 per ASTM D1784.
- C. Provide pipe and fittings manufactured in compliance to ASTM D1785 meeting and/or exceeding the Quality Assurance test requirements of this standard with regard to material, workmanship, burst pressure, flattening, and extrusion quality.
- D. Provide pipe and fittings manufactured in the USA, using domestic materials, by an ISO 9002 certified manufacturer. Store all pipe shall be stored indoors after production at the manufacturing site until shipped from factory.
- E. Provide standard lengths of pipe sizes 10-inch and larger beveled each end by the pipe manufacturer.
- F. Provide pipe and fittings with the National Sanitation Foundation (NSF) seal of approval for potable water applications.
- G. Joining:
 - 1. Solvent cementing process.
 - 2. Provide flanges at valves, pumps and equipment only or as indicated and specified.
 - 3. Provide Type 316 stainless steel flange bolting and hardware for all piping system except sodium hypochlorite use titanium.

2.04 PVC CLEAR PIPE AND FITTINGS:

- A. Schedule 80 Clear pipe
- B. Material: Type I, Grade I Polyvinyl Chloride (PVC) compound with a Cell Classification of 12454 per ASTM D1784.
- C. Provide pipe and fittings manufactured in compliance to ASTM D1785, consistently meeting and/or exceeding the applicable Quality Assurance test requirements of this standard with regard to material, workmanship, burst pressure, flattening, and extrusion quality.
- D. Provide pipe and fittings manufactured in the USA by an ISO 9002 certified manufacturer.
- E. Provide all Clear PVC pipe and fittings packaged immediately after its manufacture to prevent damage, and stored indoors at the manufacturing site until shipped from factory.
- F. Joining:
 - 1. Solvent cementing process. Use a clear, medium-bodied, fast-setting cement in conjunction with a clear primer for optimum joint integrity, such as IPS Weld-on 705 Clear cement and IPS Weld-On P-70 Clear primer or acceptable equivalent product.
 - 2. Clear female threaded transition fittings, incorporating a Type 316 stainless steel retaining ring. Provide all threaded joints with three wraps of tape in the direction of the threads on the male end, followed by one to two turns beyond finger tight.

3. Standard rigid thermoplastic pipe fittings with flanges, molded grooved coupling adapters and unions.
4. Provide Type 316 stainless steel flange bolting and hardware for all piping system except sodium hypochlorite use titanium.

2.05 COPPER PIPE AND FITTINGS:

A. Materials:

1. Seamless, ASTM B88
2. All materials must meet ANSI/NSF 61

B. Type:

1. Provide Type L within buildings.
2. Provide Type K for buried service.

C. Joints: Soldered, flared or grooved joints, as indicated.

D. Solder: 95 percent tin, 5 percent antimony.

1. Cored solder is not acceptable.

E. Fittings: Cast-bronze

1. Wrought Copper, Socket-Type, ASTM B75, ASME B16.22 Standard
2. Grooved-End Fittings: ASME B16.22 wrought copper and ASME B16.18 bronze casting. Victaulic Copper-Connection.
 - a. Provide ends manufactured to copper-tubing dimensions. Flaring tube or fitting ends to accommodate alternate sized couplings is not acceptable.
3. Threaded adapters, bronze ASTM B62, 150-pound.
4. Threaded, ASME B16.15 Standard
5. Unions bronze ASTM B62, 125-pound with ground joint seats.
6. Grooved Joint Couplings: Provide couplings consisting of two ductile iron housing segments to ASTM A536 cast with offsetting angle-pattern bolt pads to provide joint rigidity, pressure responsive grade EHP gasket, suitable for water service to +250 degrees F (121 degrees C), and zinc electroplated steel bolts and nuts to ASTM A449. Victaulic Style 607H, Installation-Ready, for direct stab installation without field disassembly.

2.06 CHEMICAL TUBING AND FITTINGS:

A. Manufacturers:

1. New Age Industries
2. Nalge Inc.
3. Norton Company Tubing:
4. Provide braided reinforced flexible PVC tubing resistant to the chemical specified.
5. Tubing to allow tight compression fittings for leak proof connections.
6. Tubing to comply with FDA standards.

7. Tubing to handle a maximum of 130 psi at 70 degrees F (21 degrees C).

B. Fittings:

1. Provide no flow restriction compression fittings when connecting pieces is required.
2. Provide transition connections as detailed on the drawings.

2.07 PRESSURE GAUGES:

A. Gauges:

1. Non-liquid filled type.
2. Helical wound bourdon tube, Inconel X-750.
3. Welded parts: Type 316 stainless steel.
4. Bearings: Precision Sapphire Type.
5. ½-inch NPT bottom male thread connection.
6. Accuracy: ½ percent of scale range.
7. 4-1/2-inch diameter with ABS plastic case.
8. Provide external adjustment.
9. Pipe and Fittings: Schedule 5 Pressfit or Schedule 40 threaded or socket welded, Type 316L stainless steel.
10. Pump Suction Gauges: Provide gauges with range to cover both the normal operating range and the range of pressures that will result from flushing.
11. Pump Discharge Gauges: Provide gauges with range to cover the normal operating range, above the pump shutoff head and the range of pressures that will result from flushing.
12. Seal Water Gauges: Provide gauges with range to cover both the normal operating range and the range of pressures that will result from flushing.
13. Double Wall Stainless Steel Expansion Joint Gauges: Provide gauges with ranges to suit process line pressure as specified and indicated for the service specified in the Process Piping Schedule.

B. Pipe and fittings: Type 316L stainless steel, provide as specified herein.

C. Ball valves: General service stainless steel ball valves in accordance with Section 40 23 13.01.

D. Pressure Sensor Rings:

1. 1-inch and Larger: Provide sensor/isolators that fit inside the bolt circle of 150-pound (PN10) or 300-pound (PN20) ANSI flanges as required.
2. 3/4-inch and Smaller: Provide sensor/isolators full flange or threaded as specified and indicated. For chemical system provide full flange, threaded connections are not acceptable.
3. Face to face length of the sensor: Conform to Specification MSS-SP67.
4. Type: Flow through design with flexible sleeve around full circumference. The center section shall have a cavity behind the sleeve filled with silicone fluid to transfer pressure to the gauge.
5. Rigidly support all pressure instruments by a post at least 7/8-inch diameter welded to the isolator. On sensor rings with more than one instrument, provide all connections 1/2-inch NPT as a minimum, 1/4-inch NPT fittings are not acceptable.

6. Provide sensor/isolator rings that do not have any fill plugs or valves that can be inadvertently removed with the resultant loss of fill fluid. Pressure sensor/isolators using valves are not acceptable.
7. Provide liquid filled sensor/isolators permanently vacuum sealed at the factory with a modular seal consisting of a membrane and needle fitting to allow removal and replacement of pressure instruments without compromising the vacuum fill. Sensor/isolators using valves are not acceptable.
8. Provide the needle fitting with both ¼-inch NPT(F) threads and ½-inch NPT(M) threads.
9. Provide the pressure sensor/isolator capable of operating under pressure with all pressure instruments removed with no loss of fill fluid and without the need for isolating valves.
10. Attach pressure instruments to the isolator with a hand tightened lock ring.
11. It shall be possible to remove or attach pressure instruments to the isolator without requiring the use of any tools.
12. Permanently fill the pressure sensor with high viscosity silicone instrument oil to damp out surges or pressure spikes without the requirement for a separate snubber.
13. Pressure rating: 200 psi minimum for all lines tested at 150 psi or less and 600 psi minimum per lines tested above 150 psi.
14. Provide gauges as specified herein. Provide all other types of instruments indicated and specified in accordance with Section 40 90 10.
15. Materials:
 - a. Pressure sensor/isolator rings: Provide materials suitable for the service conditions specified and indicated, as a minimum provide the following

Service	Body & Plates	Sleeve
Water	Type 316L Stainless Steel	Natural Rubber
Fluosilicic Acid	Non-metallic	-----
Sodum hypochloite	Non-metallic	

2.08 PRESSURE AND FLOW INSTRUMENTATION:

- A. Provide in accordance with Section 40 91 12 and Section 40 95 14.

