

CHLORINATION BUILDING

MPWMD SANTA MARGARITA

ASR FACILITY

PROJECT MANUAL /
TECHNICAL SPECIFICATIONS

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WRD Project No: 18014.2

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SECTION 011000
SUMMARY OF WORK

PART 1 - GENERAL

1.1 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.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Work covered by the Contract Documents.
 - 2. Type of the Contract.
 - 3. Use of premises.
 - 4. Owner's occupancy requirements.
 - 5. Work restrictions.
 - 6. Specification formats and conventions.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

- A. Project Identification: WRD Project No. 18014.2
- B. The Work consists of the following:
 - 1. SANTA MARGARITA CHLORINATION FACILITY.

1.4 TYPE OF CONTRACT

- A. Project will be constructed under a single prime contract.

1.5 TIME OF COMPLETION

- A. As specified in MPWMD Bidding Documents.

1.6 USE OF PREMISES

- A. General: Contractor shall have limited use of premises for construction operations as indicated on Drawings.

1.7 OWNER'S OCCUPANCY REQUIREMENTS

- A. Full Owner Occupancy: Owner will occupy site and existing building during construction period as indicated on Drawings. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits, unless otherwise indicated.

1.8 WORK RESTRICTIONS

- A. On-Site Work Hours: Work shall be generally performed during normal business working hours of 8:00 a.m. to 6:30 p.m., Monday through Friday, unless other arrangements have been made.
 - 1. Weekend Hours: Upon architect and owner approval.
 - 2. Hours for Utility Shutdowns: After 3:00 p.m. with 72 hour notice to architect and owner and other times upon architect and owner approval..
- B. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by owner.

1.9 SPECIFICATION FORMATS AND CONVENTIONS

- A. Specification Format: The Specifications are organized into Divisions and Sections using the 50-division format and CSI/CSC's "MasterFormat" numbering system.
- B. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 - 1. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.
 - 2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 012600

CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 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.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

1.3 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within time specified in Proposal Request or 14 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.
 - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 - e. Quotation Form: Use forms acceptable to Architect.
- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.
 - 1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.

2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Division 01 Section "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
7. Proposal Request Form: Use form acceptable to Architect.

1.4 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

**SECTION 012900
PAYMENT PROCEDURES**

PART 1 - GENERAL

1.1 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.

1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.

1.3 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.

1.4 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule.
 - 1. Correlate 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. Submittals Schedule.
 - c. Contractor's Construction Schedule.
 - 2. Submit the Schedule of Values to Architect at earliest possible date but no later than ten (10) days after date established in Notice to Proceed.
- B. Format and Content: Use the Project Manual 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 Architect.
 - c. Architect's project number.
 - d. Contractor's name and address.
 - e. Date of submittal.
 - 2. Submit draft of AIA Document G703 Continuation Sheets.

3. 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.
 - 1) Percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide several line items for principal subcontract amounts, where appropriate.
5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
6. 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 specified, include evidence of insurance or bonded warehousing.
7. 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.
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.
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.

1.5 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
 1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
- B. 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.

- C. Payment Application Forms: Use AIA Document G702CMA and AIA Document G703 Continuation Sheets as form for Applications for Payment.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect 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 of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
- E. Transmittal: Submit four (4) signed and notarized original copies of each Application for Payment to Architect 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.
- F. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's liens from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.
 - 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 final or full waivers.
 - 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 - 4. Submit final Application for Payment with or preceded by final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
 - 5. Waiver Forms: Submit waivers of lien on forms, executed in a manner acceptable to Owner.
- G. 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. Contractor's Construction Schedule (preliminary if not final).
 - 4. Products list.
 - 5. Submittals Schedule (preliminary if not final).
 - 6. List of Contractor's staff assignments.
 - 7. List of Contractor's principal consultants.
 - 8. Initial progress report.
 - 9. Report of preconstruction conference.
- H. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted.

PART 2 - PRODUCTS (Not Used)

PART 3 - PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

SECTION 013200

CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 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.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Preliminary Construction Schedule.
 - 2. Contractor's Construction Schedule.
 - 3. Submittals Schedule.
 - 4. Special reports.

1.3 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
 - 1. Critical activities are activities on the critical path. They must start and finish on the planned early start and finish times.
 - 2. Predecessor Activity: An activity that precedes another activity in the network.
 - 3. Successor Activity: An activity that follows another activity in the network.
- B. Cost Loading: The allocation of the Schedule of Values for the completion of an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum, unless otherwise approved by Architect.
- C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.
- D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- E. Event: The starting or ending point of an activity.
- F. Float: The measure of leeway in starting and completing an activity.

1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

G. Milestone: A key or critical point in time for reference or measurement.

1.4 SUBMITTALS

A. Qualification Data: For scheduling consultant.

B. Submittals Schedule: Submit five (5) copies of schedule. Arrange the following information in a tabular format:

1. Scheduled date for first submittal.
2. Specification Section number and title.
3. Submittal category (action or informational).
4. Name of subcontractor.
5. Description of the Work covered.

C. Preliminary Construction Schedule:

1. Approval of cost-loaded preliminary construction schedule will not constitute approval of Schedule of Values for cost-loaded activities.

D. Contractor's Construction Schedule: For entire construction period.

1.5 COORDINATION

A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.

B. Coordinate Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from parties involved.
2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 SUBMITTALS SCHEDULE

- A. Preparation: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, resubmittal, ordering, manufacturing, fabrication, and delivery when establishing dates.
 - 1. Coordinate Submittals Schedule with list of subcontracts, the Schedule of Values, and Contractor's Construction Schedule.
 - 2. Initial Submittal: Submit concurrently with preliminary bar-chart schedule. Include submittals required during the first 60 days of construction. List those required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
 - 3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's Construction Schedule.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Procedures: Comply with procedures contained in AGC's "Construction Planning & Scheduling."
- B. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Final Completion.
 - 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
 - 2. Provide float time in the schedule as defined in section 1.3 F of this Section.
- C. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using fragnets to demonstrate the effect of the proposed change on the overall project schedule.
- D. Computer Software: Prepare schedules using a program that has been developed specifically to manage construction schedules.

2.3 PRELIMINARY CONSTRUCTION SCHEDULE

- A. Bar-Chart Schedule: Submit preliminary horizontal bar-chart-type construction schedule within seven (7) days of date established for the Notice to Proceed.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first sixty (60) days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

2.4 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)

- A. General: Prepare network diagrams using AON (activity-on-node) format.
- B. CPM Schedule: Prepare Contractor's Construction Schedule using a computerized, time-scaled CPM network analysis diagram for the Work.
 - 1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than thirty (30) days after date established for the Notice to Proceed.
 - a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates, regardless of Architect's approval of the schedule.
 - 2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
 - 3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
 - 4. Use "one workday" as the unit of time. Include list of nonworking days and holidays incorporated into the schedule.
- C. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the preliminary network diagram, prepare a skeleton network to identify probable critical paths.
 - 1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
 - a. Preparation and processing of submittals.
 - b. Mobilization and demobilization.
 - c. Purchase of materials.
 - d. Delivery.
 - e. Fabrication.
 - f. Utility interruptions.
 - g. Installation.
 - h. Work by Owner that may affect or be affected by Contractor's activities.
 - i. Testing.
 - 2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
 - 3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
 - 4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
- D. Initial Issue of Schedule: Prepare initial network diagram from a list of straight "early start-total float" sort. Identify critical activities. Prepare tabulated reports showing the following:
 - 1. Contractor or subcontractor and the Work or activity.

2. Description of activity.
 3. Principal events of activity.
 4. Immediate preceding and succeeding activities.
 5. Early and late start dates.
 6. Early and late finish dates.
 7. Activity duration in workdays.
 8. Total float or slack time.
- E. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
1. Identification of activities that have changed.
 2. Changes in early and late start dates.
 3. Changes in early and late finish dates.
 4. Changes in activity durations in workdays.
 5. Changes in the critical path.
 6. Changes in total float or slack time.
 7. Changes in the Contract Time.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
 3. As the Work progresses, indicate Actual Completion percentage for each activity.
- B. Distribution: Distribute copies of approved schedule to Architect and Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
1. Post copies in Project meeting rooms and temporary field offices.
 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 013200

SECTION 001300

CONTRACTOR SUBMITTALS

1.01 GENERAL

- A. General: Wherever submittals are required hereunder, all such submittals by the Contractor shall be submitted to the Project Representative for recording and forwarding to the Engineer. A Submittal is defined as any drawing, calculation, specification, product data, samples, manuals, requests for substitutes, spare parts, photographs, survey data, record drawings, bonds, or similar items required to be submitted to the Engineer under the terms of the contract.
- B. Submittals Required Within 7 Days After Notice to Proceed: Within 7 days after the date of commencement as stated in the Notice to Proceed, the Contractor shall submit the following items to the Engineer for review:
1. A Preliminary Construction Schedule indicating the starting and completion dates of the various stages of the Work shall be submitted as specified therein.
 2. A preliminary schedule of Shop Drawing, Sample, and proposed substitutes or "Or Equal" submittals.
 3. A list of all permits and licenses the Contractor shall obtain indicating the agency required to grant the permit and the expected date of submittal for the permit and required date for receipt of the permit.
 4. A preliminary schedule of values including price breakdowns for all of the Work which will include quantities and prices of items aggregating the Contract Price and will subdivide the Work into component parts in sufficient detail to serve as the basis for progress payments during construction. Such prices shall include an appropriate amount of overhead and profit applicable to each item of work which will be confirmed in writing by the Contractor at the time of submittal.
- C. Submittals Required Within 30 Days After Agreement: Contractor shall, within 30 calendar days after execution of the Agreement, submit to the Engineer all proposed Substitutes or "Or Equal" products for the Engineer's review and approval. All such submittals shall be in conformance with the requirements of Paragraph 1.04, herein.
- D. The Contractor hereby agrees that failure to submit alternative product requests within the stipulated time period shall act as a waiver of any future rights to offer such substitutes, and the Contractor hereby agrees to provide one of the specific products called for in the Contract Documents.

1.02 SHOP DRAWINGS

- A. Wherever called for in the Contract Documents, or where required by the Engineer, the Contractor shall furnish to the Engineer for review, 4 copies of each shop drawing

submittal, or electronically by one pdf file of submittal. The term "Shop Drawings" as used herein shall be understood to include detail design calculations, shop drawings, fabrication and installation drawings, erection drawings, lists, graphs, operating instruction, catalog sheets, data sheets, and similar items. Unless otherwise required, said Shop Drawings shall be submitted to the Engineer at a time sufficiently early to allow review of same by the Engineer, and to accommodate the rate of construction progress required under the Contract.

- B. All Shop Drawings shall be accompanied by the Engineer's standard submittal transmittal form. This form may be obtained in quantity from the Engineer at reproduction cost. Any submittal not accompanied by such a form, or where all applicable items on the form are completed, will be returned for resubmittal.
- C. Normally, a separate transmittal form shall be used for each specific items or class of material or equipment for which a submittal is required. Transmittal of a submittal of various items using a single transmittal form will be permitted only when the items taken together constitute a manufacturer's "package" or are so functionally related that expediency indicates review of the group or package as a whole. A multiple-page submittal shall be collated into sets, and each set shall be stapled or bound, as appropriate, prior to transmittal to the Engineer.
- D. Except as may otherwise be provided herein, the Engineer will return prints of each submittal to the Contractor with its comments noted thereon, within 21 calendar days following their receipt by the Engineer. It is considered reasonable that the Contractor shall make a complete and acceptable submittal to the Engineer by the second submission of a submittal item. The MPWMD reserves the right to withhold monies due the Contractor to cover additional cost of the Engineer's review beyond the second submittal.
- E. If 2 copies of a submittal are returned to the Contractor marked "APPROVED" or "ACCEPTED" or "NO EXCEPTIONS TAKEN," formal revision and resubmission of said submittal will not be required,
- F. If one copy of the submittal is returned to the Contractor marked "AMEND-RESUBMIT," the Contractor shall revise said submittal and shall resubmit 6 copies of said revised submittal to the Engineer.
- G. If one copy of the submittal is returned to the Contractor marked "REJECTED - RESUBMIT," the Contractor shall revise said submittal and shall resubmit 6 copies of said revised submittal to the Engineer.
- H. Fabrication of an item may be commenced only after the Engineer has reviewed the pertinent submittals and returned copies to the Contractor marked either "NO EXCEPTIONS TAKEN" or "APPROVED" or "ACCEPTED" or "MAKE CORRECTIONS NOTED." Corrections indicated on submittals shall be considered as changes necessary to meet the requirements of the Contract Documents and shall not be taken as the basis of claims for extra work.
- I. All Contractor submittals shall be carefully reviewed by an authorized representative of the

Contractor, prior to submittal to the Engineer. Each submittal shall be dated, signed, and certified by the Contractor, as being correct and in strict conformance with the Contract Documents. In the case of shop drawings, each sheet shall be so dated, signed, and certified. No consideration for review by the Engineer of any Contractor submittals will be made for any items which have not been so certified by the Contractor. All non-certified submittals will be returned to the Contractor without action taken by the Engineer, and any delays caused thereby shall be the total responsibility of the Contractor.