2.09 COUPLINGS-SLEEVE TYPE:

- A. Manufacturers:

1. Romac
2. Smith Blair
3. Viking Johnson
4. Dresser

- B. Provide couplings meeting AWWA C219

- C. Couplings 12-inch (300 mm) and smaller:

1. End rings and center rings: ASTM A536 ductile iron, fusion bonded epoxy coated
2. Gaskets: Buna-N, NSF 61 approved
3. Hardware: Type 316 stainless steel

- D. Couplings 14-inch and larger:
 - 1. End rings and center rings: ASTM A36 steel, fusion bonded epoxy coated
 - 2. Gaskets: Buna-N, NSF 61 approved
 - 3. Hardware: Type 316 stainless steel
- E. Bridles and tierods: Minimum 3/4-inch diameter, except where tierods replace flange bolts of smaller size, in which case fit with nut on each side of pair of flanges.
 - 1. Provide as indicated

2.10 COUPLINGS-BOLTED SPLIT SLEEVE TYPE:

- A. Manufacturers:
 - 1. Victaulic Depend-O-Lok
- B. Type: Bolted, split-sleeve type coupling consisting of four basic components; one piece housing, gaskets assembly, bolts and nuts, and restraint rings as required for restraint.
 - 1. Provide split-sleeve with a double arch cross section closing around pipe ends that are smooth for expansion or contraction requirements or pipe ends with end rings affixed for pipe end restraint requirements. As the coupling housing closes, it confines the elastomeric gasket beneath the arches of the sleeve to create the radial seal. The axial seal is affected by the sealing plate at the closure plates as the bolts pull the coupling housing snug around the pipe.
 - 2. Provide sealing members comprised of two “O” ring gaskets and an elastomer sealing pad bonded to the integral sealing plate.
- C. Provide couplings designed for the type, size, and working pressure of the piping system as indicated in the Process Piping Schedule and specified.
- D. Materials:
 - 1. Split-sleeve:
 - a. Carbon Steel and Ductile Iron pipelines: ASTM A36 Carbon Steel.
 - b. Stainless steel pipelines, ASTM A240 Type 316L stainless steel.
 - c. Provide stainless steel couplings where there is a transition for ductile iron to stainless steel piping.
 - 2. Gaskets:
 - a. Material: Elastomers in accordance with ASTM D2000.
 - (1) Air Service: Silicone conforming to ASTM D2000 for air service up to 240 degrees F (115 degrees C) with intermittent exposure to 280 degrees F (138 degrees C).
 - (2) Liquid Service: Isoprene or Buna-N conforming to ASTM D2000 for service within the temperature range of -20 degrees F (-29 degrees C) to 180 degrees F (38 degrees C).

3. Bolts and Nuts:
 - a. Bolts: Stainless steel conforming to ASTM F593 Type 316, minimum tensile strength 85,000 psi. (or threaded studs to ASTM A193, Class 2 Grade B8M Type 316)
 - b. Nuts: ASTM F593 Type 316.
 4. End Restraint Rings:
 - a. Provide restraint rings of the same material as the coupling housing.
 - b. Non-restrained (ExE) type couplings allows for up to 4 degree deflection. Provides for coupling joint where restraint is not required. If restraint is required, it must be provided independent of the coupling.
 - c. Fixed x Expansion (FxE) type couplings: Allows for thermal expansion and contraction at the pipe joint. Provide one or two restraint rings fixed to one end of the pipe to keep coupling in the proper location. Where split sleeve coupling FxE for expansion is used provide the expansion side of the coupling with a combination of fixed and sliding supports for thermal movement.
 - d. Fixed x Fixed (FxF) type couplings: Provides a fully restrained pipe joint. Provide one restraint ring welded to each of the pipe ends fitting beneath the coupling to prevent the pipe joint from pulling apart.
 - e. Provide type as indicated and specified.
 - f. Follow manufacturer's written recommendations and instructions for location dimensions and welding detail required to attach the restraint rings.
- E. Provide a Type 316 stainless steel nameplate welded to each coupling with the following data:
1. Manufacturer and date fabricated.
 2. Type of Coupling (ExE, FxE, FxF).
 3. Working Pressure in psi.
 4. Test Pressure in psi.
 5. Materials for coupling, hardware and gaskets.
- F. Protective Coating: Prior to installation, couplings shall be coated on the I.D. and O.D. in accordance with Section 09 96 10.
- G. Couplings installed underground: Provide bitumastic coating or joint tape wrap.
- H. Installation of couplings shall be in accordance with manufacturer's recommendation.
1. The coupling housing shall be assembled pulling the closure plates together with the bolts tightened to assure snug coupling housing contact with the pipe OD. Follow the manufacturer's recommendation regarding the installation and tightening of the bolts.
- 2.11 EXPANSION JOINTS-ELASTOMERIC FLEXIBLE CONNECTION:
- A. General: Provide flexible connectors as indicated, specified and as required for ductile iron, steel and stainless steel piping
1. At equipment connection: To eliminate vibration and stress on equipment.

2. Elsewhere: Designed for expansion/contraction.
 - a. Hot Water Systems: 1.25-inch per 100 feet.
 - b. All other Piping Systems: 0.5-inch per 100 feet.

B. Manufacturers:

1. Mercer Rubber Co.
2. General Rubber Co.
3. Garlock, Inc.
4. Proco.

C. Products:

1. Straight-through or tapered design as required.
2. Filled arch type for wastewater, sludge and scum applications
3. Furnish control rods for test pressures as indicated or required.
4. Materials: Suitable for service specified and indicated.
5. At expansion joints, provide guide supports located per manufacturer's recommendations.
6. Flanges: 125 pound (PN 10) drilling.
7. Provide Type 316 stainless steel retaining rings.

D. Install joints in their neutral position.

2.12 EXPANSION JOINTS-STAINLESS STEEL:

A. Manufacturers:

1. Pathway
2. Flexonic
3. Adscio
4. Victaulic Omni-Flex

B. Design Criteria:

1. Liquid: Service as indicated in the Process Pump Schedule.
2. Liquid Temperature: As indicated in the Process Pump Schedule.
3. Minimum Pressure Rating: 150 psi minimum or as indicated in the Process Piping Schedule.
4. Minimum Lateral Movement: 0.125-inch.
5. Minimum Axial Movement: 0.4-inch.
6. For expansion joints used on pump discharge nozzles the Contractor shall coordinate the rod size and movement allowable with the pump manufacturer and provide a statement from the pump manufacturer that the expansion joint and rod size is acceptable for the pump provided.

C. Products:

1. Provide bellows of two ply construction formed from concentric tubes having only longitudinal seams.

2. For two ply construction, each ply shall be capable of retaining the rated pressure at the specified temperature independently.
3. For two ply construction, seal weld both plies so that no gas or liquid leaks out at the ends.
4. For two-ply construction, provide a pressure monitoring connection with pressure gauge and pressure switch as specified herein for the annular space.
5. Provide control rods for test pressure.
6. Provide minimum two lifting lugs on each joint. Each lug shall be designed to carry the entire weight of the assembly.
7. Provide each joint with a liner and mark a flow arrow on the outside to indicate direction of flow.
8. Provide each expansion joint with a Type 316 stainless steel nameplate indicating size, bellows material, pressure and temperature rating, lateral and axial limits on movement, date of manufacturer, and the manufacturer.

D. Materials:

1. Bellows:
 - a. Inner Ply: Inconel alloy 625, minimum 0.048-inch thick.
 - b. Outer Ply: Inconel alloy 625, minimum 0.048-inch thick.
 - c. Fully annealed stainless steel, Type 316 or 321; to ASTM A240.
2. Liner: Type 316L stainless steel, minimum 0.1875-inch thick.
3. Flanges: Type 316L stainless steel, Class 150 (PN10).
4. End Preparation: Stainless steel; suitable for installation with Victaulic Depend-O-Lok couplings.
5. Limit Rods/Nuts and Hardware: Type 316 stainless steel.

E. Install joints in their neutral position.

2.13 EXPANSION JOINTS-CHEMICAL SERVICE:

A. Service Conditions:

1. 15 to 20 percent sodium hypochlorite solution.
 - a. Temperature: 110 degrees C.
 - b. pH: 11 to 13.5.
2. 50 percent caustic soda.
3. Working Pressure: 150 psi.
4. Mating Pipe: SCH 80 CPVC, SCH 80 PVC, Kynar lined steel, titanium or stainless steel as indicated in the Process Piping Schedule.

B. Type: Bellows

1. Capable of angular, parallel and rotary misalignment at maximum extended and minimum retracted length when mechanically limited by restraints.
2. Joints, as specified, must be manufacturer's standard cataloged product.

C. Materials:

1. Convoluted Components: Pure white virgin PTFE-Fluorocarbon resin conforming to ASTM D1457 without pigments, lubricants or additives of any kind and suitable for the service specified. Provide a written recommendation from the expansion joint manufacturer.
 - a. Wall thickness: Suitable for the service specified or indicated and as recommended by the joint manufacturer.
2. Reinforcing rings:
 - a. Type 316 stainless steel for caustic service.
 - b. Titanium or Kynar coated for sodium hypochlorite service.
3. Flanges: Drilled and tapped to 150-pound ANSI (PN 10) standard.
 - a. Type 316 stainless steel for caustic service.
 - b. Titanium or Kynar coated for sodium hypochlorite service.
4. Hardware:
 - a. Type 316 stainless steel for caustic service.
 - b. Titanium for sodium hypochlorite service.

D. Joint Testing:

1. Leak free after 100,000 cycles at maximum rated travel 10 cycles per minute at 21 degrees C.
2. Test at 75 psi.
3. Provide high intensity light test to detect any imperfections or inclusions.
4. Provide a 10,000 volt spark test, no arcing is acceptable.

2.14 SAFETY SHIELDS-CHEMICAL SERVICE:

- A. Provide shield type and materials for the service specified. Provide a written recommendation from the safety shield manufacturer.
- B. Material: Non-porous teflon-impregnated glass cloth with a 5 mil thickness and sewn with 100 percent teflon thread and velcor closures and folded in a trifold design with an 0.82 mil teflon cord inserted on the sides to act as a draw string tying on the flange neck. Provide for use with 150 lb ANSI (PN10) flanges.
- C. Draw string or cord: 100 percent virgin unbleached teflon fiber.
- D. Provide a clear leak indicating window with a pH paper insert that will change color to indicate a leak.
- E. Provide shields with a working temperature rating of 93 degrees C and a working pressure rating of 200 psi.