- J. The Engineer's review of Contractor submittals shall not relieve the Contractor of the entire responsibility for the correctness of details and dimensions. The Contractor shall assume all responsibility and risk for any misfits due to any errors in Contractor submittals. The Contractor shall be responsible for the dimensions and the design of adequate connections and details.

1.03 PROPOSED SUBSTITUTES OR "OR EQUAL" ITEMS

- A. For convenience in designation in the Contract Documents, any material, product, or equipment to be incorporated in the Work may be designated under a brand or trade name or the name of a manufacturer and its catalog information. The use of any substitute material, product, or equipment which is equal in quality and utility and possesses the required characteristics for the purpose intended will be permitted, subject to the following requirements:
1. The burden of proof as to the quality and utility of any such substitute material, product, or equipment shall be upon the Contractor.
 2. The Engineer will be the sole judge as to the quality and utility of any such substitute material, product, or equipment and its decision shall be final.
- B. Wherever in the Contract Documents the name or the name and address of a manufacturer or Supplier is given for a material, product, or equipment, or if any other source of a material, product, or equipment is indicated therefor, such information is given for the convenience of the Contractor only, and no limit, restriction, or direction is indicated or intended thereby, nor is the accuracy or reliability of such information guaranteed. It shall be the responsibility of the Contractor to determine the accurate identity and location of any such manufacturer, supplier, or other source of any material, product, or equipment called for in the Contract Documents.
- C. The Contractor may offer any material, product, or equipment which it considers equal to those specified. Unless otherwise provided by law or authorized in writing by the Engineer, the substantiation of any proposed substitute or "or-equal" material, product, or equipment must be submitted within 35 days after the execution of the Agreement. The Contractor, at its sole expense, shall furnish data concerning items it has offered as substitute or "or-equal" to those specified. The Contractor shall provide the data required by the Engineer to determine that the quality, strength, physical, chemical, or other characteristics, including durability, finish, efficiency, dimensions, service, and suitability are such that the substitute or "or-equal" item will fulfill its intended function.
- D. The Contractor's attention is further directed to the requirement that its failure to submit data substantiating a request for a substitution of an "or equal" item within said 35-day period shall be deemed to mean that the Contractor intends to furnish one of the specific brand or trade-named material, product, or equipment specified in the Contract Documents and the Contractor does hereby waive all rights to offer or use substitute materials, products, or equipment in each such case. Wherever a proposed substitute material, product, or equipment has not been submitted within said 35-day period, or wherever the submission of a proposed substitute materials, product, or equipment fails to meet the requirements of the Specifications and an acceptable resubmittal is not received by the Engineer within said 35-day period, the Contractor shall furnish only one of the materials, products, or equipment originally-named in the Contract Documents. Approval by the Engineer of a substitute item proposed by the Contractor shall not relieve Contractor of the responsibility for full compliance with the Contract Documents and for adequacy of the substituted item. The Contractor shall also be responsible for resultant changes and all additional costs which the substitution requires in its work, the work of its subcontractors and of other contractors and shall effect such changes without cost to

District.

1.04 SAMPLES

- A. Unless otherwise specified, whenever in the Specifications samples are required, the Contractor shall submit not less than 3 units of each such sample item or material to the Engineer for approval at no additional cost to the District.
- B. Samples, as required herein, shall be submitted for approval a minimum of 7 days prior to ordering such material for delivery to the job-site, and shall be submitted in an orderly sequence so that dependent materials or equipment can be assembled and reviewed without causing delays in the Work.
- C. All samples shall be individually and indelibly labeled or tagged, indicating thereon all specified physical characteristics and manufacturer's names for identification and submittal to the Engineer for approval. Upon receiving approval of the Engineer, one set of the samples will be stamped and dated by the Engineer and returned to the Contractor, one set will be retained by the Engineer, and one set of samples shall remain at the job site for reference by the Engineer until completion of the Work.
- D. Unless otherwise specified, all colors and textures of specified items will be selected by the Engineer from the manufacturer's standard colors and standard materials, products, or equipment lines.

1.05 RECORD DRAWINGS

- A. General: The Contractor shall keep and maintain, at the job site, one record set of Contract Drawings. On these, it shall mark all project conditions, locations, configurations, and any other changes or deviations which may vary from the details represented on the original Contract Drawings, including buried or concealed construction and utility features which are revealed during the course of construction.
- B. Special attention shall be given to recording the horizontal and vertical location of all buried utilities that differ from the locations indicated, or which were not indicated on the Contract Drawings. Said record drawings shall be supplemented by any detailed sketches as necessary or directed to indicate, fully, the Work as actually constructed.
- C. These master record drawings of the Contractor's representation of "as-built" conditions, including all revisions made necessary by addenda, change orders, and the like shall be maintained up-to-date during the progress of the Work.
- D. In the case of those drawings which depict the detail requirement for equipment to be assembled and wired in the factory, the record drawings shall be updated by indicating those portions which are superseded by change order drawings or final shop drawings, and by including appropriate reference information describing the change orders by number and the shop drawings by manufacturer, drawing, and revision numbers.

- E. Record drawings prepared by the Contractor shall be accessible to the Engineer at all times during the construction period and shall be delivered to the Engineer upon completion of the work.
- F. Effect on Progress Payments: Requests for partial payments will not be approved if the record drawings are not kept current. All such Record Drawings will be inspected by the Engineer each month, showing all variations between the Work as actually constructed and as originally shown on the Contract Drawings or other Contract Documents, and the District will not process monthly payment requests until such drawings are made current each month.
- G. Final Record Drawings: Upon substantial completion of the Work and prior to final acceptance by the District, the Contractor shall complete and deliver the completed set of Record Drawings to the Engineer for transmittal to the District, conforming to the construction records of the Contractor. This set of drawings shall consist of corrected plans showing the reported location of the Work. The information submitted by the Contractor and incorporated by the Engineer into the Record Drawings will be assumed to be reliable, and the Engineer will not be responsible for the accuracy of such information, nor for any errors or omissions which may appear on the Record Drawings as a result.
- H. Effect on Final Payment: Final payment will not be approved until the Contractor-prepared Final Record Drawings have been delivered to the Engineer. Said up-to-date, Record Drawings may be in the form of a set of prints with carefully plotted information overlaid in pencil.

1.06 SHEETING, SHORING, BRACING, OR SLOPING OF EXCAVATIONS

- A. Prior to commencement of any excavation, 5 feet or greater in depth, the Contractor shall submit to the District or its Engineer, a detailed plan showing the design of sheeting, shoring, bracing, sloping, or equivalent method and shall be in receipt of the District's acceptance of same, all as specified in Article 18.14 of the General Conditions, entitled "Protection of Workers in Trench Excavations."

END OF SECTION

SECTION 014000
QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 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.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

1.3 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.
- C. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with industry standards.
- D. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.

- E. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- F. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- G. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
 - 1. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespeople of the corresponding generic name.
- H. Experienced: When used with an entity, "experienced" means having successfully completed a minimum of five (5) previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 CONFLICTING REQUIREMENTS

- A. General: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Architect for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this Article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- C. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.
 - 1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
 - 2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

- D. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- E. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
 - 1. Contractor responsibilities include the following:
 - a. Provide test specimens representative of proposed products and construction.
 - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
 - c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
 - 2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

1.6 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
 - 1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
 - 2. Costs for retesting and re-inspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
- B. Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
 - 1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
 - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 - 2. Notify testing agencies at least twenty-four (24) hours in advance of time when Work that requires testing or inspecting will be performed.
 - 3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 - 4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.

5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Retesting/Re-inspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and re-inspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- D. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 6. Do not perform any duties of Contractor.
- E. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
1. Provide materials and comply with installation requirements specified in other Specification Sections. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.
- B. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

SECTION 015000

TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 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.

1.2 SUMMARY

- A. This Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

1.3 USE CHARGES

- A. General: Unless noted cost or use charges for temporary facilities shall be included in the Contract Sum.
- B. Water Service: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations, without impact to owners operation.
- C. Electric Power Service: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations, without impact to owners operation.

1.4 SUBMITTALS

- A. Site Plan (Contractor Staging Plan): Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

1.5 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Installer of each permanent service shall assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Portable Chain-Link Fencing: minimum 8 feet high with galvanized steel pipe posts. Provide concrete bases for supporting posts, tamper resistant connections and pad lockable entry panels and gates.

2.2 TEMPORARY FACILITIES

- A. Common-Use Field Office: Of sufficient size to accommodate needs of construction personnel. Keep office clean and orderly. Furnish and equip offices as follows:
 - 1. Furniture including tables and chairs and storage storage furniture required for meetings of up to 8 individuals, storage and display of Project-site documents.
 - 2. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
 - 3. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.
- B. Storage and Fabrication Containers and Sheds: Provide containers and sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Locate facilities as directed by owner and architect.
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities until project completion.

3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service.
 - 1. Arrange with utility company to make connections for temporary services.
- B. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

- C. Heating: Provide temporary heating required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
- D. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
- E. Electric Power Service: Provide temporary service.
- F. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
 - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
- G. Telephone Service: Provide cellular telephone service for use by all construction personnel.
- H. Electronic Communication Service: Provide temporary electronic communication service, including electronic mail, in common-use facilities.

3.3 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
 - 1. Maintain support facilities until near Substantial Completion. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Traffic Controls: Comply with requirements of authorities having jurisdiction.
 - 1. Protect existing site improvements to remain including curbs, pavement, and utilities.
 - 2. Maintain access for fire-fighting equipment and access to fire hydrants.
- C. Parking: Use owner parking upon owner and architect permission.
- D. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
 - 1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties nor endanger permanent Work or temporary facilities.
- E. Project Identification and Temporary Signs: All signage is prohibited except as approved by owner and architect or emergency and safety signage and as required by Authorities having Jurisdiction.
- F. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
 - 1. Comply with work restrictions specified in Division 01 Section "Summary."
 - 2. Obtain Owner approval for all temporary facilities. Final location shall be per Owner for accessibility and maintenance.
- B. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction, including Monterey County.
 - 1. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
- C. Stormwater Control: Comply with authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- D. Planting Protection: Protect planting root systems from damage, flooding, and erosion.
- E. Work Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence at all areas of new Site Work.
- F. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

3.5 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
 - 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
 - 1. Materials and facilities that constitute temporary facilities are property of Contractor.

2. Remove temporary paving not intended for or acceptable for integration into permanent paving. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
3. At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements specified in Division 01 Section "Closeout Procedures."

END OF SECTION 015000

SECTION 015500
OWNER FURNISHED CONTRACTOR INSTALLED (OFCI) ITEMS

PART 1 - GENERAL

1.01 SUMMARY

- .A This Section includes requirements for the contractor to accept, offload, inspect, install and coordinate testing of Owner Furnished Contractor Installed Items.

1.02 OFCI ITEMS DESCRIPTION

- .A Prominent Hypochlorite Chemical Injection skid assembly (2 each)
- .B Prominent Phosphate Corrosion Inhibitor Chemical Injection skid assembly (2 each)
- .C Prominent Chlorine Residual Analyzer assembly (2 each)

1.03 DEFINITIONS

- .A **OFCI** – Owner Furnished Contractor Installed
- .B **OFCI Manager** – Contractor's employee responsible for managing all OFCI items.

1.04 OFCI MANAGER

- .A Submit a letter to the Owner identifying on-site individual that will act as the Contractor's OFCI Manager.
 - .1 This OFCI Manager will be responsible for:
 - .a Documenting receipt and reporting of all shipments received.
 - .b Proper storage and handling of OFCI items at all times.
 - .2 If the originally designated OFCI Manager is replaced, designate a new OFCI Manager and immediately submit written notification thereof to the Owner.

1.05 PURCHASE ORDERS

- .A The Owner will furnish copies of purchase orders covering OFCI items.
 - .1 The nature of the procurement actions involved prevents the furnishing of a complete set of purchase orders immediately after the start of construction.
 - .2 Purchase Orders will be forwarded to Contractor at the time of issuance to the suppliers.
 - .3 Contractor must retain copies of Owner's Purchase Order(s) for the Contractor's control records.
 - .4 Purchase Orders for items subject to "phased" delivery will be accompanied by appropriate delivery lists.

1.06 OFCI DELIVERY SCHEDULE

- .A The OFCI delivery shall be coordinated between the OWNER and CONTRACTOR. OWNER shall notify CONTRACTOR at least two weeks prior to delivery of OFCI items.

1.07 SHIPMENT DELIVERY

- .A Upon receipt of a shipment of OFCI item(s), the Contractor must:
 - .1 Count the number of cartons to verify the quantity received corresponds with the freight bill.
 - .a Clearly note any discrepancies on the original freight bill or delivery ticket.
 - .2 Prior to signing for anything, carefully examine the merchandise for obvious damage
 - .a If such damage is observed, refuse the shipment.
 - .b Upon refusal, notify the Owner, and give complete details.
 - .3 Open cartons or uncrate equipment to permit examination prior to departure of the carrier.
 - .a If the size of the shipment makes this impossible, release the driver and inspect the shipment for concealed damage not later than 24 hours after receipt.
 - .b If it is determined concealed damage does exist, contact Owner immediately.