- F. Install safety shield for the following:
 - 1. Expansion joints chemical services.
 - 2. Flanged connections on chemical system pipe and fittings.

- 2.15 Y-PATTERN STRAINERS-CLEAR NON METALLIC:
 - A. Sizes: 1/2-inch thru 2-inch .
 - B. Materials:
 - 1. Body and Cap: Clear Type I, Grade I Polyvinyl Chloride (PVC) compound with a Cell Classification of 12454 per ASTM D1784.
 - 2. Seals: Viton
 - 3. Screen: PVC with 1/32-inch perforations
 - C. Ends: Socket
 - D. Pressure Rating: 150 psi at 70 degrees F (21 degrees C).

- 2.16 Y-PATTERN STRAINERS-METALLIC:
 - A. 3-inch and Smaller:
 - 1. Materials:
 - a. Body, Cover and Plug: ASTM A351 CF8M (316) stainless steel
 - b. Screen: Type 316 stainless steel
 - 2. Screens:
 - a. 2-inch and Smaller: 20 mesh
 - b. 2-1/2-inch and 3-inch: 0.045 perforations
 - 3. Ends: Threaded
 - 4. Pressure Rating: 1440 psi 100 degrees F (38 degrees C) WOG
 - 5. Blow Off: Provide an NPT tapped blow off connection of the size recommended by the strainer manufacturer.

- 2.17 BASKET STRAINERS-CHEMICAL SERVICE:
 - A. Service Conditions:
 - 1. Provide strainers suitable for the chemical service as indicated in the equipment schedules.
 - 2. Provide size and type, simplex and duplex, as indicated.
 - B. Materials:
 - 1. Body and Cover: CPVC
 - 2. Valves for duplex strainers: CPVC
 - 3. O-rings: EPDM or suitable for the service specified and indicated.
 - 4. Baskets: CPVC with 1/16-inch perforations

- C. Covers: Threaded with hand operable vent.
- D. Body:
 - 1. Provide with and operable drain.
- E. Provide with integral flat mounting base.
- F. Ball Valves for duplex strainers: Provide a 3-way ball valve at the inlet and outlet, mechanically connected with true-union connections.
- G. Pressure Rating: 150 psi.
- H. End Connections: Flanged 150 psi ANSI (PN10) standard.
- I. Duplex Strainer Configuration: Provide configuration as indicated.

2.18 WALL AND FLOOR SLEEVES:

- A. Materials:
 - 1. Floor Sleeves:
 - a. Schedule 40 Galvanized steel ASTM A53 GRB
 - 2. Wall Sleeves Between a Dry Area and a Wet Area (Tank, Channel etc)
 - a. Schedule 40 Type 316L stainless steel
 - 3. Wall Sleeves Between Dry Area or Between Dry Area and Ground
 - a. Schedule 40 Galvanized steel ASTM A53 GRB
- B. Water Stops: Provide water stops welded on both sides. Provide water stops 1/4-inch thick and 2-inch high and centered on the wall thickness.
- C. Provide modular, mechanical type seals, consisting of inter-locking synthetic rubber links shaped to continuously fill the annular space between the pipe and the wall opening.
- D. Provide the elastomeric elements sized and selected per manufacturer's recommendations and have the following properties as designated by ASTM. Coloration shall be throughout elastomer for positive field inspection. Each link shall have a permanent identification of the size and manufacturer's name molded into it.
- E. Temperature Range: -40 to +250 degrees F (-40 to 121 degrees C).
 - 1. Material: EPDM, ATSM D2000 M3 BA510
 - 2. Color: Black

F. Modular seal pressure plates: Molded of glass reinforced Nylon Polymer with the following properties:

1. Izod Impact – Notched: 2.05ft-lb/in. per ASTM D256
2. Flexural Strength @ Yield: 30,750 psi per ASTM D790
3. Flexural Modulus: 1,124,000 psi per ASTM D790
4. Elongation Break: 11.07 percent per ASTM D638
5. Specific Gravity:1.38 per ASTM D792

G. Hardware: Type 316 stainless steel.

2.19 TRANSITION COUPLINGS:

A. Provide coupling in accordance with AWWA C219 as specified herein

B. Sizes: 2-inch through 24-inch.

C. Materials:

1. End rings and center rings: Ductile iron ASTM A536.
2. Gaskets: Virgin Styrene Butadiene Rubber(SBR) suitable for potable water and wastewater service, ASTM D2000 MBA 710.
3. Provide 5/8-inch, Type 316 Stainless steel bolts and nuts

D. Working Pressure: 250 psi.

E. Lining and Coating: Fusion bonded epoxy in accordance with AWWA C213.

2.20 DISMANTLING JOINTS:

A. Materials:

1. Flanged Spool: AWWA Class D steel ring flange compatible with ANSI class 125 and 150 bolt circles. Provide pipe of ASTM A36 plate 1 percent cold expanded to size.
2. End Ring and Body: ASTM A36 steel
3. Gaskets: ASTM 2000 Virgin NBR suitable for wastewater service
4. Bolts and Nuts: Type 316 stainless steel
5. Tie Rods: Type 316 stainless steel

B. Assembly Tolerance: 3 inches

C. Coating: Fusion bonded epoxy, NSF 61 certified

D. Pressure Rating: 150 psi working pressure

E. Manufacturers

1. Romac
2. Viking Johnson

2.21 SEAL WATER CONTROL AND MONITORING UNIT:

A. Manufacturer:

1. John Crane Safematic/Safeunit

B. Provide a single assembly to control and monitor seal water flow and pressure

1. Provide a flow rate indicator with memory pin
2. Provide a pressure gauge with memory pin
3. Provide a flow regulating valve
4. Provide an inductive low flow alarm and signal
5. Provide non-clog valves
6. Provide manual cleaning valve capable of operation while unit and pump is in service
7. Provide a pressure regulating valve

C. Pressure and Temperature Rating:

1. 150 psi
2. 360 psi
3. Maximum Temperature: 175 degree F (75 degree C)

D. Flow Range: Provide range suitable for system and as recommended by pump manufacturer.

2.22 CHEMICAL INJECTORS:

A. Quantity - 4

B. Manufacturer:

1. SAF-T-FLO

C. Provide assemblies consisting of the following components:

1. Brass corporation stop with safety device to prevent release of solution tube under line pressure of Type 316 stainless steel ball valve.
2. Suitable for 12% sodium hydroxide solution and 19% hydrofluorosilicic acid solution.
3. Extends 1/3 of pipe diameter.
4. Pressure guage at injection location
5. Type 316 stainless steel flange tapped to accept the corporation stop or ball valve.
6. Solution Tube of the length required with a locking device to prevent release of the tube under line pressure.
 - a. Ball check valve as specified in Section 40 23 13.01.
 - b. Type 316 stainless steel safety chain.
7. Chemical line connection to the assembly:
 - a. Provide a section of flexible tubing or hose suitable for the service conditions specified and indicated.
 - b. Isolation valve of the type indicated and specified.

2.23 SUBMERISBLE PUMP BACKWASH/FILTER TO WASTE TANK:

- A. Quantity - 1
- B. Manufacturer:
 - 1. Zoeller
 - 2. Or equal
- C. Cast iron powder-coated body.
- D. 110 volt, 20 foot plug, 1hp, 60hz, 12A.
- E. Integral float
- F. Flexible hose with cam lock connection to hard piping.
- G. 20 feet of head and 60 gpm.
- H. Lifting chain.
- I. Pump weight less than 50 lbs.

2.24 SHOP PAINTING:

- A. Provide in accordance with Section 09 96 10.

PART 3 - EXECUTION

3.01 INSTALLATION OF PIPE:

- A. Install pipelines parallel to building walls wherever possible. Install piping to lines and grades indicated and support. Where temporary supports are used, provide temporary supports as specified in Section 40 23 19.01 to prevent shifting or distortion of pipe. Provide for expansion.
- B. Slope piping toward low points and provide for draining at low points.
- C. Before assembly, remove debris from inside pipes and fittings.
- D. Before flanges pieces are assembled, remove rust resistant coating from machined surfaces, clean gaskets and smooth burrs. Make up flanged joints tight, and prevent strain upon valves or other pieces of equipment.
- E. Install grooved joints in accordance with the manufacturer's written recommendations.
 - 1. Grooved ends: Clean and free from indentations, projections, or roll marks.
 - 2. Gaskets: Molded and produced by the coupling manufacturer of an elastomer suitable for the service pecified and indicated.

3. The coupling manufacturer's factory trained representative shall provide on-site training for the contractor's field personnel in the use of grooving tools and installation of product. The representative shall periodically visit the job site to ensure best practices in grooved product installation are being followed.

F. Install tierods, pipe clamps or bridles when sleeve type couplings or fittings are used in piping system as indicated, and at changes in direction or other places to prevent joints from pulling apart under pressures indicated in the Process Pipe Schedule.

G. Examine pieces for damage. Do not install pieces that are damaged according to Engineer. If any damaged piece should be discovered after having been installed, remove and replace with a sound piece at no additional cost to the Authority.

H. Handle pipe with equipment such as nylon slings and padded skids, designed to prevent damage to the coating. Repair abrasions and injuries to the coating prior to the application of insulation or prior to the application of final field coating.