1.08 EQUIPMENT RECEIVING LOG

- .A CONTRACTOR shall keep an "Equipment Receiving Log," updated at all times, at the Job Site.
- .B The "Equipment Receiving Log" must be in a format furnished or Approved by the Owner.
- .C CONTRACTOR shall provide a copy of all installation , Operating, and Maintenance instructions received with OCFI shipments to the Owner upon arrival.

1.09 STORAGE

- .A Store all OFCI items in a secure area either on-site or off-site.
 - .1 The area must be lockable and secure from vandalism or theft.
 - .2 It must be weatherproof and waterproof with adequate ventilation.
 - .3 Provide protection and security of OFCI items.
- .B Provide Certificates of Insurance for all off-site storage areas in accordance with the requirements of the Contract Documents.

1.10 INSPECTION OF RECORDS

- .A The Owner may inspect the Owner-furnished equipment records on a periodic basis during construction to assure that the data is maintained in an accurate and current condition.

1.11 DAMAGED MERCHANDISE

.A Exterior or Visible Damage:

- .1 If container received shows exterior or visible damage, make a notation to that effect on the delivery ticket and have it signed by the delivery carrier and by personnel responsible for receiving the merchandise.
- .2 Refuse acceptance of damaged merchandise.

.B Concealed Damage:

- .1 If container received shows no evidence of damage, but upon examination of the contents thereof "concealed damage" is discovered, notify the Owner immediately and request an inspection.

.C F.O.B. (Freight on Board) Shipping Point:

- .1 If the merchandise is damaged Contractor must:
 - .a Request an inspection by the delivery carrier's inspector. Do not destroy the original carton, box, etc.
 - .b Notify the Owner of damaged merchandise and request replacement shipment.
 - .c Submit the following to Owner, Attention: Owner's Project Manager:
 - .1 Inspection Report
 - .2 Bill of Lading
 - .3 Invoice
 - .4 Freight Bill or Delivery Ticket
 - .d Hold the damaged merchandise until instructions for its disposition are received from the Owner.
- .2 F.O.B. (Freight on Board) Destination:
 - .a If the merchandise is damaged and the F.O.B. is "Destination," then the complete and total liability is assumed by the Vendor from the point it is placed in the hands of the common carrier to the point of delivery. It is the Vendor's responsibility to file a claim with the carrier to recover the loss of merchandise damaged.
 - .b The Contractor must:
 - .1 Request an inspection by the delivery carrier's inspector. Do not destroy the original carton, box, etc.
 - .2 Notify the Vendor of damaged merchandise and obtain authorization from Owner and replace shipment.

- .3 Hold damaged merchandise until instructions for disposition are received from the Vendor.
- .4 Send the following original documents to the Vendor to assist in filing claim with carrier, retaining a copy for Contractor's records:
 - .a Inspection Report
 - .b Bill of Lading and/or Freight Bill or Delivery Ticket

1.12 Warrantees/Guarantees

- .A Contractor must provide Guarantees/Warranties for all products and equipment that is purchased (and/or pre-purchased) by the Owner and installed by the Contractor.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

.A The CONTRACTOR shall provide all fittings, closure pieces, bends, reducers, wyes, tees, crosses, outlets, manifolds, and other bolts, nuts, gaskets, jointing materials, mounting materials, anchors and all other appurtenances as required to provide a complete and workable installation of the OCFI items. OCFI items shall be mounted, installed, and connected in strict accordance with the Manufacturers recommendations. Where pipe support details are indicated, the supports shall conform thereto and shall be placed as indicated; provided, that the support for all exposed piping shall be complete and adequate regardless of whether or not supporting devices are specifically indicated.

PART 4 - FORMS

OFCI DELIVERY SCHEDULE SAMPLE FORM 015500-F1

<u>ORDERED</u>		<u>ITEM DESCRIPTION</u>	<u>DELIVERY</u>	
PO #	Date			

END OF SECTION 015500

SECTION 015723

TEMPORARY WATER POLLUTION CONTROL

PART 1 – GENERAL

SECTION INCLUDES

Work in this section includes furnishing all labor, equipment and materials necessary for the implementation of temporary Water Pollution Controls, including implementation, monitoring, and maintenance of Best Management Practices (BMPs).

The anticipated area of disturbance for this project is less than one acre. If the area of disturbance will exceed one acre, the OWNER must obtain coverage under the State's Construction General Permit. The CONTRACTOR shall notify the ENGINEER in the event he anticipates the area of disturbance will exceed one acre. The CONTRACTOR shall not disturb more than one acre on the site, including staging, material lay-down, and equipment storage areas, if the OWNER has not gained coverage under the Permit

Principal items of work include:

1. Training employees and subcontractors in stormwater Best Management Practices (BMPs)
2. Stormwater site inspections
3. Reporting and recordkeeping
4. Implementing and maintaining BMPs, and removing BMPs when no longer needed.
5. Non-stormwater management and good housekeeping practices
6. Final site cleanup

REFERENCES

Standard Specifications, State of California, Department of Transportation (Caltrans), 2015 edition

Standard Plans, State of California, Department of Transportation (Caltrans), 2015 edition

Construction Site Best Management Practices Manual (BMP Manual), State of California, Department of Transportation (Caltrans), 2003 edition

QUALITY ASSURANCE

CONTRACTOR's Water Pollution Control Manager (WPCM) is responsible for overseeing the implementation of Temporary Water Pollution Control (WPC) work on a day-to-day basis. The WPCM shall be an employee of the Contractor and shall be on site regularly.

The WPCM shall educate, direct and enforce compliance with WPC requirements by all employees and subcontractors.

All contractor employees, subcontractors, and heavy equipment operators shall attend a pre-construction WPC training session conducted by the Contractor's WPCM.

GENERAL PERFORMANCE REQUIREMENTS

All storm water and non-storm water discharges shall be in compliance with all applicable federal, state, and local requirements.

This Section outlines the contract minimum requirements, and does not relieve the Contractor of his responsibilities for protection of water quality in accordance with all federal, state, and local requirements.

Additional BMPs shall be required if the BMPs which are utilized are not adequately protecting water quality.

The Contractor shall update the Water Pollution Control Drawings to indicate current operations, equipment used, sequence of work, and other aspects of the project.

Contractor is responsible for the performance of subcontractors. Contractor's WPCM shall inspect and monitor all subcontractors' work and storage areas for compliance with this Section.

FINES AND PENALTIES

Contractor shall pay any fines and be liable for any other penalties that may be imposed by any federal, state, or local regulatory agency for non-compliance with any water quality requirement during the course of work.

Contractor is responsible for implementing any and all BMP corrective measures, at his own expense, as may be directed by the regulatory agencies.

PART 2 – PRODUCTS

MATERIALS

Provide all temporary and permanent water pollution control measures, equipment and materials as required by this Section and the Construction Drawings.

Materials shall conform to the Caltrans Standard Specifications and Caltrans Standard Plans including Standard Specifications sections:

1. 13-4 Job Site Management
2. 13-5 Temporary Soil Stabilization
3. 13-6 Temporary Sediment Control
4. 13-7 Temporary Tracking Control
5. 13-8 Temporary Active Treatment System
6. 13-9 Temporary Concrete Washouts
7. 13-10 Temporary Linear Sediment Barriers
8. 14-9 Air Quality
9. 14-10 Solid Waste Disposal and Recycling
10. 14-11 Hazardous Waste and Contamination

SUBMITTALS

Provide documentation for WPCM, employee and subcontractor training, including pre-construction WPC training.

PART 3 – EXECUTION

MONITORING, INSPECTIONS AND REPORTING

Monitor the National Weather Service (NWS) forecast on a daily basis during the rainy season.

Conduct inspections:

11. Within 72 hours prior to predicted rain events to ensure that the site is prepared for the rain event

12. Within 48 hours after a rain event to evaluate BMP performance and identify corrective actions
13. Conduct daily inspections of adjoining public roadways, material storage areas, and vehicle and equipment areas.

Implement identified corrective actions within 72 hours, unless a later date is authorized.

Notify the OWNER of any site visits by or correspondence received from any federal, state, or local agency, which are related to activities under this Section.

BEST MANAGEMENT PRACTICES

Implement Best Management Practices as required by Sections 13 and 14 of the Caltrans Standard Specifications.

Work shall comply with the following Caltrans Standard Specifications Sections, as applicable:

14. 13-4 Job Site Management
15. 13-5 Temporary Soil Stabilization
16. 13-6 Temporary Sediment Control
17. 13-7 Temporary Tracking Control
18. 13-8 Temporary Active Treatment System
19. 13-9 Temporary Concrete Washouts
20. 13-10 Temporary Linear Sediment Barriers
21. 14-9 Air Quality
22. 14-10 Solid Waste Disposal and Recycling
23. 14-11 Hazardous Waste and Contamination

Best Management Practices shall be implemented concurrent with the commencement of construction, shall be maintained throughout construction, and shall be removed when no longer required, when approved by the ENGINEER.

COMPLETION OF WORK

Final site cleanup and stabilization shall be considered complete when all of the following have been achieved:

24. The site will not pose any additional sediment discharge risk than it did prior to the commencement of construction activity;
25. There is no potential for construction-related storm water pollutants to be discharged into site runoff;
26. Final stabilization has been reached;
27. Construction materials and wastes have been disposed of properly;
28. Post-construction storm water management measures have been installed;
29. All construction-related equipment, materials and any temporary BMPs no longer needed are removed from the site.

END OF SECTION

SECTION 016000

PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 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.

1.2 SUMMARY

- A. This 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; product substitutions; and comparable products.

1.3 DEFINITIONS

- A. Products: Items purchased 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 approved through submittal process, or where indicated as a product substitution, 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.
- B. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
- C. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.

1.4 SUBMITTALS

- A. Product List: Submit a list, in tabular form, showing specified products. Include generic names of products required. Include manufacturer's name and proprietary product names for each product.

1. Coordinate product list with Contractor's Construction Schedule and the Submittals Schedule.
 2. Form: Tabulate information for each product under the following column headings:
 - a. Specification Section number and title.
 - b. Generic name used in the Contract Documents.
 - c. Proprietary name, model number, and similar designations.
 - d. Manufacturer's name and address.
 - e. Supplier's name and address.
 - f. Installer's name and address.
 - g. Projected delivery date or time span of delivery period.
 - h. Identification of items that require early submittal approval for scheduled delivery date.
 3. Initial Submittal: Within thirty (30) days after date of commencement of the Work, submit three (3) copies of initial product list. Include a written explanation for omissions of data and for variations from Contract requirements.
 - a. At Contractor's option, initial submittal may be limited to product selections and designations that must be established early in Contract period.
 4. Completed List: Within sixty (60) days after date of commencement of the Work, submit three (3) copies of completed product list. Include a written explanation for omissions of data and for variations from Contract requirements.
 5. Architect's Action: Architect will respond in writing to Contractor within fifteen (15) calendar days of receipt of completed product list. Architect's response will include a list of unacceptable product selections and a brief explanation of reasons for this action. Architect's response, or lack of response, does not constitute a waiver of requirement to comply with the Contract Documents.
- B. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
1. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified material or product cannot be provided.
 - b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
 - g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.

- h. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
 - i. Detailed comparison of Contractor's Construction Schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delays in delivery.
 - j. Cost information, including a proposal of change, if any, in the Contract Sum.
 - k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
 - l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven (7) days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within fifteen (15) calendar days of receipt of request, seven (7) days of receipt of additional information or documentation, whichever is later.
- a. Use product specified if Architect cannot make a decision on use of a proposed substitution within time allocated.
- C. Comparable Product Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
1. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within fifteen (15) days of receipt of request, or seven (7) days of receipt of additional information or documentation, whichever is later.
- a. Form of Approval: As specified in Division 01 Section "Submittal Procedures."
 - b. Use product specified if Architect cannot make a decision on use of a comparable product request within time allocated.
- D. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 01 Section "Submittal Procedures." Show compliance with requirements.
- 1.5 QUALITY ASSURANCE
- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.
- 1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING
- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Store cementitious products and materials on elevated platforms.
5. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
7. Protect stored products from damage and liquids from freezing.

1.7 PRODUCT WARRANTIES

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: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final 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 appropriate form properly executed.
3. Refer to Divisions 02 through 49 Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Division 01 Section "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that are new at time of installation.
 - 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 - 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 - 3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
 - 4. Where products are accompanied by the term "as selected," Architect will make selection.
 - 5. Where products are accompanied by the term "match sample," sample to be matched is Architect's.
 - 6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
 - 7. Or Equal: Where products are specified by name and accompanied by the term "or equal" or "or approved equal" or "or approved," comply with provisions in Part 2 "Comparable Products" Article to obtain approval for use of an unnamed product.
- B. Product Selection Procedures:
 - 1. Available Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
 - 2. Available Manufacturers: Where Specifications include a list of manufacturers, provide a product by one of the manufacturers listed, or an unnamed manufacturer, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
 - 3. Product Options: Where Specifications indicate that sizes, profiles, and dimensional requirements on Drawings are based on a specific product or system, provide the specified product or system. Comply with provisions in Part 2 "Product Substitutions" Article for consideration of an unnamed product or system.
 - 4. Basis-of-Design Product: Where Specifications name a product and include a list of manufacturers, provide the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product by the other named manufacturers.
 - 5. Visual Matching Specification: Where Specifications require matching an established Sample, select a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
 - a. If no product available within specified category matches and complies with other specified requirements, comply with provisions in Part 2 "Product Substitutions" Article for proposal of product.

6. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product that complies with other specified requirements.
 - a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, density, or texture from manufacturer's product line that does not include premium items.
 - b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 PRODUCT SUBSTITUTIONS

- A. Timing: Architect will consider requests for substitution if received within sixty (60) days after the Notice to Proceed. Requests received after that time may be considered or rejected at discretion of Architect.
- B. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 1. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
 2. Requested substitution does not require extensive revisions to the Contract Documents.
 3. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 4. Substitution request is fully documented and properly submitted.
 5. Requested substitution will not adversely affect Contractor's Construction Schedule.
 6. Requested substitution has received necessary approvals of authorities having jurisdiction.
 7. Requested substitution is compatible with other portions of the Work.
 8. Requested substitution has been coordinated with other portions of the Work.
 9. Requested substitution provides specified warranty.
 10. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

2.3 COMPARABLE PRODUCTS

- A. Conditions: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 1. Evidence that the proposed product does not require extensive revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.

2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

SECTION 017300

EXECUTION

PART 1 - GENERAL

1.1 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.

1.2 SUMMARY

- A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering and surveying.
 - 3. General installation of products.
 - 4. Coordination of Owner-installed products.
 - 5. Progress cleaning.
 - 6. Starting and adjusting.
 - 7. Protection of installed construction.
 - 8. Correction of the Work.

1.3 SUBMITTALS

- A. Qualification Data: For land surveyor.
- B. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.

1.4 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.
 - 1. Before construction, verify the location and points of connection of utility services.
- B. Existing Utilities: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.
 - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; and underground electrical services.
 - 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- C. Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 - 1. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 - 2. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 - 3. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 - 4. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents.

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.
- B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.
 - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
 - 2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 - 3. Inform installers of lines and levels to which they must comply.
 - 4. Check the location, level and plumb, of every major element as the Work progresses.
 - 5. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
 - 6. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
 - 1. Make vertical work plumb and make horizontal work level.
 - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 - 3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Tools and Equipment: Do not use tools or equipment that produce harmful noise or vibration levels.
- F. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- G. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
 - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 - 2. Allow for building movement, including thermal expansion and contraction.
 - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- H. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.5 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.
 - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 - 2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F (27 deg C).
 - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
 - 1. Remove liquid spills promptly.
 - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.
- H. There shall be no discharge of any kind into the site basin unless advance Owner approval is obtained in writing.
- I. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.6 STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 01 Section "Quality Requirements."

3.7 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.8 CORRECTION OF THE WORK

- A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Division 01 Section "Cutting and Patching."
 - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Restore permanent facilities used during construction to their specified condition.
- C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
- D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 017300

SECTION 017700
CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 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.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Inspection procedures.
 - 2. Warranties.
 - 3. Final cleaning.

1.3 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.
 - 1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete. Submit three (3) copies 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.
 - 2. Advise Owner of pending insurance changeover requirements.
 - 3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 - 4. Prepare and submit Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
 - 5. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
 - 6. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 - 7. Complete startup testing of systems.
 - 8. Submit test/adjust/balance records.
 - 9. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 - 10. Advise Owner of changeover in heat and other utilities.
 - 11. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
 - 12. Complete final cleaning requirements, including touchup painting.
 - 13. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

- B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect 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 Architect, 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.
- 1.4 FINAL COMPLETION
- A. Upon completion of all Punchlist Work and before requesting final inspection for determining date of Final Completion, complete the following:
 - 1. Submit a final Application for Payment according to Division 01 Section "Payment Procedures."
 - 2. Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 - 3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 - 4. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
 - B. Submit all required written warranties. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, and thickness as necessary to accommodate contents. Provide additional copies of each warranty to include in operation and maintenance manuals.
 - C. Submit Project Record Documents.
 - D. Perform Final Cleaning.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. 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 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. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. Remove snow and ice to provide safe access to building.
 - f. 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.
 - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - h. Sweep concrete floors broom clean in unoccupied spaces.
 - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
 - j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - k. Remove labels that are not permanent.
 - l. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
- 1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
- m. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - n. Replace parts subject to unusual operating conditions.
 - o. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - p. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - q. Clean ducts, blowers, and coils if units were operated without filters during construction.
 - r. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
 - s. Leave Project clean and ready for occupancy.
- B. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

END OF SECTION 017700

SECTION 025720

STEEL PIPE FABRICATED SPECIALS (AWWA C200, MODIFIED)

PART 1 - GENERAL

1.1 REQUIREMENTS

- A. The CONTRACTOR shall provide bends, reducers, wyes, tees, crosses, outlets, manifolds, and other steel plate specials, complete in place, in accordance with the Contract Documents.
- B. A single pipe manufacturer shall be made responsible for furnishing all the specials.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section 025700 – Steel Pipe, Mortar Lined & Coated
Section 025710 – Steel Pipe, Mortar Lined & Coal Tar Enamel/Tape Coated
Section 098000 – Protective Coatings

1.3 CONTRACTOR SUBMITTALS

- A. **Shop Drawings:** The CONTRACTOR shall submit Shop Drawings and laying diagrams of pipe, joints, bends, reducers, wyes, tees, crosses, outlets, manifolds, and other steel plate specials in accordance with Section 013300 - Contractor Submittals.
- B. Design calculations shall be submitted to the PROJECT ENGINEER for review prior to manufacture of pipe specials.
- C. **Certifications:** A certified affidavit of compliance shall be furnished for all steel plate specials and other products or materials furnished under this Section.
- D. **Manufacturer's Qualifications:** Furnish a copy of manufacturer's certification by SPFA or LRQA and documentation of manufacturer's experience in fabricating AWWA C200 pipe.

1.4 QUALITY ASSURANCE

- A. **Manufacturer Qualifications:** The manufacturer shall be certified by the Steel Plate Fabricators Association (SPFA) or Lloyds Register Quality Assurance (LRQA) and shall be experienced in fabrication of AWWA C200 pipe of similar diameters, lengths, and wall thickness to the WORK. Experience shall be in the production facilities and personnel, not the name of the company that owns the production facility or employs the personnel.
- B. Shop Testing of Steel Plate Specials
 - 1. If any special has been fabricated from straight pipe not previously tested and is of the type listed below, the special shall be hydrostatically tested with a pressure equal to 1-1/2 times the design working pressure: all bends, wyes, crosses, tees with side outlet diameter greater than 30 percent of the main pipe diameter, and manifolds.

2. All specials not required to be hydrostatically tested shall be tested by liquid dye penetrant inspection method in accordance with ASTM E 165 - Standard Test Methods for Liquid Penetrant Examination, Method A or the magnetic particle method in ASME Section VIII, Division 1, Appendix VI.

3. Reinforcing plates shall be tested by the solution method using approximately 40 psi air pressure introduced between the plates through a threaded test hole. Test hole shall be properly plugged following successful testing.

4. Any weld defects, cracks, leaks, distortion, or signs of distress during testing shall require corrective measures. Weld defects shall be gouged out and re-welded. After corrections, the special shall be retested.

5. Where welded test heads or bulkheads are used, extra length shall be provided to each opening of the special. After removal of each test head, the special shall be trimmed back to the design points with all finished plate edges ground smooth, straight, and prepared for the field joint.

6. Testing shall be performed before joints have been coated or lined.

C. Ultrasonic Examination:

1. Steel plate that will be in welded joints or welded stiffener elements shall be examined ultrasonically for laminar discontinuities where both of the following conditions exist:

- a. Any plate in the welded joint has a thickness exceeding 1/2-inch.
- b. Any plate in the welded joint is subject to transverse tensile stress through its thickness during the welding or service.

2. Ultrasonic examination may be waived where joints are designated to minimize potential laminar tearing.

3. The ultrasonic examination shall be in accordance with ASTM A 578 - Straight Beam Ultrasonic Examination of Plain and Clad Steel Plates for Special Applications with a Level I acceptance standard.

4. Plates that are not in conformance with the acceptance criteria in ASTM A 578 may be used in the WORK if the areas that contain the discontinuities are a distance at least four times the greatest dimension of the discontinuity away from the weld joint.

D. Field Testing: Field testing shall conform to the requirements of Section 02643 – Waterline Disinfection & Testing.

E. Welding Requirements: Welding procedures used to fabricate pipe shall be prequalified under the provisions of ANSI/AWS D1.1 or ASME Pressure Vessel Code, Section 9. Welding procedures shall be required for longitudinal and girth or spiral welds for pipe cylinders, spigot and bell ring attachments, reinforcing plates and ring flange welds, and plates for lug connections.

F. Welder Qualifications: Welding shall be done by skilled welders, welding operators, and tackers who have had adequate experience in the methods and materials to be used. Welders shall

be qualified under the provisions of ANSI/AWS D1.1 or ASME Pressure Vessel Code, Section 9 by an independent local, approved testing agency not more than 6 months prior to commencing work on the pipeline. Machines and electrodes similar to those used in the WORK shall be used in qualification tests. The CONTRACTOR shall be responsible for the expense of qualifying welders as part of the WORK.

PART 2 - PRODUCTS

2.1 GENERAL

A. Specials are defined as fittings, closure pieces, bends, reducers, wyes, tees, crosses, outlets, manifolds, and other steel plate specials wherever located, and all piping above ground or in structures. **Aboveground pipe spools shall include 2each, 1" NPT thread-o-let fittings welded at 0 and 90 degrees, located 8 inches from the flange face, unless otherwise noted in the Plans.**

2.2 DESIGN

A. **Design:** Except as otherwise indicated, materials, fabrication and shop testing of straight pipe shall conform to the requirements of ANSI/AWWA C200 - Steel Water Pipe 6 in and Larger, and shall conform to the dimensions of ANSI/AWWA C208 - Dimensions for Fabricated Steel Water Pipe Fittings. The minimum thickness of plate for pipe from which specials are to be fabricated shall be the greatest of those determined by the following 4 criteria:

1. Working and Transient Pressure Design

$$T = \frac{P_w D / 2}{Y / S_w}$$

$$T = \frac{P_t D / 2}{Y / S_t}$$

Where: T = Steel cylinder thickness in inches
D = Outside diameter of steel cylinder in inches
P_w = Design working pressure in psi
P_t = Design transient pressure in psi
Y = Specified minimum yield point of steel in psi
S_w = Safety factor of 2.5 at design working pressure
S_t = Safety factor at design transient pressure; for elbows 1.875, and 2.0 for other specials

2. **Mainline Pipe Thickness:** Plate thickness for specials shall not be less than for the adjacent mainline pipe.

3. Thickness based on Pipe Diameter:

Nominal Pipe Diameter (in)	Pipe Manifolds Piping Above Ground Piping Structures	Elbows Bends Reducers
24 and under	3/16-in	10-ga
25 to 48	1/4-in	1/4-in
over 48	5/16-in	5/16-in

B. Specials installed on saddle supports shall be designed to limit the longitudinal bending stress to a maximum of 10,000 psi. Design shall be in accordance with the provisions of Chapter 7 of AWWA M-11.

2.3 FABRICATION AND MATERIALS

A. General

1. **Coatings:** All fabricated specials covered in this section shall be Fusion Bonded Epoxy coated in accordance with AWWA D-213. See section 098000 for details on additional exterior coating of above ground piping spools and manifolds.

2. Reinforcement for wyes, tees, outlets, and nozzles shall be designed in accordance with AWWA Manual M-11. Reinforcement shall be designed for the design pressure indicated and shall be in accordance with the Drawings. Specials and fittings shall be equal in pressure design strength and shall have the same lining and coating as the adjoining pipe. Unless otherwise indicated, the minimum radius of elbows shall be 2.5 times the pipe diameter and the maximum miter angle on each section of the elbow shall not exceed 11-1/4 degrees.

B. Specials and fittings that cannot be mechanically lined and coated shall be lined and coated by hand-application using the same materials as used for the pipe and in accordance with the applicable AWWA or ASTM Standards, as modified by the applicable pipe section in these Specifications. Coating and lining applied in this manner shall provide protection equal to that for the pipe. Fittings may be fabricated from pipe that has been mechanically lined and/or coated. Areas of lining and coating that have been damaged by such fabrication shall be repaired by hand-applications.

C. Access manholes with covers shall be as indicated. Threaded outlets shall be forged steel suitable for 3000 psi service, and shall be as manufactured by Vogt or equal.

D. Moderate deflections and long radius curves may be made by means of beveled joint rings, by pulling standard joints, by using short lengths or pipe, or a combination of these methods; provided that pulled joints shall not be used in combination with bevels. The maximum total allowable angle for beveled joints shall be 5 degrees per pipe joint. Bevels shall be provided on the bell ends. Mitering of the spigot ends will not be permitted. The maximum allowable angle for pulled joints shall be in accordance with the manufacturer's recommendations or the angle which results from a 3/4-inch pull out from normal joint closure, whichever is less. All horizontal deflections or fabricated angles shall fall on the alignment. In congested city streets or at other locations where underground obstructions may be encountered, the chord produced by deflecting the pipe shall be no further than 6 inches from the alignment indicated.