I. Support piping laid in trenches in trench on bed of selected backfill material which maintains desired line and grade.

J. Use dielectric bushings or unions when ferrous pipes join nonferrous pipes carrying liquid either underground or elsewhere.

K. Welding in accordance with AN Standard B31 and AWS B3.0.

3.02 WALL SLEEVE SEALS:

A. Expand rubber against pipe and sleeve by tightening bolts when assembled around pipe and inserted in wall.

3.03 TEMPORARY PLUGS:

A. Close open ends of pipe with temporary plugs or caps when pipe installation is not in progress. Use watertight plugs for exterior, buried piping and if water or debris is in trench when work is resumed, do not remove until adequate provision has been made to prevent any water or debris entering pipe even if it necessitates dewatering trench.

3.04 PHYSICAL CHECKOUT, FIELD AND FUNCTIONAL TESTING:

A. Clean dirt, dust, oil, grease and other foreign material, before pressure and leakage tests.

B. Water for testing provided by the Contractor.

C. Pressure and Leakage Tests:

1. Provide temporary testing plugs or caps; pressure pumps, pipe connections, meters, gages, equipment, and labor.
2. Test pipelines in sections of acceptable length.
3. Fill section of pipe with water and expel air.

4. Pressure and leakage test consists of first raising pressure (based on elevation of lowest point of section under test and corrected to gage location) to pressure in psi numerically equal to test pressures indicated in the Process Pipe Schedule.
 5. No visible leakage in joint is acceptable.
 6. If unable to achieve and maintain specified pressure for one hour with no additional pumping, section has failed to pass test.
 7. If section fails pressure and/or leakage test, locate, uncover, and repair or replace defective pipe, fitting, or joint, and conduct additional tests and repairs until section passes test at no additional cost and without any time extensions.
- D. Make piping connections to equipment with pipe in a free supported state and without application of vertical or horizontal forces to align piping with the equipment flanges.
 - E. Do not cover joints in underground piping with backfill material until piping has successfully passed pressure test.
 - F. Test pressures as indicated in Process Pipe Schedule.
 - G. Repair faulty joints even to extent of disassembling and remaking joint, remove defective pipe and fittings and replace in manner satisfactory to the Owner.
- 3.05 FIELD PAINTING:
- A. Provide in accordance with Section 09 96 10.
- 3.06 CONTRACT CLOSEOUT:
- A. Provide in accordance with Section 01 77 00.

END OF SECTION

PROCESS MECHANICAL PIPE SCHEDULE 40 23 19.05 - 1

SERVICE	SIZE (IN)	PIPE MATERIAL	SPECIFICATION SECTION	LOCATION	TEST PRESSURE	COLOR	REMARKS
RW / TW	8/10	CEMENT LINED DUCTILE IRON PIPE	40 23 19.04	INTERIOR TO BUILDING	150	GREEN / BLUE	
CHLORINE		PE TUBING IN 2 INCH PVC CONDUIT	40 23 19.05	PUMP ROOM AND CHLORINE ROOM	150	YELLOW	SEAL ENDS AND PROVIDE TUBING SIZE PER 40 23 19.05
FLUORIDE		PE TUBING IN 2 INCH PVC CONDUIT	40 23 19.05	PUMP ROOM AND FLUORIDE ROOM	150	LIGHT BLUE WITH RED BAND	SEAL ENDS AND PROVIDE TUBING SIZE PER 40 23 19.05
AR	¾	COPPER TUBE TYPE L	40 23 13.01	TREATMENT ROOM – VARIOUS	N/A	MATCH WALLS	TERMINATE AIR / VACUUM RELEASE VALVES 2 FEET ABOVE FINISHED FLOOR WITH INSECT MESH SCREEN.
WASTE AND VENT	2, 3, 4, 6	PVC SCHEDULE 40	22 00 10	EXPOSED	PER PLUMBING CODE	MATCH WALLS	PIPE TO BE PRESSURE TESTED DUE TO PROXIMITY TO POTABLE WATER WELL
WASTE AND VENT	4 INCH	PVC SCHEDULE 80	22 00 10	BURIED	PER PLUMBING CODE	N/A	PIPE TO BE PRESSURE TESTED DUE TO PROXIMITY TO POTABLE WATER WELL

END OF SECTION

SECTION 40 90 10

GENERAL PROVISIONS FOR INSTRUMENTATION AND CONTROLS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. General requirements for package and non-package Instrumentation and Control Systems unless otherwise specified in other sections.

1.02 DEFINITIONS

- A. Selector Switch: When used under panel component description refers to maintained contact type switches. Loss and return of control power to circuit does not change control mode of requirements in switch position.
- B. Push-button: When used under panel component description refers to momentary contact type switches which, unless specified otherwise, shall require electrical interlock. Loss of control power shall, unless specified otherwise, result in loss of electrical interlock and stoppage of previous mode of operations.

1.03 SYSTEM DESCRIPTION

A. Design Requirements:

1. Provide run/fail, alarm, and equipment status functions.
2. Unless otherwise specified, "run" signals shall be derived from motor starter normally open auxiliary contacts.
3. Unless otherwise specified, discrete input and output signals shall conform to:
 - a. Isolated unpowered (dry) contact closures.
 - b. Power contact from panel receiving signal or device receiving signal.
4. Unless otherwise specified, input and output analog signals shall conform to:
 - a. 4-20 mA_{dc}.
 - b. For 2-wire transmitter, provide isolated type and power with 24 or 48 vdc at panel or device receiving signal.
 - c. Where isolation is required to interface with particular equipment furnished, provide necessary current-to-current isolators.
5. For PLC based systems manual control devices, in panel or field, shall be independent from PLC to provide maintenance and redundancy function.

6. Panels, panel devices, and field devices shall meet or exceed NEMA requirements as follows:
 - a. NEMA 4X: Wet locations or outdoors.
 - 1) Instrumentation and control panels shall be 316 stainless steel.
 - 2) Instruments and device enclosures shall be 316 stainless steel, fiberglass, or ABS plastic.
 - b. NEMA 7: Class I, Division 1 or 2 areas.
 - c. NEMA 12: Other areas.
7. Design Life: Design control system for min. 10 yr life at following temperatures:
 - a. Permit continuous operation with panel external ambient temperatures of up to +40°C (+104°F).
 - b. Outdoor Panels: Permit operation with panel external ambient temperatures of down to -29°C (-20°F).
 - c. Indoor Panels: Permit operation with panel external ambient temperatures of down to +8°C (+40°F).
8. When motor controller disconnecting means is off, deenergize associated equipment devices powered from panel.
9. Electrical wiring and controls shall conform to Division 26.

B. Identify equipment on panel or screens with indication below:

1. Green Light On: Equipment running.
2. Red Light On: Equipment failure when called to run, but not running due to power failure, overload, breaker, disconnect, or remote switch call for equipment to stop.
 - a. Provide parallel “required” contact wired to panel for items such as pumps and valves.
 - b. Provide necessary relay logic and adjustable timers to sense discrepancy between “required” and “running” and activate respective “Run” and “Fail” light from these signals. Provide horn when specified.
3. Amber Light On: Indicate equipment status such as valve open or closed.
4. White Light On: Equipment off.

C. Alarm Sequence:

1. Manual Reset Sequence: Alarm condition shall illuminate corresponding visual alarm point. Depressing push-button shall turn off light. Subsequent alarm condition shall repeat above sequence. If alarm condition ceases, steady visual alarm shall not go out until reset push-button depressed. Momentary alarms shall lock-in until reset. Depressing test push-buttons for alarm functions shall turn on visual alarm points simultaneously or use press to test lights.

1.04 SUBMITTALS

A. General:

1. Submit following information tabulated in booklet form for each piece of equipment or system furnished under this section.
2. Table of Contents of Submittals: Include for each booklet when more than 1 item of equipment is included in submittal:
 - a. ENGINEER'S instrument tag number.
 - b. Instrument manufacturer's model number.
 - c. Related piping, electrical, and dimension drawings.

B. Product Data:

1. Construction materials.
2. Ranges.
3. Output/Input signals.
4. Accessories.
5. Mounting location.
6. ENGINEER'S tag number on manufacturer's specifications sheets.
7. Interconnect reference for associated field and panel instruments.
8. Component specification sheets.

C. Shop Drawings:

1. Panel fabrication and dimension drawings, nameplate legends, ENGINEER'S tag numbers, and wiring and piping schematic drawings. Project specific drawings are required for each panel, typical are not acceptable.
2. Equipment dimension drawings.
3. Equipment terminal and piping connections.
4. Loop-by-loop system electrical schematic showing terminal-to-terminal interconnections between related panel and field instruments.
5. Front of panel layout.
6. PLC I/O module connection diagram for PLC based systems.
7. Ladder/logic system electrical schematic showing wiring of each component, including ranges and set points. Wiring and ladder diagram shall have reference numbers on every line for cross referencing. Each device on ladder shall be cross-referenced with line number as to wherever it is located.
8. Terminal to terminal interconnection drawings showing wiring for panel to panel/MCC and panel to field equipment.

D. Miscellaneous:

1. Certificate of UL or nationally recognized testing laboratory (NRTL) inspection and approval for each completely assembled panel prior to shipment to Project.
2. Include ENGINEER'S tag number when available on each submittal document or page wherever specific component appears.
3. Extra materials list.

E. Operation and Maintenance (O&M) Data:

1. Include O&M data for each panel and field device:
 - a. PLC ladder logic software (electronic and printed) including tags, comments, operational database values and passwords or pass codes.
 - b. Configured software on electronic media to install program on spare PLC processors and programmable controller.
 - c. Bill of materials.
 - d. Instruction Manual: Includes detailed operating sequence descriptions.
 - e. Maintenance Manual: Instructions for maintaining equipment to include calibrating, cleaning, and trouble shooting.
 - f. Front and rear panel layout drawings.
 - g. Name plate data.
2. Submit 1 package:
 - a. Equipment provided under Section 40 90 15.

F. Submit in accordance with Section 01 33 00.

1.05 QUALITY ASSURANCE

A. Standardization:

1. Drawings and Specifications are intended to provide overall system functions. Provide equipment necessary to provide complete and operable system.
2. CONTRACTOR is responsible for costs resulting from deviations from Contract Documents.

B. Items provided under sections referenced to this section shall be listed or labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in OSHA Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code (NEC), Article 100.

C. Regulatory Requirements:

1. National Electrical Code (NEC): Components and installation shall comply with National Fire Protection Association (NFPA) 70.

PART 2 PRODUCTS

2.01 EQUIPMENT MARKERS

- A. Furnish equipment markers with ENGINEER'S equipment name and tag number.

2.02 SOURCE QUALITY CONTROL

- A. Perform UL inspection and certification for each completely assembled panel before shipment to Project site.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install equipment in locations indicated on Drawings and in accordance with manufacturer's written instructions and approved submittals.

3.02 EQUIPMENT MARKERS

- A. Fasten to equipment to be visible.

END OF SECTION

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SECTION 40 90 15

INSTRUMENTATION AND CONTROLS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. General provisions and requirements for instrumentation and control equipment and systems.

1.02 DEFINITIONS

- A. Systems House: Supplier whose principle function is design, manufacture, and service of instrumentation and control (I&C) systems.
- B. Process Control System: Portion of I&C system including PCs, PLCs, data highways, and software.

1.03 SYSTEM DESCRIPTION

- A. Instrumentation and control package for plant process control. Does not include process equipment package panels.

1.04 QUALITY ASSURANCE

A. Standardization:

1. Instrumentation and Control system shall be provided by a single Systems House.
2. Equipment shall be latest model or version available at time bids are opened, unless otherwise noted.
3. When more than one I&C equipment component of like function is required, end products shall be of single manufacturer to achieve standardization for maintenance, spare parts, operation, and service.
4. Maintain consistent front of panel layout for panels.
5. Systems House shall coordinate data highway communication with process package systems.

B. Experience:

1. Systems House shall have at least 5 yrs experience in design, manufacture, installation, and successful operation of instrumentation systems similar to specified.

1.05 MAINTENANCE

A. Extra Materials:

1. Packaging:

- a. Obtain spare parts from manufacturer of equipment. Do not provide third-party equivalent replacements.
- b. Package spare parts for protection against dirt, moisture, and static discharge. Label each package as to its contents with description and part number.
- c. Size packages for convenient storage and handling. Packages shall weigh no more than 30 lbs each and be no larger than 30 in. long by 18 in. deep by 18 in. wide unless individual components exceed these dimensions.
- d. Do not place spare part items for different equipment in same package.

2. Parts:

a. PLC: Provide spare module for each type used on Project for following:

- 1) Processor.
- 2) Power supply.
- 3) I/O.
- 4) Communications.
- 5) I/O chassis.

- b. Lightning/Surge Protection: Provide spare module for each type used on Project.
- c. Data Highway Hub: Provide spare module for each type used on Project.
- d. Fiber Optic Media Hub: Provide spare module for each type used on Project.
- e. One media converters.
- f. Two of each type patch cables (fiber and copper).

3. Extra materials identified in Section 40 95 13 for equipment in this Section.

PART 2 PRODUCTS

2.01 EQUIPMENT

A. Equipment provided under this section includes:

1. Instrumentation and Control Panels: Section 40 90 40.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install and wire in accordance with manufacturer's written instructions and approved submittals.
- B. Wire instrumentation and control package panels specified in Divisions 40.
- C. Wire components specified in Divisions 40 and 44.

3.02 FIELD QUALITY CONTROL

A. System's House/Manufacturer's Field Services:

1. Manufacturer's engineer shall direct services to system and equipment operation, maintenance, troubleshooting, and equipment and system related areas other than process design and philosophy. See Section 01 61 00.
2. Provide services of qualified service engineer to supervise and inspect equipment installation to ensure system is installed in accordance with manufacturer's recommendations.
3. Field calibrate equipment at time of complete system startup on loop-by-loop basis. Document field calibration results for each piece of equipment and provide to OWNER.
4. Make adjustments necessary to place equipment in satisfactory operation.
5. Manufacturer's engineer for equipment specified shall be present at job site or classroom designated by OWNER for person-days indicated, travel time excluded, for assistance during plant construction, plant startup, equipment adjustment, and training of OWNER'S personnel for plant operation. Include minimum of:
 - a. Instrumentation and Control Panels, Section 40 90 40:
 - 1) 2 person-day for Installation Services.
 - 2) 1 person-day for Instructional Services.
 - 3) 2 person-day for Post Startup Services.

END OF SECTION

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SECTION 40 90 40

INSTRUMENTATION AND CONTROL PANELS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section, in conjunction with P&IDs, describes I&C panels and remote devices.
- B. Owner is performing all panel updates.

1.02 DEFINITIONS

- A. Abbreviations:
 - 1. PLC: Programmable logic controller.
 - 2. OIU: Operator Interface unit.
 - 3. LCP: Local control panel.

PART 2 - PRODUCTS

2.01 INSTRUMENTATION AND CONTROL (I&C) EQUIPMENT

- A. Equipment provided in this section shall conform to following:
 - 1. General Provisions for Instrument and Control: Section 40 90 10.
 - 2. Panel and Field Devices: Section 40 95 14.
 - 3. Electronic Transmitters: Section 40 91 12.

2.02. Existing Conditions:

- A. The Owner has as an existing PLC, OIU, and radio network. HMI software is Wonderware, licenses are current.

2.03 WELL 15 PUMP STATION SCADA PANEL (LCP-1)

- A. General:
 - 1. OWNER will reprogram SCADA system to operate the new water treatment process. r
- B. Functional Description:
 - 1. Granular Activated Carbon GAC and Ion Exchange:
 - a. When UW15 WP-15-1 is called to run, open filter-to-waste valves (FCV15-2 and FCV 15-4) and close treated water valve (FCV 15-1 and FCV 15-3) .

- b. When Flow Meter FIT 15-01 is above 250 gpm, start timer QT-1 for 10 minutes (operator adjustable). When Flow Meter FIT 15-02 is above 250 gpm, start timer QT-2 for 10 minutes (operator adjustable).
 - c. When QT-1 has reached the operator set time (initial setting 10 minutes), open treated water valve over 5 minutes and close filter-to-waste valve over 10 minutes using onboard motor operated valve close setting controls. When QT-2 has reached the operator set time (initial setting 10 minutes), open treated water valve over 5 minutes and close filter-to-waste valve over 10 minutes using onboard motor operated valve close setting controls.
 - d. Confirm valve positions with ZS 15-1, ZS 15-2, ZS 15-3, and ZS 15-4 integrated positions switches within the flow control valve operator. Alarm if valve options after timers complete are not confirmed open or closed as required.
 - e. If PDIT 15-1, PDIT 15-2, PDIT 15-3, or PDIT 15-4 exceeds the operator alarm setup point (initial setting 15 feet), generate a notification alarm.
 - f. If PDIT 15-1 PDIT 15-2, PDIT 15-3, or PDIT 15-4 exceeds the operator alarm setup point for shut-down (initial setting of 20 feet), shut-down UW15 (WP-15-1) and generate an alarm.
 - g. If FIT 15-01 or FIT 15-02 is above 700 gpm, send a notification alarm to operator.
 - h. If FIT 15-01 or FIT 15-02 is above 800 gpm, shutdown UW15 (WP 15-1).
2. Backwash / Filter-to-Waste Tank Monitoring:
- a. If tank high and high-high floats (LSH 15-5-2 and LSH 15-5-3) are not alarmed and LIT 15-5 indicates a startup permissive level (set at 5 feet but operator adjustable), permit UW15 (WP-15-1) to start.
 - b. If LSH 15-5-2 is active – send a notification alarm to the operator (set at 1 foot below overflow)
 - c. If LSHH 15-5-3 is active (set at 3 inches below overflow)– send a notification alarm to the operator and shutdown UW15 (WP 15-1).