E. Vertical deflections shall fall on the alignment and at locations adjacent to underground obstructions, points of minimum earth cover, and pipeline outlets and structures. The pipe angle points shall match the angle points indicated.

F. Outlets, Tees, Wyes, and Crosses

1. Outlets 12-inch and smaller may be fabricated from Schedule 30 or heavier steel pipe in the standard outside diameters, i.e., 12-3/4-inch, 10-3/4-inch, 8-5/8-inch, 6-5/8-inch, and 4-1/2-inch. Minimum plate thickness for reinforcements shall be 10-gauge.

2. The design of outlet reinforcement shall be in accordance with the procedures given in Chapter 13 of AWWA Manual M-11, and the design pressures and factors of safety above.
 3. In lieu of saddle or wrapper reinforcement as provided by the design procedure in Manual M-11, pipe or specials with outlets may be fabricated in their entirety of steel plate having a thickness equal to the sum of the pipe wall plus the required reinforcement.
 4. Where Manual M-11 requires the design procedure for crotch plate reinforcement, such reinforcement shall be provided.
 5. Outlets shall be fabricated so that there is always at least a 12-inch distance between the outer edge of the reinforcing plate and any field welded joints. For outlets without reinforcing plates, outlets shall penetrate the steel cylinders so that there is at least a 12-inch clearance between the outlet and any field welded joints.
- G. Tees, wyes, crosses, elbows, and manifolds shall be fabricated so that the outlet clearances and reinforcing plates from any weld joints are a minimum of 5 times cylinder thickness or 2 inches, whichever is greater. Longitudinal weld joints in adjacent cylinder sections shall be oriented so that there is a minimum offset of 5 times cylinder thickness or 2 inches, whichever is greater.
- H. **Steel Welding Fittings:** Steel welding fittings shall conform to ASTM A 234 - Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service. **Aboveground pipe spools shall include 2 each, 1" NPT thread-o-let fittings welded at 0 and 90 degrees, located 8 inches from the flange face, unless otherwise noted in the Plans.**
- I. **Ends for Mechanical-Type Couplings:** Except as otherwise indicated, where mechanical-type couplings are indicated, the ends of pipe shall be banded with Type C collared ends using double fillet welds. Where pipe 12-inch and smaller is furnished in standard schedule thicknesses, and where the wall thickness equals or exceeds the coupling manufacturer's minimum wall thickness, the pipe ends may be grooved.
- J. Lining shall conform to the requirements of ANSI/AWWA C205 - Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 in and Larger - Shop Applied, for lining of specials.
- K. **Coating:** All requirements pertaining to thickness and application of coating of adjacent straight pipe shall apply to specials. Unless otherwise indicated, the coating on the buried portion of a pipe section passing through a structure wall shall extend to the center of the wall, or to a wall flange, if one is indicated. Pipe above ground or in structures shall be field-painted in accordance with Section 098000 - Protective Coatings.
- L. **Marking:** A mark indicating the true vertical axis of the special shall be placed on the top and bottom of the special.

PART 3 - EXECUTION

3.1 GENERAL

- A. The CONTRACTOR shall provide all fittings, closure pieces, bends, reducers, wyes, tees, crosses, outlets, manifolds, and other steel plate specials, bolts, nuts, gaskets, jointing materials, and all other appurtenances as required to provide a complete and workable installation. Where pipe support details are indicated, the supports shall conform thereto and shall be placed as indicated;

provided, that the support for all exposed piping shall be complete and adequate regardless of whether or not supporting devices are specifically indicated. Where indicated, concrete thrust blocks and welded joints shall be provided. At all times when the WORK of installing pipe is not in progress, openings into the pipe and the ends of the pipe in trenches or structures shall be kept tightly closed to prevent entrance of animals and foreign materials. The CONTRACTOR shall take all necessary precautions to prevent the pipe from floating due to water entering the trench from any source, shall assume full responsibility for any damage due to this cause, and shall at its own expense restore and replace the pipe to its required condition and grade if it is displaced due to floating. The CONTRACTOR shall maintain the inside of the pipe free from foreign materials and in a clean and sanitary condition until acceptance by the OWNER.

3.2 LAYING

A. Trenches shall be in a reasonably dry condition when the pipe special is laid. Necessary facilities including slings shall be provided for lowering and properly placing the pipe sections in the trench without damage. The pipe and specials shall be laid to the line and grade indicated and shall be closely jointed to form a smooth flow line. Immediately before placing each section of pipe in final position for jointing, the bedding shall be checked for firmness and uniformity of surface.

3.3 COATING

A. Above ground piping shall be coated in accordance with Section 098000 after installation. For the 16" and 20" metering and chemical injection manifolds and the 4" utility line and backflow preventer, use the System 3 Epoxy coating system in Section 098000. Coordinate with the OWNER with respect to final color selection. For the Chemical room interior metallic piping, Contractor may use the System 1 or System 2 coating procedure. Coordinate color selection with the OWNER.

END OF SECTION

SECTION 026430

WATERLINE DISINFECTION & TESTING

PART 1 - GENERAL

1.1 REQUIREMENTS

A. The CONTRACTOR shall perform flushing, disinfection, and testing of all waterlines, services, and appurtenances, complete, in accordance with the Contract Documents.

1.2 RELATED WORK SPECIFIED ELSEWHERE

None

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards:

ANSI/AWWA B300 Hypochlorites.

ANSI/AWWA B301 Liquid Chlorine.

ANSI/AWWA C651 Disinfecting Water Mains.

1.4 CONTRACTOR SUBMITTALS

A. A proposed plan and schedule for water conveyance, cleaning, disinfection, flushing and water disposal, and pressure testing shall be submitted in writing for approval a minimum of 48 hours before testing is to start. The plan shall demonstrate that personnel are experienced and prepared to resolve problems which may arise.

PART 2 - PRODUCTS

2.1 MATERIALS REQUIREMENTS

A. All test equipment, chemicals for chlorination, temporary valves, bulkheads, or other water control equipment and materials shall be selected and furnished by the CONTRACTOR subject to the MPWMD's review. No materials shall be used which would be injurious to the construction or its future function.

B. Chlorine for disinfection may be in the form of liquid chlorine, sodium hypochlorite solution, or calcium hypochlorite tablets.

C. Liquid chlorine shall be in accordance with the requirements of ANSI/AWWA B301. Liquid chlorine shall be used only:

1. In combination with appropriate gas flow chlorinators and ejectors;
2. Under the direct supervision of an experienced technician;
3. When appropriate safety practices are observed.

D. Sodium hypochlorite and calcium hypochlorite shall be in accordance with the requirements of ANSI/AWWA B300.

PART 3 - EXECUTION

3.1 GENERAL

A. All waterlines, services, and appurtenances shall be disinfected prior to pressure and leakage testing. Unless otherwise indicated, water for disinfecting and testing waterlines shall be furnished by the OWNER. The CONTRACTOR shall make all necessary provisions for conveying the water from the MPWMD-designated source to the points of use. The CONTRACTOR shall furnish all equipment and materials for disinfection and testing of waterlines and any treatment of flush waters and/or disinfection waters.

B. Disinfection shall be accomplished by chlorination. All disinfection and testing operations shall be performed in the presence of the MPWMD. All pressure waterlines, services, and appurtenances shall be disinfected and tested.

C. Disinfection operations shall be scheduled by the CONTRACTOR as late as possible during the contract time period so as to assure the maximum degree of sterility of the facilities at the time the WORK is accepted by the MPWMD.

3.2 DISINFECTING PIPELINES

A. **General:** All potable waterlines, services, and appurtenances shall be disinfected in accordance with the requirements of ANSI/AWWA C651. Prior to disinfecting, waterlines shall be flushed or blown out as appropriate.

B. **Chlorine-water solution method:** A chlorine-water solution shall be uniformly introduced into the waterline by means of a solution-feed chlorinating device. The chlorine solution shall be introduced at one end of the pipeline through a tap such that the concentration of free chlorine in the water entering the pipe is a minimum of 25 mg/l. Care shall be taken to prevent the strong chlorine solution in the waterline being disinfected from flowing back into the line supplying the water. The table below provides the quantity of chlorine required to produce 25 mg/L concentration in 100 feet of pipe – by diameter.

Pipe Diameter in	100 % Chlorine (Lb.)	1 % Chlorine Solution (Gal.)
4	.013	0.16
6	.030	0.36
12	.120	1.44
16	.217	2.60
30	.750	9.00

C. **Tablet Method:** The tablet method may be used only when all foreign materials have been kept out of the waterline during construction. If groundwater has entered the pipe during installation and tablets have been installed, CONTRACTOR shall flush main and use chlorine-water solution method. Do not use this method if the temperature is below 41 degrees Fahrenheit. Tablets shall be secured with non-toxic adhesive in each pipe length in top of pipe. The table below provides the number of 5-g hypochlorite tablets required for a minimum dose of 25 mg/L, based on 3.25g available chlorine per tablet.

Pipe Diameter	Length of pipe section				
	13 ft	18 ft	20 ft	30 ft	40 ft
6	1	1	1	2	2
12	3	4	4	6	7
16	4	6	7	10	13
30	19	24	25	36	44

D. **Disinfection:** Assure valves are closed on existing system to prevent chlorine solution flowing into water supply system. Chlorinated water shall be retained in the waterline long enough to destroy all non-spore-forming bacteria. This period shall be at least 24 hours. After the chlorine-treated water has been retained for the required time, the free chlorine residual at the waterline extremities and at other representative points shall be at least 10 mg/l. Should the chlorine level drop below 10 mg/l at the end of 24 hours, the waterline shall be flushed and the disinfection procedure repeated until 10 mg/l residual is achieved.

E. **Chlorinating Valves:** During the disinfection process of chlorinating the waterline, all valves, hydrants, and other appurtenances shall be operated while the pipeline is filled with the heavily-chlorinated water.

F. **Sampling Ports:** The CONTRACTOR shall provide sampling ports along the waterline as defined in AWWA C651.

G. **Preliminary Flushing:** Prior to chlorinating, waterlines shall be filled to eliminate air pockets and flushed to remove particulates.

H. **Final Flushing:** After disinfection is successfully completed, the heavily chlorinated water shall be flushed from the pipeline using fresh potable water until chlorine measurements show that the concentration in the water leaving the pipeline is no higher than 2 mg/l. The CONTRACTOR shall notify the MPWMD when final flushing will be required at least 48 hours in advance. The MPWMD will then send appropriate personnel to operate all valves and assist the CONTRACTOR with the final flushing. To prevent any damage to the environment, CONTRACTOR shall apply a reducing agent to the water to thoroughly neutralize the chlorine residual remaining in the water. Flush water and disinfection water shall be discharged to the percolation pit on site.

I. **Bacteriological Testing:** After final flushing and before the waterline is placed in service, two consecutive sets of samples, taken at least 24 hours apart shall be collected from the ends and intermediate points of the line. Samples shall be tested for bacteriological quality in accordance with the requirements of the State Department of Health Services. For this purpose, for the first set of samples, the pipe shall be re-filled with fresh potable water and left for a period of 24 hours before any sample is collected, for the second set of samples, wait at least 24 hours after the first set of samples were collected and tested before any sample is collected. CONTRACTOR shall contact the MPWMD a minimum of 3 working days prior to requested date of sampling. The MPWMD or its designee will collect samples and perform bacteriological tests. Should the initial disinfection treatment fail to produce satisfactory bacteriological test results, the disinfection procedure shall be repeated until acceptable results are obtained at no cost to the OWNER.

3.3 PRESSURE AND LEAKAGE TESTING OF WATERLINES

A. Prior to pressure and leakage testing, waterlines shall be flushed or blown out as appropriate. The CONTRACTOR shall test all waterlines either in sections or as a unit. Test sections shall not exceed 1000 feet in length. No section of waterline shall be tested until all field-placed concrete or mortar has attained an age of 14 days, or the waterline has been fully restrained

against thrust forces. The test shall be made by closing valves when available, or by placing temporary bulkheads in the pipe and filling the line slowly with water. The CONTRACTOR shall be responsible for ascertaining that all test bulkheads are suitably restrained to resist the thrust of the test pressure without damage to, or movement of, the adjacent pipe. Any unharnessed sleeve-type couplings, expansion joints, or other sliding joints shall be restrained or suitably anchored prior to the test, to avoid movement and damage to piping and equipment. The CONTRACTOR shall utilize waterline appurtenances or provide sufficient temporary air taps in the waterline to allow for evacuation of all entrapped air in each pipe segment to be tested. After completion of the tests, such taps shall be permanently plugged. Care shall be taken to see that all air vents are open during filling.

B. The waterline shall be filled at a rate which will not cause any surges or exceed the rate at which the air can be released through the air valves at a reasonable velocity and all the air within the pipeline shall be properly purged. For steel and ductile iron pipe, after the waterline has been filled, it shall be allowed to stand under a slight pressure for at least 24 hours to allow the mortar lining to absorb what water it will and to allow air to escape from any air pockets. During this period, bulkheads, valves, and connections shall be examined for leaks. If leaks are found, corrective measures shall be taken.

C. **Pressure Test:** The hydrostatic test shall consist of holding the test pressure (+/- 5 psi) on the waterline for a period of 2 hours. The test pressure shall be 200 psi at the low point of the section being tested. At the end of the pressure test period, the amount of water used to maintain the test pressure shall be determined.

D. **Leakage Test:** The leakage test shall be conducted concurrently with the pressure test. Leakage is defined as the quantity of water that must be supplied to a section of pipe to maintain the pressure within 5 psi of the specified test pressure after the pressure test has begun. The maximum allowable leakage shall be according to the following formula:

$$L = S \times D \times P^{1/2} / 133,200$$

where:

L = leakage (gallons per hour)

S = length (feet), the lessor of the actual length being tested or the maximum length for determining leakage. Maximum length for determining leakage is [2000 feet].

D = pipe diameter (inches)

P = test pressure (psi)

Pipe with welded joints shall have no leakage.

E. Waterlines, services, and appurtenances that fail to pass the prescribed pressure and leakage test shall be considered defective WORK. The CONTRACTOR shall determine the cause of the failure/leakage, repair the leaks, and shall retest the waterline.

3.4 CONNECTIONS TO EXISTING SYSTEM

A. Where connections are to be made to an existing potable water system, the interior surfaces of all pipe and fittings used in making the connections shall be swabbed or sprayed with a one percent hypochlorite solution before they are installed. Thorough flushing shall be started as soon as the connection is completed and shall be continued until discolored water is eliminated.

END OF SECTION

**SECTION 033000
CAST-IN-PLACE CONCRETE**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 SUBMITTALS

- A. General: Submit the following according to Conditions of the Contract and Division 1 Specifications Sections.
- B. Design Mixtures: For each concrete mixture.
- C. Laboratory test reports for concrete materials and mix design test.

1.4 QUALITY ASSURANCE

- A. Codes and Standards: Comply with provisions of the following codes, specifications, and standards, except where more stringent requirements are shown or specified:
 - 1. American Concrete Institute (ACI) 301, "Specifications for Structural Concrete for Buildings"
 - 2. ACI 318 "Building Code Requirements for Reinforced Concrete".
 - 3. Concrete Reinforcing Steel Institute (CRSI) "Manual of Standard Practice".
- B. Concrete Testing Service: Coordinate with Owner's qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
- C. Materials and installed work may require testing during progress of work. Testing to be paid for by the Owner except retesting of rejected materials for installed work shall be done at Contractor's expense.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615 Grade 60.

2.2 REINFORCEMENT ACCESSORIES

- A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete.

2.3 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 - 1. Portland Cement: ASTM C 150, Type II, gray. Supplement with the following:
 - a. Fly Ash: ASTM C 618, Class F.
- B. Normal-Weight Aggregates: ASTM C 33, coarse aggregate or better, graded. Provide aggregates from a single source.
 - 1. Maximum Coarse-Aggregate Size: 3/4 inch at footings, slabs on grade, nominal.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: potable.

2.4 ADMIXTURES

- A. General: Concrete admixtures that contain chloride are not permitted.
 - 1. Any admixture proposed by the contractor shall be subject to approval by the Architect, Engineer and Testing Lab.

2.5 RELATED MATERIALS

- A. Drainage Fill: Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D448; coarse-aggregate grading Size 57; with 100-percent passing a 1-1/2 inch sieve and 0 to 5 percent passing a No. 8 sieve.
- B. Curing Compounds: Any curing compound proposed by the Contractor shall be subject to approval by the Architect, Engineer and Testing Lab.

2.6 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Prepare design mixtures for each type and strength of concrete, by either laboratory trial batch or field experience (Method B) as specified in ACI 301. For the trial batch method, use an independent testing agency acceptable to the Architect for preparing and reporting proposed mix designs.
 - 1. Conform to requirements of CCR T24, 1905A.
- B. Submit written reports to Architect of each proposed mix for each class of concrete at least 15 days prior to start of Work. Do not begin concrete production until the Architect has reviewed proposed mix designs.
- C. Footings and Retaining Walls: Proportion normal-weight concrete mixture as follows:
 - 1. Minimum Compressive Strength: 3000 psi at 28 days.
 - 2. Maximum Water-Cementitious Materials Ratio: 0.50.
 - 3. Slump Limit: 4 inches.
- D. Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:
 - 1. Minimum Compressive Strength: 3000 psi at 28 days.
 - 2. Slump Limit: 4 inches.
 - 3. Maximum Water Cement Ratio: 0.50.
 - 4. Moisture Vapor Reduction Admixture: For mix designs ranging from 0.42 to 0.52 w/cm, dose at 14 ounces per 100 pounds of total cementitious materials. Remove an equal amount of water from the mix. Add separately from other admixtures at the tail end of the load. Mix designs below 0.42 and above 0.52 may require adjustment.

2.7 FABRICATING REINFORCEMENT

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

2.8 CONCRETE MIXING

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

PART 3 - EXECUTION

3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:

1. Class A, tolerances for concrete surfaces exposed to view.
 2. Class C, tolerances for other concrete surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for removal without damage to concrete surfaces.
- F. Clean forms and adjacent surfaces prior to placing concrete.
- 3.2 EMBEDDED ITEMS
- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete.
- 3.3 REMOVING FORMS
- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.
- 3.4 STEEL REINFORCEMENT
- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Minimum Concrete Coverage:
1. Formed Surfaces Below Grade: 2 inches
 2. Earth formed Surfaces: 3 inches
 3. Slab on Grade: Center in depth, unless noted otherwise
- 3.5 JOINTS
- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated or 64 square feet maximum. Construct contraction joints for a depth equal to at least one-third of concrete thickness as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.

3.6 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.
- C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
 1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
- D. Cold-Weather Placement: Comply with ACI 306.1.
- E. Hot-Weather Placement: Comply with ACI 301.

3.7 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

3.8 FINISHING FLOORS AND SLABS

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

3.9 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

- B. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
 - C. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 - d.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
- 3.10 JOINT FILLING
- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 - 1. Defer joint filling until concrete has aged at least one month. Do not fill joints until construction traffic has permanently ceased.
 - B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
 - C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.
- 3.11 DEFECTIVE CONCRETE
- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- 3.12 FIELD QUALITY CONTROL
- A. Testing and Inspecting: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

- B. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 2. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
 5. Compressive-Strength Tests: ASTM C 39; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
 - a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
 - b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
 6. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
 7. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
 8. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by Architect.
 9. Correct deficiencies in the Work that test reports and inspections indicate does not comply with the Contract Documents.

END OF SECTION 033000

SECTION 034000

PRESTRESSED HOLLOW CORE SLABS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This section includes the performance criteria, materials, production, and erection of prestressed, precast hollow core slabs. The work performed under this section includes all labor, material, equipment, related services, and supervision required for the manufacture and erection.

1.3 PERFORMANCE REQUIREMENTS

- A. Governing building code: **CBC 2016 Edition.**
- B. Structural Performance: Provide structural precast concrete units and connections capable of withstanding design loads within limits and under conditions indicated on drawings. Member deflections shall meet the limits of ACI 318.

1.4 SUBMITTALS

- A. Erection Drawings: Detail installation of structural precast concrete units. Indicate member locations, plans, elevations, dimensions, shapes, cross sections, openings, connections, and support conditions.
 - 1. Indicate welded connections by AWS standard symbols. Detail loose and cast-in hardware, connections, and joints.
 - 2. Indicate locations and details of anchorage devices to be embedded in or attached to structure or other construction.
 - 3. Indicate plans showing member locations with all openings larger than 10 in shown and located.
 - 4. Indicate location of each structural precast concrete unit by same identification mark placed on unit.
 - 5. Indicate relationship of structural precast concrete members to adjacent materials.
 - 6. Estimated cambers.
 - 7. Design Modifications:
 - a. If design modifications are necessary to meet the performance requirements and field conditions, notify the Architect immediately and submit design calculations and drawings. Do not adversely affect the appearance, durability or strength of units by modifying details or materials. Maintain the general design concept when altering size of members and alignment.
- B. Comprehensive engineering design signed and sealed by a professional engineer responsible for its preparation and registered in the state in which the project is located.

1.5 QUALITY ASSURANCE

A. Erector Qualifications: 5 years of experience in structural precast concrete work comparable to that shown and specified in not less than three projects of similar scope

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Store units with adequate dunnage and protect units to prevent contact with soil, staining, and to prevent cracking, distortion, warping or other physical damage.
- B. Store units, unless otherwise specified, with dunnage across full width of each bearing point.
- C. Place stored units so identification marks are clearly visible, and product can be inspected.
- D. Deliver all structural precast concrete units to the project site in such quantities and at such times to assure compliance with the schedule and proper setting sequence to ensure continuity of installation.
- E. Handle and transport units in a position consistent with their design in order to avoid excessive stresses which would cause cracking or damage.
- F. Lift and support units only at designated points shown on the Shop Drawings.
- G. Place dunnage of even thickness between each unit.

PART 2 – PRODUCTS

2.1 FABRICATORS

- A. See Drawings

2.2 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A 615, Grade 60 or Grade 40, deformed
- B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706, deformed.

2.3 PRESTRESSING TENDONS

- A. Prestressing Strand: ASTM A 416, Grade 250 or Grade 270, uncoated, 7-wire, low-relaxation strand.

2.4 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type I or III.
- B. Normal-Weight Aggregates: Except as modified by PCI MNL 116, ASTM C 33, with coarse aggregates.
- C. Water: Potable; free from deleterious material that may affect setting or strength of concrete

and complying with chemical limits of PCI MNL 116.

D. Admixtures containing calcium chloride, chloride ions or other salts are not permitted.

2.5 STEEL CONNECTION MATERIALS AND ACCESSORIES

- A. Carbon-Steel Shapes and Plates: ASTM A 36 except silicon (Si) content in the range of 0 to 0.03% or 0.15 to 0.25% for materials to be galvanized. Steel with chemistry conforming to the formula $Si + 2.5P \leq 0.09$ is also acceptable.
- B. Carbon-Steel Headed Studs: ASTM A 108, Grades 1010 through 1020, cold finished and bearing the minimum mechanical properties for studs as indicated under PCI MNL 116, Table 3.2.3.; AWS D1.1, Type A or B, with arc shields.
- C. Carbon-Steel Plate: ASTM A 283.
- D. High-Strength, Low-Alloy Structural Steel: ASTM A 572 except silicon (Si) content in the range of 0 to 0.03% or 0.15 to 0.25% for materials to be galvanized. Steel with chemistry conforming to the formula $Si + 2.5P \leq 0.09$ is also acceptable.
- E. Carbon-Steel Bolts and Studs: ASTM A 307, Grade A or C carbon-steel, hex-head bolts and studs; carbon-steel nuts (ASTM A 563, Grade A); and flat, unhardened steel washers (ASTM F 844).
- F. Welding Electrodes: Comply with AWS standards.

2.6 BEARING PADS

- A. High-Density Plastic: Multimonomer, nonleaching, plastic strip capable of supporting construction loads with no visible overall expansion.
- B. Hardboard: Tempered hardboard strips, smooth on both sides.

2.7 GROUT MATERIALS

- A. Sand-Cement Grout: Portland cement, ASTM C 150, Type I, and clean, natural sand, ASTM C 144, or ASTM C 404. Mix at ratio of 1 part cement to 3 parts sand, by volume, with minimum water required for placement and hydration.

2.8 CONCRETE MIXES

- A. Design mixes may be prepared by a qualified independent testing agency or by qualified precast plant personnel at structural precast concrete fabricator's option.
- B. Limit water-soluble chloride ions to the maximum percentage by weight of cement permitted by ACI 318 or PCI MNL 116 when tested in accordance with ASTM C 1218.
- C. Proportion mixes by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:

1. Compressive Strength (28 Days): minimum 4000 psi.
2. Release Strength: as required by design

2.9 FABRICATION

- A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement. Do not relocate bearing plates in units unless approved by Architect.
 1. Weld headed studs and deformed bar anchors used for anchorage according to AWS D1.1 and AWS C5.4, "Recommended Practices for Stud Welding."
- B. Furnish loose steel plates, clip angles, anchors, dowels, hangers, and other hardware shapes for securing precast concrete units to supporting and adjacent construction.
- C. Cast-in slots, holes, and other accessories in structural precast concrete units as indicated on contract drawings.
- D. Reinforcement: Comply with recommendations in PCI MNL 116 for fabrication, placing, and supporting reinforcement.
 1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete.
 2. Accurately position, support, and secure reinforcement against displacement during concrete-placement and consolidation operations.
 3. Place reinforcing steel and prestressing steel to maintain a minimum 3/4 -inch concrete cover. Increase cover requirements in accordance with ACI 318 when units are exposed to corrosive environment or severe exposure conditions.
- E. Reinforce structural precast concrete units to resist handling, transportation, and erection stresses.
 1. Delay detensioning of precast prestressed concrete units until concrete has reached its indicated minimum design release compressive strength as established by test cylinders cured under the same conditions as concrete member.
 2. Detension pretensioned tendons either by gradually releasing tensioning jacks or by heat-cutting tendons, using a sequence and pattern to prevent shock or unbalanced loading.
- F. Mix concrete according to PCI MNL 116 and requirements in this Section. After concrete batching, no additional water may be added.