G. New Field Devices:

P&ID Drawing	Designation	Description	Range, Setting
9-N-01	PI 15-1A, PI 15-1B, PI 15-2A, PI 12-2B	Manual pressure gauges	0-75 psi
	PDIT 15-1 PDIT 15-2	Differential pressure indicating transmitters for tanks	0 to 50 psi
9-N-02	PI 15-1A, PI 15-1B, PI 15-2A, PI 12-2B	Manual pressure gauges	0-75 psi
	PDIT 15-1 PDIT 15-2	Differential pressure indicating transmitters for tanks	0 to 50 psi
	FCV 15-1, FCV 15-2, FCV 15-3, FCV 15-4 ZS 15-1, ZS 15-2 ZS 15-3 ZS 15-4	Flow control valves for treated water and filter to waste water	NA
09-N-03	LSL/H/HH-1-4-1, 1-4-2	Backwash Filter to Waste Tank float switches	NA
	LIT-7-1, 8-1	Backwash / Filter to Waste Tank Level Indicating Transmitter	0 to 15 ft
	S-15-5	Switched outlet with remote control option.	NA
	FE-15-5	Turbine flow meter	4 to 100 gpm
	SP-15-1	Submersible pump with onboard float switches. Power from plug	0 to 100 gpm
	PI 15-1A, PI 15-1B	Pressure indicators on each side of strainer protecting flow meter	0 to 50 psi
	FS-15-5	Flood switch	NA
	SP-15-2	Sump Pump	NA

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install and wire in accordance with manufacturer's written instructions and approved submittals.

3.02 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services:

1. Supplier's or manufacturer's representative for equipment specified herein shall be present at jobsite or classroom designated by OWNER for person-days indicated, travel time excluded, for assistance during plant construction, plant startup, and training of OWNER'S personnel for plant operation. Include minimum person-days indicated in Section 40 90 15.

3.03 FIELD TESTING

A. Preparation:

1. Schedule field testing which affects plant operation through OWNER 48 hrs before testing.
2. Resolve interface discrepancies.
3. Maintenance:
 - a. Perform maintenance on equipment throughout course of Work.
 - b. Perform preventative maintenance in accordance with manufacturer's recommendations.
 - c. Keep maintenance records with equipment and make records available for examination during Work.
4. Conduct field testing in conjunction with Section 40 90 10.
5. Before start of testing:
 - a. Have O&M manuals for each item of equipment on-site during testing.
 - b. Have spare parts, expendables, and test equipment pertinent to equipment being tested on-site during testing.
 - c. Check equipment against submittals.
 - d. Verify equipment is installed properly.

B. Testing:

1. Test in accordance with Contract Documents and manufacturer's recommendations.
2. Power up equipment to verify proper operation.
3. Loop-by-loop testing from field devices to control panel devices.
 - a. Calibrate device to correct range for analog signals.
 - b. Verify that discrete signals are being transmitted.
4. After installation of equipment test panels and field devices:
 - a. Verify signals between system components.
 - b. Test panel devices from field device and panel to panel to verify operation.
 - c. Use actual signals whenever possible using installed equipment. When not possible, simulated signals are acceptable.
5. Correct deficiencies found during testing.

END OF SECTION

SECTION 40 91 12

FIELD ELECTRONIC TRANSMITTERS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Field transmitters for instrumentation and control (I&C) system.

1.02 SUBMITTALS

A. Product Data:

1. Catalog cuts and manufacturer's specification for each device.
2. Standard wiring diagrams.

B. Shop Drawings:

1. Drawing showing location of instrumentation in system.
2. Wiring diagram between devices where vendor cables are required.

PART 2 PRODUCTS

2.01 ELECTRONIC GAUGE PRESSURE TRANSMITTER

A. Manufacturers:

1. Endress + Hauser.
2. ABB.
3. Rosemount.
4. Or equal.

B. Electro-mechanical device to produce analog current signal as function of pressure input to it.

C. Mounting: Universal bracket for 2 in. pipe mounting.

D. Housing: Threaded, metal NEMA 4.

E. Connections: 1/2 in. NTP.

F. Wetted Parts: Type 316 stainless steel.

G. Calibration Capability: Gauge, vacuum, and absolute.

H. Output: 4-20 mA_{dc} into 400 ohms (24 vdc power) or 1,000 ohms (45 vdc power).

- I. Adjustments: Zero and span, for 5:1 rangeability.
- J. Power: 24 to 45 vdc.
- K. Accuracy: $\pm 0.5\%$ of span.
- L. Accessories:
 1. Weatherproof integral output indicator 0% to 100% linear.
 2. Zero elevation/suppression of at least 100% of span.

2.02 ELECTRONIC FLANGE MOUNTED LEVEL TRANSMITTER

- A. Manufacturers:
 1. Endress + Hauser.
 2. ABB.
 3. Rosemount.
 4. Or equal.
- B. Differential capacitance open loop principle device to produce analog current signal as function of liquid level input to it.
- C. Mounting: 3 in., 150 lb flange mount.
- D. Housing: Threaded cover, metal, NEMA 4.
- E. Wetted Parts (Process Side): Flush mount, Type 316 stainless steel diaphragm.
- F. Water Span Adjustment: 20 to 200 in., 160 to 785 in. water.
- G. Provide elevation/suppression kit.
- H. Output: 4-20 mA_{dc} into 400 ohms (24 vdc power) or 1,000 ohms (45 vdc power).
- I. Adjustments: Zero, span, and dampening.
- J. Accuracy: $\pm 0.25\%$ of span.
- K. Construction: Explosionproof, FM approved for Class I, Division 1 service (see specification for requirement).
- L. Accessories: Weatherproof integral output indicator scaled 0% to 100% linear, with input.

2.03 SUBMERSIBLE LEVEL TRANSMITTER

- A. Manufacturers:
 1. Endress + Hauser.
 2. Delta.
 3. Druck.

- 4. Or equal.
- B. Hydrostatic pressure sensor for submerged level measurement in wells. Diameter less than 1 inch. Transmitter consisting of variable capacitance, gauge pressure sensing assembly enclosed in submersible Type 316 stainless steel housing with ceramic sensor.
- C. Accuracy: +/- 0.2% of full scale.
- D. Power Supply: 10 to 30 V DC.
- E. Accessories:
 - 1. Cable suspension mounting clamp.
 - 2. Weight accessory.
 - 3. Protective cap.

2.03 FLOW METER - TURBINE

- A. Manufacturers:
 - 1. Badger.
 - 2. Druck
 - 3. Rosemont
 - 4. Or equal.
- B. 3" Diameter flanged connections.
- C. Accuracy: +/- 2% of full scale (4 to 550 gpm).
- D. Power Supply: Direct read, no power.
- E. Lead-free construction and meeting AWWWA Standard C701 Class II
- D. 3" flanged Z-Plate Meter Strainer, Low Lead installed upstream.

2.04 TAGGING

- A. Provide Type 316 stainless steel tag permanently affixed to unit (sensor and transmitter separately mounted).
- B. Engrave with process application as listed in Specifications.
- C. Include ENGINEER'S tag number as listed in Specifications and on P&ID'S.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's written instructions and approved submittals.

END OF SECTION

SECTION 40 95 14
PANEL AND FIELD DEVICES

PART 1 - GENERAL

1.01 SUMMARY

- A. Comply with Section 40 90 10.

PART 2 - PRODUCTS

2.01 FLOAT SWITCHES

- A. Manufacturers:
 - 1. Consolidated 9GEF.
 - 2. Anchor Scientific GP.
 - 3. Or equal.
- B. Float: 316 stainless steel. 5.5-inch diameter
- C. Provide sufficient length of nitrile PVC jacketed cable.
- D. For Class I, Divisions 1 or 2, hazardous areas, provide intrinsically safe relays in corresponding control panel.
- E. Mounting Hardware: 316 stainless steel.
- F. Switch: Non-Mercury tilt type switch with minimum rating of 10 million cycles.

2.07 TEMPERATURE SWITCH

- A. Manufacturers:
 - 1. Ashcroft, T400 Series or T700 Series.
 - 2. United Electric, 400 Series pr 120 Series.
 - 3. Or equal.
- B. Type: Ambient compensated filled system with snap-action SPDT contacts rated for 10 amps continuous at 120 vac.
- C. Automatic reset type. Temperature differential for switch reset shall be 3°F or less.
- D. Enclosure: Suitable for horizontal or vertical mounting.
- E. Set point Shift: $\pm 1\%$ of range per 500°F.
- F. Repeatability: $\pm 1\%$ of range.

- G. Adjustable Set point range shall be such that noted Set point falls between 30% and 70% of adjustable range. Span shall be at least 100°F.
- H. Minimum Accuracy: $\pm 2\%$ of unit range.
- I. Temperature Sensor: Stainless steel.
 - 1. For units requiring remote mounting of switch provide remote mounted temperature sensor complete with Type 304 stainless steel armored capillary tube.
 - 2. Provide screwed Type 316 stainless steel protective well for sensor to permit removal of sensor without shutting process down.

2.08 DOOR/HATCH SWITCHES

- A. Manufacturers:
 - 1. General Electric 2500 Series.
 - 2. Or equal.
- B. Surface Mount.
- C. Sealed and potted magnetic, suitable for use in wet and corrosive environments.
- D. For Class 1, Division 1 or 2, hazardous classification areas, provide intrinsically safe relays in corresponding control panel.

2.09 FLOODING LEVEL SWITCHES

- A. Manufacturers:
 - 1. Gems LS-270.
 - 2. Or equal.
- B. Stem/Mounting Material: 404 stainless steel.
- C. Float Material: Buna N.
- D. Shield Material: Lucite.
- E. Switch: 50 va.

2.10 FLOW SWITCHES

- A. Manufacturers
 - 1. MacDonnel and Miller, FS5 or FS7 Series.
 - 2. Magnetrol, F-10 or F-50.
 - 3. Or equal.
- B. Materials: Stainless steel body and wetted parts.