2.10 FABRICATION TOLERANCES

- A. Fabricate structural precast concrete units straight and true to size and shape with exposed edges and corners precise and true so each finished unit complies with PCI MNL 116 or PCI MNL 135 product tolerances as well as position tolerances for cast-in items.

2.11 SOURCE QUALITY CONTROL

- A. Quality-Control Testing: Test and inspect precast concrete according to PCI MNL 116 requirements.
- B. Precast concrete units will be considered deficient if units fail to comply with ACI 318 strength requirements.
- C. Defective Work: Structural precast concrete units that do not comply with acceptability requirements in PCI MNL 116, including concrete strength and manufacturing tolerances, are unacceptable. Chipped, spalled or cracked units may be repaired. Replace unacceptable units with precast concrete units that comply with requirements.

PART 3 – EXECUTION

3.1 PREPARATION

- A. Deliver anchorage devices that are embedded in or attached to the building structural frame or foundation before start of such work. Provide locations, setting diagrams, and templates for the proper installation of each anchorage device.

3.2 EXAMINATION

- A. Examine supporting structure or foundation and conditions for compliance with requirements for installation tolerances, true and level bearing surfaces, and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 ERECTION

- A. Install loose clips, hangers, bearing pads, and other accessories required for connecting structural precast concrete units to supporting members and backup materials.
- B. Erect precast concrete level, and square within the specified allowable tolerances.
 - 1. Maintain joint alignment and uniform joint width as erection progresses.
 - 2. Provide and install headers of structural-steel shapes for openings larger than one slab width according to hollow-core slab unit fabricator's written recommendations.
- C. Connect structural precast concrete units in position by bolting, welding, grouting, or as otherwise indicated on approved Erection Drawings.
- D. Welding: Comply with applicable AWS D1.1 and AWS D1.4 requirements for welding, welding electrodes, appearance, quality of welds, and methods used in correcting welding work.
 - 1. Protect structural precast concrete units and bearing pads from damage by field welding or cutting operations and provide noncombustible shields as required.
 - 2. Visually inspect all welds critical to precast connections. Visually check all welds for completion and remove, reweld or repair all defective welds, if services of AWS-certified

welding inspector are not furnished by Owner.

- E. At bolted connections, use lock washers or other acceptable means to prevent loosening of nuts after final adjustment.
 - 1. Where slotted connections are used, check bolt position and tightness. For sliding connections, properly secure bolt but allow bolt to move within connection slot. For friction connection apply specified bolt torque and check 25 percent of bolts at random by calibrated torque wrench.
- F. Grout open spaces at keyways, and joints where required or indicated. Fill joints completely without seepage to other surfaces. Promptly remove grout material from exposed surfaces before it affects finishes or hardens.
- G. Field cutting of precast units is not permitted without approval of the Engineer.
- H. Fasteners: Do not use drilled or powder-actuated fasteners for attaching accessory items to precast, prestressed concrete units unless approved by Engineer.

3.4 ERECTION TOLERANCES

- A. Erect structural precast concrete units level, square, true, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 135. Level out variations between adjacent members by jacking, loading, or any other feasible method as recommended by the manufacturer and acceptable to the Architect.

3.5 FIELD QUALITY CONTROL

- D. Repair or remove and replace work that does not comply with specified requirements.

END OF SECTION 034000

**SECTION 042000
UNIT MASONRY**

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concrete masonry units.

1.2 SUBMITTALS

A. Product Data: For each type of product.

B. Material Certificates: For each type and size of product.

C. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91/C 91M for air content.
2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

1.3 FIELD CONDITIONS

A. Cold-Weather Requirements: Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

B. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 - PRODUCTS

2.1 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6.

2.2 CONCRETE MASONRY UNITS

A. CMUs: ASTM C 90.

1. Minimum Unit Compressive Strength: 3,000 p.s.i.

2.3 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C 150/C 150M, 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.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- D. Masonry Cement: ASTM C 91/C 91M.
- E. Aggregate for Mortar: ASTM C 144.
 - 1. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
 - 2. White-Mortar Aggregates: Natural white sand or crushed white stone.
 - 3. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.
- F. Aggregate for Grout: ASTM C 404.
- G. Water: Potable.

2.4 REINFORCEMENT

- A. Uncoated-Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.

2.5 MORTAR AND GROUT MIXES

- A. 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.
- B. Mortar for Unit Masonry: Comply with ASTM C 270.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

3.2 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in plan, cross section or elevation, do not vary by more than plus or minus 1/4 inch.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch.

3.3 LAYING MASONRY WALLS

- #### A.
- Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

- #### B.
- Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

3.4 MORTAR BEDDING AND JOINTING

A. Bed as follows:

1. Bed face shells in mortar and make head joints of depth equal to bed joints.

3.5 REINFORCED UNIT MASONRY INSTALLATION

- #### A.
- Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.

- #### B.
- Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Limit height of vertical grout pours to not more than 60 inches.

3.6 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. Clay Masonry Unit Test: For each type of unit provided, according to ASTM C 67 for compressive strength.
- C. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.
- D. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.
- E. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780.
- F. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

3.7 REPAIRING AND CLEANING

- A. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry.

END OF SECTION 042000

SECTION 051200
STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Structural steel.
 - 2. Grout.

1.2 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show fabrication of structural-steel components.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.
- B. Welding certificates.
- C. Mill test reports for structural steel, including chemical and physical properties.
- D. Source quality-control reports.
- E. Field quality-control and special inspection reports.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD, or is accredited by the IAS Fabricator Inspection Program for Structural Steel (AC 172).
- B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator to withstand loads indicated and comply with other information and restrictions indicated.
1. Select and complete connections using schematic details indicated and AISC 360.

2.2 STRUCTURAL-STEEL MATERIALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 20 percent.
- B. W-Shapes: ASTM A 572/A 572M, Grade 50 (345).
- C. Plate and Bar: ASTM A 36/A 36M
- D. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, (ASTM A 563M, Class 8S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers; all with plain finish.
1. Direct-Tension Indicators: ASTM F 959, Type 325 (ASTM F 959M, Type 8.8), compressible-washer type with plain finish.
- B. High-Strength Bolts, Nuts, and Washers: ASTM A 490 (ASTM A 490M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade DH, (ASTM A 563M, Class 10S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers with plain finish.
1. Direct-Tension Indicators: ASTM F 959, Type 490 (ASTM F 959M, Type 10.9), compressible-washer type with plain finish.
- C. Zinc-Coated High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade DH (ASTM A 563M, Class 10S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers.
1. Finish: Hot-dip zinc coating.

- D. Unheaded Anchor Rods: ASTM F 1554, Grade 36
 - 1. Configuration: Hooked.
 - 2. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C at exterior conditions.
 - E. Threaded Rods: ASTM A 36/A 36M
 - 1. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C at exterior conditions.
- 2.4 PRIMER
- A. Primer: Comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
 - B. Primer: SSPC-Paint 25, Type II, zinc oxide, alkyd, linseed oil primer.
 - C. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.
- 2.5 GROUT
- A. Metallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.
 - B. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.
- 2.6 FABRICATION
- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," and to AISC 360.
 - B. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.
- 2.7 SHOP CONNECTIONS
- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened
 - B. Weld Connections: Comply with AWS D1.1/D1.1M[for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

2.8 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
 - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
 - 2. Surfaces to be field welded.
 - 3. Surfaces of high-strength bolted, slip-critical connections.
 - 4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
 - 5. Galvanized surfaces.
 - 6. Surfaces enclosed in interior construction.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
 - 1. SSPC-SP 2, "Hand Tool Cleaning."
 - 2. SSPC-SP 3, "Power Tool Cleaning."
 - 3. SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

2.9 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.
 - 1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. Bolted Connections: Inspect[shop-bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- C. Welded Connections: Visually inspect shop-welded connections according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - 1. Liquid Penetrant Inspection: ASTM E 165.
 - 2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - 3. Ultrasonic Inspection: ASTM E 164.
 - 4. Radiographic Inspection: ASTM E 94.
- D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
- B. Baseplates Bearing Plates and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Weld plate washers to top of baseplate.
 - 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 - 4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- C. Maintain erection tolerances of structural steel within AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

3.3 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened
- B. Weld Connections: Comply with AWS D1.1/D1.1M[for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
 - 2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.
 - 3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," for mill material.

3.4 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
 - 1. Verify structural-steel materials and inspect steel frame joint details.
 - 2. Verify weld materials and inspect welds.
 - 3. Verify connection materials and inspect high-strength bolted connections.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- C. Bolted Connections: Inspect bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- D. Welded Connections: Visually inspect field welds according to AWS D1.1/D1.1M.
 - 1. In addition to visual inspection, test and inspect field welds according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E 165.
 - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - c. Ultrasonic Inspection: ASTM E 164.
 - d. Radiographic Inspection: ASTM E 94.

END OF SECTION 051200

SECTION 055133

ALTERNATING TREAD STAIRS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Aluminum Alternating Tread Stairs.

1.2 REFERENCES

- A. OSHA 1910.25: Stairways.

1.3 SUBMITTALS

- A. Submit under provisions of Section 013300.
- B. Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
- C. Shop Drawings for Stairs:
 - 1. Plan and section of stair installation based on field measurements.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store stair until installation inside under cover. If stored outside, under a tarp or suitable cover.

1.5 WARRANTY

- A. Limited Warranty: Five years against defective material and workmanship, covering parts only, no labor or freight. Defective parts, if deemed so by the manufacturer, will be replaced at no charge, freight excluded, upon inspection at manufacturer's plant which warrants same.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Precision Ladders, LLC, which is located at: P. O. Box 2279; Morristown, TN 37816-2279; Toll Free Tel: 800-225-7814; Tel: 423-586-2265; Fax: 423-586-2091; Web: www.PrecisionLadders.com
- B. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.

2.2 ALUMINUM ALTERNATING TREAD STAIR

- A. Aluminum Alternating Tread Stair and Components: Stair, mounting brackets and handrails on both sides.
 - 1. Aluminum Alternating Tread Stair as manufactured by Precision Ladders, LLC.
 - 2. Capacity: Unit shall support a 1,000 lb (227 kg) total load without failure.
 - 3. Degree of Incline: 56 degrees.
 - 4. Performance Standard: Units designed and manufactured to meet or exceed OSHA 1910.25.
- B. Components:
 - 1. Stair Side Stringers: 3 inch by 2 inch by 1/8 inch (76 mm by 51 mm by 3 mm) extruded 6005-T5 aluminum tubing. Pitch: 56 or 68 degrees.
 - 2. Stair Center Stringer: 10 inch by 1/4 inch (254 mm by 6 mm) extruded 6005-T5 aluminum flat bar. Note: Neoprene trim adhered to front edge of center stringer to protect climber.
 - 3. Stair Treads: 1 inch aluminum Bar Grating, 9 13/16" (249 mm) deep by 9 7/8" (250 mm) wide on hatch-access models (11 7/8" (302 mm) wide on Walk-thru models).
 - 4. Stair Mounting Brackets: 6 inch by 1/4 inch (153 mm by 6 mm) aluminum flat bar
 - 5. Handrails: 1-1/4 inches (32 mm) Schedule 40, 6005-T5 aluminum pipe provided with internal aluminum fittings.
 - 6. Finishes:

- a. Finish: Clear Anodized
- 2.3 FABRICATION
 - A. Completely fabricate stair ready for installation before shipment to the site.

PART 3 EXECUTION

- 3.1 EXAMINATION
 - A. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
 - B. Examine materials upon arrival at site. Notify the carrier and manufacturer of any damage.
- 3.2 INSTALLATION
 - A. Install in accordance with approved submittals.
- 3.3 PROTECTION
 - A. Protect installed products until completion of project.
 - B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 055213

METAL PIPE RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Steel pipe railings.
- B. Related Sections:
 - 1. Section 061000 "Rough Carpentry" for wood blocking for anchoring railings.

1.3 PERFORMANCE REQUIREMENTS

- A. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
 - 1. Steel: 72 percent of minimum yield strength.
- B. Structural Performance: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Handrails:
 - a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
 - b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
- D. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Manufacturer's product lines of mechanically connected railings.

2. Railing brackets.

- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of railing from single source from single manufacturer.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.6 PROJECT CONDITIONS

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

1.7 COORDINATION AND SCHEDULING

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

2.2 STEEL AND IRON

- A. Tubing: ASTM A 500 (cold formed) or ASTM A 513.
- B. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
 - 1. Provide galvanized finish for exterior installations and where indicated.
- C. Plates, Shapes, and Bars: ASTM A 36/A 36M.

2.3 FASTENERS

- A. General: Provide the following:
 - 1. Hot-Dip Galvanized Railings with painted finish: Type 304 stainless-steel or hot-dip zinc-coated steel fasteners complying with ASTM A 153/A 153M or ASTM F 2329 for zinc coating.
- B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated.
- C. Fasteners for Interconnecting Railing Components:
 - 1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.