- C. Actuation Velocity: Min. 1 ft/sec. or less, adjustable.
 - D. Type: Paddle actuated insertion or piston flow-through.
 - E. Contacts: SPDT-rated for 5 amps at 120 vac.
 - F. Pressure Rating: 150 psi min.
- 2.11 TAGGING
- A. Provide Type 316 stainless steel tag on field-mounted units and permanently affix tag to unit.
 - B. Engrave with process application as listed in Specifications.
 - C. Include ENGINEER'S tag number as listed in Specifications and on P&ID's.
- 2.12 CARD ACCESS SYSTEM
- A. Card readers, programming, setup shall be provided by Innovative Systems, 9880 South Ridgeway Drive, Oak Creek, Wisconsin 53154, 1-800-750-7350. CONTRACTOR shall coordinate requirements with Innovative Systems. Existing control panel shall remain and new devices shall terminate in control panel.
- 2.13 VIDEO SURVEILLANCE SYSTEM
- A. Video cameras, enclosures, motion sensors, heaters, programming, and setup shall be provided by Replogix, Inc. 114 Parkview Drive Ext. Painted Post, New York, 1-800-437-5508 (Robert Lecher). Contractor shall coordinate requirements with Replogix. Existing control panel shall remain and new devices shall terminate in control panel.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's written instructions, applicable requirements of NEC, NECA "Standard of Installation," and recognized industry practices.
- B. Control Relays:
 - 1. Provide control relays for general purpose logic circuits.
 - 2. Provide motor starter control relays when load exceeds rating of general purpose control relays.

END OF SECTION

DIVISION 44
POLLUTION CONTROL EQUIPMENT

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SECTION 44 43 31

PRESSURE FILTRATION EQUIPMENT – GAC AND ION EXCHANGE

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. Provide and test filtration equipment including, pressure vessel[s], valves, piping, fittings, underdrains, media, with water from potable water drinking water supply as indicated and in compliance with Contract Documents.
- B. Granular Activated Carbon (GAC) and Ion Exchange (IX) will not be backwashed automatically. Media replacement and backwash will be operated manually.
- C. All materials shall meet Buy America – Build America Act.
- D. Provide equipment information with bid as noted in the bid form.

1.02 REFERENCES:

- A. American Society for Testing and Materials International (ASTM):
 - 1. A53/A53M: Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
- B. American Water Works Association (AWWA):
 - 1. B100: Granular Filter Material
 - 2. C200: Steel Water Pipe - 6 in. (150 mm) and Larger
 - 3. C207: Steel Pipe Flanges for Waterworks Service— Sizes 4 In. Through 144 In. (100 mm Through 3,600 mm)
- C. NSF International (NSF):
 - 1. 61: Drinking Water System Components - Health Effects

1.03 SUBMITTALS:

- A. Submit the following shop drawings in accordance with Section 01 33 00.
 - 1. Certified shop and erection drawings.
 - 2. Data, regarding filter characteristics and performance:
 - a. Prior to fabrication and testing, provide guaranteed performance based on service conditions specified.
 - 3. Shop drawing data for accessory items.

4. Certified setting plans, with tolerances, for anchor bolts.
 5. Manufacturer's literature as needed to supplement certified data.
 6. Operating and maintenance instructions and parts lists.
 7. Listing of reference installations as specified with contact names and telephone numbers.
 8. Qualifications of field service engineer.
 9. Shop and Field inspections reports.
 10. List of spare parts.
 11. Recommendations for short and long term storage.
 12. Special tools.
 13. Shop and field testing procedures and equipment to be used.
 14. Recommended location and mounting of equipment and appurtenances.
 15. Number of service person days provided and per diem field service rate.
 16. Manufacturer's product data and specifications for shop painting including statement of compliance for compatibility and NSF Std. 61 approval.
 17. The latest ISO 9001 series certification or other quality control plan.
 18. Material Certification:
 - a. Provide certification from the equipment manufacturer that the materials of construction specified are recommended and suitable for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated including an installation list of a minimum of five (5) installations in operation for a minimum of five (5) years. Provide proposed materials at no additional cost to the Owner.
 - b. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated.
- B. A copy of the contract mechanical process, electrical and instrumentation drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with "No changes required" or provide a statement that no changes are required.

1. Failure to include all drawings or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.
- C. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.
1. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.
 2. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specifications and justifications are submitted in a complete package.
- 1.04 SPARE PARTS:
- A. Comply with the requirements specified in Section 01 61 00.
- 1.05 QUALITY ASSURANCE:
- A. Comply with the requirements specified in Section 01 43 00.
- B. Standardization and System Responsibility:
1. For specific purposes of standardization and total system responsibility, equipment included in this section shall be furnished by single manufacturer.
 2. To ensure proper operating systems, manufacturer of filtration equipment shall also be responsible for providing following:
 - a. Butterfly valves, ball valves, and air release valves associated with equipment operation.
 - b. Piping associated with standard equipment package. Piping shall include all piping to vessel isolation valves.
- C. Services of Manufacturer's Representative as stated in Section 01 43 00 and as specified herein.
- D. Provide services of factory-trained Service Technician, specifically trained on type of equipment specified:
1. Service Technician must have a minimum of five (5) years of experience, all within the last seven (7) years, on the type and size of equipment.
 2. Service Technician must be present on site for all items listed below. Person-day requirements listed are exclusive of travel time, and do not relieve Contractor of the obligation to place equipment in operation as specified.

3. Installation: Inspect grouting, location of anchor bolts; setting, leveling, alignment, field erection; coordination of piping, electrical and miscellaneous utility connection:
 - a. 2 person-days.
 4. Functional Testing: Calibrate, check alignment and perform a functional test dry and a test with water. Tests to include all items specified.
 - a. 4 person-days.
 5. Performance Testing: Field performance test equipment specified.
 - a. 2 person-days.
 6. Vendor Training: Provide classroom and field operation and maintenance instruction including all materials, slides, videos, handouts and preparation to lead and teach classroom sessions.
 - a. 1 person-days.
 7. Credit to the Owner, all unused service person-days specified above, at the manufacturer's published field service rate.
 8. Any additional time required of the factory trained service technician to assist in placing the equipment in operation, or testing or to correct deficiencies in installation, equipment or material shall be provided at no additional cost to the Owner.
- E. Manufacturer of specified equipment shall have a minimum of ten (10) operating installations with equipment of the size specified and in the same service as specified operating for not less than five (5) years.

1.06 DELIVERY STORAGE AND HANDLING:

- A. Comply with the requirements specified in Section 01 61 00.
- B. Transport and store media to avoid contamination.
- C. Transport, delivery and store in accordance with written instructions from the manufacturer.

PART 2 - PRODUCTS

2.01 SYSTEM DESCRIPTION:

- A. Design Requirements:
 1. Hydraulic Conditions:
 - a. Design Flow, gpm: 700
 - b. Working Pressure, psi: less than 100

- c. Maximum Loading Rate, gpm/ft²: 6.2

2.02 MANUFACTURERS:

- A. Calgon Carbon.
- B. AqueoUS Vets.

2.03 PRESSURE VESSELS:

A. Vertical Pressure Filter:

1. Minimum Filtering Area/Filter, feet²: 113.1
2. Number of Vessels: 4
3. Filter size: 12 feet diameter
 - a. 20,000 lb capacity GAC media
 - b. 3 minute minimum IX media contact time.
 - c. 3 foot minimum IX media depth .
4. Maximum overall height – see drawings
5. Material: Welded Steel Construction:
 - a. SA-516 Grade 70 steel.
 - b. Design with safety factor of 4.
 - c. Factory test to 50 percent above design system pressure.
 - d. ASME code with stamp.
6. Access manhole in each filter with spare gasket, Minimum 12 inches (300 mm) x 16 inches (400 mm) manway.
7. Adjustable cast iron jacklegs.
8. Flanges for piping connections.

B. Vessel:

1. Provide all pressure vessels constructed in accordance with Section VIII of the ASME code requirements for cold fired pressure vessels, and bear the ASME stamp.
 - a. Minimum thicknesses: Provide accordance with ASME code requirements. Verification of ASME code design to include calculated head and shell thicknesses. Submit with the first submittal drawing and be approved by the Engineer Representative prior to authorization of fabrication. Vessels shall be fabricated in a

facility holding a current ASME U-stamp. Facilities holding an ASME R (“repair”) or other certification are not acceptable.

2. Provide all flanges, plates, angles, channels, and beams, including side shell to head connections, joined by full penetration welds, each side, continuous welding.
3. Flanges: Factory welded on split centers.

C. Vessel Interior Construction:

1. Influent and Collection System:

- a. The influent and collection system shall be the manufacturer standard design and shall be capable of continuously collecting water at the maximum design loading rates.
- b. Provide the influent and collection system capable of uniform water distribution.
- c. Adjust IX media influent system to accommodate reduced media capacity in vessel.

D. Vessel Miscellaneous Components:

1. Provide each filter cell equipped with a sufficient number of 14-inches (350 mm) x 18-inches (450 mm) manways, rated for the working pressure of the vessel for the purposes of media loading, observation of backwash functions and inspection.
2. Provide 1/2-inch (13 mm) diameter, full couplings for sample taps.
3. Provide Type 316 anchor bolts and hardware.
4. Provide pipe and isolation valves for media replacement as noted in drawings.

2.04 GAC MEDIA:

A. 20,000 lbs of C400 Calgon Carbon GAC media per 2 vessels (40,000 lbs total):

1. F400 Media
2. Mesh Size 12x40
3. Mean Diameter 9.7 micrometer
4. Conform to NSF 61.

B. Media installed in field.

2.05 IX MEDIA:

A. PFA 694 E by Purolite OR PSR 2+ by Dow

1. Mesh Size 16x50 Or 16x40

2. Conform to NSF 61.
- B. Media installed in field.
- 2.06 SUPPORT GRAVELS MEDIA:
- A. In lieu of support gravel, GAC or IX media shall be used, respectively, and collection headers shall be self-supporting.
- 2.07 VALVES:
- A. Filter function valves: Provide motor actuated valves.
 1. Valve size as specified and indicated
 - B. Valves: Wafer lug style butterfly valves in accordance with Section 40 23 13.01.
 - C. Provide four motor actuators for FCV 15-, FCV 15-2, FCV 15-3, FCV 15-4.
 1. Rotork QT-3 or Equal.
 - D. Provide position switches integral to motor operator.
 - E. Provide all valves with visual valve position indicators.
 - F. Provide manual hand-wheel overrides.
 - G. Combination air/ vacuum release valves, provide in accordance with Section 40 23 13.01.
- 2.08 INSTRUMENTATION:
- A. Loss of Head Gauge Panel PI/PDIT 15-1, PI/PDIT 15-2, PI/PDIT 15-2, and PI/PDIT 15-4.
 1. Provide a Type 316 stainless steel loss of head gauge panel completely factory fabricated.
 2. The gauge panel shall have the following 4-1/2 inch flush-mounted gauges:
 - a. Inlet header: 0-100 psi (0 – 690 kPa)
 - b. Effluent header: 0-100 psi (0 – 690 kPa)
 - c. Loss of head - between influent and effluent headers, 0-10 psi (0 – 70 kPa) differential pressure gauge with switch
 3. Provide a differential pressure transmitter manufactured by Rosemount (3051 series) or equal to indicate the differential pressure between the influent and effluent of each filter. The 4~20 mA differential pressure signal shall be wired to the UW15 PLC control panel.
 4. Each panel shall be equipped with the following components:
 - a. Phenolic nameplates identifying gauges and sample taps.

- b. Two flush mounted sample taps for influent and effluent locations.
 - c. Manufacturer nameplate, aluminum construction.
5. Provide mounting hardware (brackets, U-bolts, nuts, washers, etc.) for affixing to face piping.

2.09 SHOP PAINTING:

- A. The interior of the filter including above and below the underdrain plate shall be sandblasted and protected from corrosion by proper application of approved coatings for potable water. The exterior of the vessel shall be sandblasted and prime painted at the factory.
- B. Surface preparation:
 - 1. Interior - Sandblast to near white blast cleaning (SSPC-SP10).
 - 2. Exterior - Sandblast to commercial blast cleaning (SSPC-SP6).
- C. Coating:
 - 1. Interior - All interior coatings shall be NSF Std. 61 approved. Stripe coating: hand-apply one coat Tnemec pota-pox tank white to all welds and hard to reach areas using high quality natural or synthetic bristle brush, to a dry film thickness of 3-5 mils. Prime coating: Tnemec pota-pox Beige primer to a dry mil thickness of 3-5 mils before any rust can form. Finish coating: Tnemec pota-pox tank white to a dry mil thickness of 4-6 mils for a total dry film thickness of 7-11 mils.
 - 2. Exterior - Stripe coating: hand-apply one coat Tnemec Series 20 tank white to all welds and hard to reach areas using high quality natural or synthetic bristle brush, to a dry film thickness of 3-5 mils. Prime coating: Tnemec Series 20 Beige primer to a dry mil thickness of 3-5 mils before any rust can form. The exterior finish coat shall be applied by others with compatible system.
- D. The total paint system shall be the product of and be applied in accordance with the recommendations of one manufacturer. Alternate paint systems must be pre-approved by Engineer Representative. Contractor shall provide an adequate amount of field touch-up paint.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Installation shall be as shown on the plans and in accordance with the manufacturer's recommendations, installation instructions and assembly drawings. Manufacturer's installation instructions and assembly drawings shall be submitted and approved by the Engineer Representative prior to shipment of equipment. Installation of the filtration system shall be in strict accordance with the details shown on the drawings and in complete conformance to manufacturer's instructions and procedures.
- B. Disinfection of IX media vessels shall be completed prior to IX media installation but following installation of all other media influent and collection piping systems within the vessel.

3.02 FACTORY SERVICES AND START-UP:

- A. Installation Supervision. The Contractor shall coordinate with the treatment equipment manufacturer to provide factory supervision (as outlined on the Equipment Schedule) or direction during critical phases of installation. Critical phases will include setting of equipment, installation of internals, installation of controls, wiring instrumentation and other components critical to the successful operation of the system.
- B. Media Installation. Installation of support gravels and filter media shall be under the direct supervision of an employee of the filter manufacturer experienced in this procedure as required by AWWA B100 standard and in accordance with the Equipment Schedule. This includes GAC backwash and IX flushing (manual processes).
- C. System Start-Up and Training:
 - 1. The contractor will verify in writing that the project is ready for manufacturer's field services. Copies of written verification shall be given to the manufacturer, Engineer Representative and Owner prior to scheduling field services.
 - 2. The contractor shall provide the services of a factory representative during installation and on-site start-up supervision of the treatment equipment. The contractor shall provide installation and on-site start-up supervision. At a minimum, the equipment manufacturer's technician shall perform the following start-up functions:
 - a. Provide the number of days indicated to the Contractor during installation of the equipment.
 - b. Inspect the final installation to assure proper installation, connection and wiring of all equipment of the manufacturer's supply.
 - c. Start-up of the equipment in the presence of the Contractor and Owner's operating personnel.
 - d. Training of Owner's operating personnel in proper operation and maintenance procedures, start-up/shutdown procedures, response to emergency conditions, and troubleshooting. The responsibility of the Contractor and the factory service representative with regard to start-up shall be fulfilled when the start-up is complete, the equipment is functioning properly, operating personnel have been trained and the equipment has been accepted by the Owner.

3.03 FIELD TOUCH-UP PAINTING:

- A. After installation and approved testing by the Engineer Representative, Contractor shall apply field touch-up paint to all scratched, abraded and damaged shop painted surfaces. Coating type and color shall match shop painting.

3.04 CONTRACT CLOSEOUT

- A. Provide in accordance with Section 01 77 00.

END OF SECTION

APPENDIX

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APPENDIX

1. FIELD ORDER..... FO-1
2. CONTRACT CLARIFICATION/INTERPRETATION REQUEST..... CR-1
3. TRANSMITTAL/ROUTING OF CONTRACTOR'S SUBMITTAL TR-1 TO TR2
4. DISCLOSURE OF OWNERSHIP FORM

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*Contract Clarification/
Interpretation Request*

Project:	Date:
Contractor:	Clarification Request No.:
Contract:	Re: Specification Section/Drawing No.:
Attn:	
This is a request for a clarification/interpretation on the following:	
Prepared By:	Date Response Needed:
Response:	
Response Prepared By:	
Response Returned to Contractor On:	
cc: Owner	

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TRANSMITTAL/ROUTING - CONTRACTOR'S SUBMITTAL

TO: AECOM
200 Indiana Avenue
Stevens Point, WI 54481
angel.gebeau@aecom.com

URGENCY: NORMAL, EXTREME

ATTN: Angel Gebeau
PROJECT: 60686092
DATE: _____
SPEC SECTION: _____

CONTRACTOR: _____
CONTRACT: MWU UW15 PFAS Treatment
TRANSMITTAL NO.: _____ SUBMITTAL NO.: _____
PARA. & SUBPARA.: _____

DRAWING NO.: _____

COPIES	DATE	NO.	DESCRIPTION

THESE ARE TRANSMITTED as checked below:

For approval As requested For your use

REMARKS: _____

- The information included with this submittal has been reviewed by the undersigned, before submitting to ENGINEER, for compliance with paragraph 6.17.D.3 of the General Conditions.
- Identified in this submittal in accordance with Paragraph 6.17.D.3 of the General Conditions are *(circle none or indicate the number)* (none) (____) variations from the Contract Documents and are indicated on the following pages:

- Contract Clarification/Interpretation forms were submitted and response received ___Yes ___No *(If Yes, attach each form to this transmittal).*

Contractor's Reviewer's Typed Name and Signature: _____

Date: _____

AECOM PROJECT NO.: 60686092

TO:	DISCIPLINE	INITIAL	DATE REC'D	DATE FWD	STATUS ASSIGNED
1. _____	_____	_____	_____	_____	_____
2. _____	_____	_____	_____	_____	_____
3. _____	_____	_____	_____	_____	_____
4. _____	_____	_____	_____	_____	_____
5. _____	_____	_____	_____	_____	_____
6. _____	_____	_____	_____	_____	_____
7. RETURN TO: _____	_____	BY: _____	_____	_____	_____

COMMENTS ON BACK:

Angel Gebeau
Project Manager AECOM
200 Indiana Avenue
Stevens Point, WI, 54481
angel.gebeau@aecom.com