2.4 MISCELLANEOUS MATERIALS

- A. Etching Cleaner for Galvanized Metal: Complying with MPI#25.
- B. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting,"
- C. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
 - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- D. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
- E. Shop Primer for Galvanized Steel: Water based galvanized metal primer complying with MPI#134.
- F. Epoxy Intermediate Coat: Complying with MPI #77 and compatible with primer and topcoat.
- G. Polyurethane Topcoat: Complying with MPI #72 and compatible with undercoat.

2.5 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage.
- B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate railings with welded connections unless otherwise indicated.
- H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove flux immediately.
 - 4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.
- I. Form changes in direction as follows:
 - 1. As detailed.
 - 2. By bending or by inserting prefabricated elbow fittings.
- J. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- K. Close exposed ends of railing members with prefabricated end fittings.
- L. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.
- M. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
 - 1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers, or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

- N. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.
- 2.6 FINISHES, GENERAL
- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
 - C. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.
- 2.7 STEEL AND IRON FINISHES
- A. Galvanized Railings:
 - 1. Hot-dip galvanize exterior steel and iron railings, including hardware, after fabrication.
 - 2. Comply with ASTM A 123/A 123M for hot-dip galvanized railings.
 - 3. Comply with ASTM A 153/A 153M for hot-dip galvanized hardware.
 - 4. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
 - B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.
 - C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.
 - D. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.
 - E. Shop-Painted Finish: Safety Yellow Industrial Enamel Finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.

- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
 - 1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 - 2. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
 - 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (5 mm in 3 m).
- C. Corrosion Protection: Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- D. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

- A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

3.4 ATTACHING RAILINGS

- 1. See Drawings

3.5 ADJUSTING AND CLEANING

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

3.6 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION 055213

SECTION 061000
ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Framing with dimension lumber.

1.3 DEFINITIONS

- A. Rough Carpentry: Carpentry work not specified in other Sections and not exposed, unless otherwise indicated.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of lumber grading agencies certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWPAC2, except that lumber that is not in contact with the ground and is continuously protected from liquid water may be treated according to AWPAC31 with inorganic boron (SBX).

2.3 DIMENSION LUMBER FRAMING

- A. General: Provide dimension lumber of grades indicated according to the American Lumber Standards Committee National Grading rule provisions of the grading agency indicated.
- B. Species and Grade: Douglas fir-larch, Douglas, No. 1 Grade unless noted otherwise: WCLIB.

- C. Maximum Moisture Content: 19 percent at the time of delivery to the job site.

2.4 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. Cants.
 - 4. Furring.
 - 5. Grounds.
- B. For items of dimension lumber size, provide Douglas Fir No. 1 grade lumber with 19 percent maximum moisture content.

2.5 PLYWOOD BACKING PANELS

- A. DOC PS 1, Exposure 1, C-D Plugged, in thickness indicated or, if not indicated, not less than 5/8-inch nominal thickness.

2.6 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 lumber, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Lag Bolts: ASME B18.2.1.
- F. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 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 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
 - 1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.

2.7 METAL FRAMING ANCHORS

- A. General: Provide framing anchors made from metal indicated, of structural capacity, type, and size indicated, and as follows:
 - 1. Research/Evaluation Reports: Provide products acceptable to authorities having jurisdiction and for which model code research/evaluation reports exist that show compliance of metal framing anchors, for application indicated, with building code in effect for Project.
- B. Galvanized Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653, G60 (Z180) coating designation.

2.8 MISCELLANEOUS MATERIALS

- A. Building Paper: Asphalt-saturated organic felt complying with ASTM D 226, Type I (No. 15 asphalt felt), unperforated.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted.
- B. Framing Standard: Comply with AF&PA's "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- C. Metal Framing Anchors: Install metal framing to comply with manufacturer's written instructions.
- D. Do not splice structural members between supports, unless otherwise indicated.
- E. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated.

3.2 WOOD GROUND, BLOCKING, AND NAILER INSTALLATION

- A. Install where required for attaching other 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.

3.3 WOOD FURRING INSTALLATION

- A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.

END OF SECTION 061000

SECTION 061600 SHEATHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Wall sheathing.
- B. Related Sections include the following:
 - 1. Division 06 Section "Rough Carpentry" for plywood backing panels.

1.3 SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
 - 1. For building wrap, include data on air-/moisture-infiltration protection based on testing according to referenced standards.
- B. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project: C.B.C. 2007 & NDS 2005.
 - 1. Building wrap.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Stack plywood and other panels flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PANEL PRODUCTS, GENERAL

- A. Plywood: Either DOC PS 1 or DOC PS 2, unless otherwise indicated.
- B. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.
- C. Factory mark panels to indicate compliance with applicable standard.

2.2 WALL SHEATHING

A. Plywood Wall Sheathing: Exterior, Structural I sheathing.

1. Span Rating: Not less than 32/16.
2. Nominal Thickness: Not less than 1/2 inch (13 mm).

2.3 ROOF SHEATHING

A. Plywood Roof Sheathing: Exposure 1, Structural I sheathing.

1. Span Rating: Not less than 48/24.
2. Nominal Thickness: As indicated on drawings.

2.4 FASTENERS

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

1. For roof and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M & ASTM B695.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: NES NER-272.

D. Wood Screws: ASME B18.6.1.

2.5 WEATHER-RESISTANT SHEATHING PAPER

A. Building Paper: UBC Standard 14-1, Grade D (water-vapor-permeable, kraft building paper), except that water resistance shall be not less than 1 hour and water-vapor transmission shall be not less than 75 g/sq. m x 24 h.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Chemical Company (The); Styrofoam Weathermate Plus Brand Housewrap.
 - b. DuPont (E. I. du Pont de Nemours and Company); Tyvek CommercialWrap.
 - c. Ludlow Coated Products; Barricade Building Wrap.
 - d. Raven Industries Inc.; Rufco-Wrap.
 - e. Reemay, Inc.; Typar HouseWrap.
3. Water-Vapor Permeance: Not less than 152 g through 1 sq. m of surface in 24 hours per ASTM E 96, Desiccant Method (Procedure A).
4. Allowable UV Exposure Time: Not less than three months.

B. Building-Wrap Tape: Pressure-sensitive plastic tape recommended by building-wrap manufacturer for sealing joints and penetrations in building wrap.

2.6 MISCELLANEOUS MATERIALS

- A. Adhesives for Field Gluing Panels to Framing: Formulation complying with APA AFG-01 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.
- B. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.030 inch (0.8 mm).
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Carlisle Coatings & Waterproofing; CCW-705-TWF Thru-Wall Flashing.
 - b. Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Vycor Plus Self-Adhered Flashing Vycor V40 Weather Barrier Strips.
 - c. MFM Building Products Corp.; Window Wrap.
 - d. Polyguard Products, Inc.; Polyguard 300.
- C. Primer for Flexible Flashing: Product recommended by manufacturer of flexible flashing for substrate.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction, unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
 - 1. NES NER-272 for power-driven fasteners.
 - 2. Table 23A-II-B-1, "Nailing Schedule," and Table 23A-II-B-2, "Wood Structural Panel Roof Sheathing Nailing Schedule," in "California Building Code, 2001 Edition, Title 24."
- D. Use common wire 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. Install fasteners without splitting wood.
- E. Coordinate wall and roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
- G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 WOOD STRUCTURAL PANEL INSTALLATION

- A. General: Comply with applicable recommendations in APA Form No. E30S, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.
- B. Fastening Methods: Fasten panels as indicated below:
 - 1. Wall and Roof Sheathing:
 - a. Nail to wood framing.
 - b. Space panels 1/8 inch (3 mm) apart at edges and ends.

3.3 WEATHER-RESISTANT SHEATHING-PAPER INSTALLATION

- A. General: Cover sheathing with weather-resistant sheathing paper as follows:
 - 1. Cut back barrier 1/2 inch (13 mm) on each side of the break in supporting members at expansion- or control-joint locations.
 - 2. Apply barrier to cover vertical flashing with a minimum 4-inch (100-mm) overlap, unless otherwise indicated.
- B. Building Paper: Apply horizontally with a 2-inch (50-mm) overlap and a 6-inch (150-mm) end lap; fasten to sheathing with galvanized staples or roofing nails.

3.4 FLEXIBLE FLASHING INSTALLATION

- A. Apply flexible flashing where indicated to comply with manufacturers written instructions.
 - 1. Prime substrates as recommended by flashing manufacturer.
 - 2. Lap seams and junctures with other materials at least 4 inches (100 mm), except that at flashing flanges of other construction, laps need not exceed flange width.
 - 3. Lap flashing over weather-resistant building paper at bottom and sides of openings.
 - 4. Lap weather-resistant building paper over flashing at heads of openings.
 - 5. After flashing has been applied, roll surfaces with a hard rubber or metal roller to ensure that flashing is completely adhered to substrates.

END OF SECTION 061600

SECTION 066100

FRP MOLDED GRATING SUBFLOOR SYSTEMS

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The CONTRACTOR shall furnish, fabricate (where necessary), and install all fiberglass reinforced plastic (FRP) items, with all appurtenances, accessories and incidentals necessary to produce a complete, operable and serviceable installation as shown on the Contract Drawings and as specified herein, and in accordance with the requirements of the Contract Documents. Fiberglass grating subfloor shall be provided for the Hypochlorite Storage & Dispensing room (Chem Room 101) and for the Orthophosphate Storage and Dispensing Room (Chem Room 102). Grating shall not be required for Chem Room 103, except for a grating cover for the waste sump in the lower double containment area.

1.2 REFERENCES

- A. The publications listed below (latest revision applicable) form a part of this specification to the extent referenced herein. The publications are referred to within the text by the designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) Test Methods:

ASTM D 635 Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position

ASTM E 84 Surface Burning Characteristics of Building Materials

NSF/ANSI STANDARD 61

1.3 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall furnish shop drawings of all fabricated gratings and accessories in accordance with the provisions of this Section.
- B. The CONTRACTOR shall furnish manufacturer's shop drawings clearly showing material sizes, types, styles, part or catalog numbers, complete details for the fabrication and erection of components including, but not limited to, location, lengths, type and sizes of fasteners, clip angles, member sizes, pedestal supports, and connection details.
- C. The CONTRACTOR shall submit the manufacturer's published literature including structural design data, structural properties data, grating load/deflection tables, corrosion resistance tables, certificates of compliance, test reports as applicable, concrete anchor systems and their allowable load tables, and design calculations for systems not sized or designed in the contract documents.
- D. The CONTRACTOR may be requested to submit sample pieces of each item specified herein

for acceptance by the ENGINEER as to quality and color. Sample pieces shall be manufactured by the method to be used in the WORK.

1.4 QUALITY ASSURANCE

- A. All items to be provided under this Section shall be furnished only by manufacturers having a minimum of ten (10) years experience in the design and manufacture of similar products and systems. Additionally, if requested, a record of at least five (5) previous, separate, similar successful installations in the last five (5) years shall be provided.
- B. Manufacturer shall offer a 3 year limited warranty on all FRP products against defects in materials and workmanship.
- C. Manufacturer shall be certified to the ISO 9001-2008 standard.
- D. Manufacturer shall provide proof of certification from at least two other quality assurance programs for its facilities or products (DNV, ABS, USCG, AARR).
- E. Manufacturer shall provide proof, via independent testing, that materials proposed as a solution do not contain heavy metals in amounts greater than that allowed by current EPA requirements.

1.5 PRODUCT DELIVERY AND STORAGE

- A. Delivery of Materials: Manufactured materials shall be delivered in original, unbroken pallets, packages, containers, or bundles bearing the label of the manufacturer. Adhesives, resins and their catalysts and hardeners shall be crated or boxed separately and noted as such to facilitate their movement to a dry indoor storage facility.
- B. Storage of Products: All materials shall be carefully handled to prevent them from abrasion, cracking, chipping, twisting, other deformations, and other types of damage. Adhesives, resins and their catalysts are to be stored in dry indoor storage facilities between 70 and 85 degrees Fahrenheit (21 to 29 degrees Celsius) until they are required.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Molded gratings shall be Fibergrate® as manufactured by

Fibergrate Composite Structures Inc.

5151 Belt Line Road, Suite 1212
Dallas, Texas 75254-7028 USA
(800) 527-4043 Phone (972) 250-1530 Fax

Website: www.fibergrate.com

E-mail: info@fibergrate.com

2.2 GENERAL

- A. All FRP items furnished under this Section shall be composed of fiberglass reinforcement and resin in qualities, quantities, properties, arrangements and dimensions as necessary to meet the design requirements and dimensions as specified in the Contract Documents.
- B. Fiberglass reinforcement shall be continuous roving in sufficient quantities as needed by the application and/or physical properties required.
- C. Resin shall be Vinyl Ester, with chemical formulations as necessary to provide the corrosion resistance, strength and other physical properties as required.
- D. All finished surfaces of FRP items and fabrications shall be smooth, resin-rich, free of voids and without dry spots, cracks, crazes or unreinforced areas. All glass fibers shall be well covered with resin to protect against their exposure due to wear or weathering.
- E. All fire-retardant molded grating products shall have a tested flame spread rating of 25 or less per ASTM E-84 Tunnel Test. Gratings shall not burn past the 25 mm reference mark and will be classified HB per ASTM D635.
- F. All mechanical grating clips and grating pedestal anchor bolts shall be manufactured of Type 316SS (stainless steel).

2.3 MOLDED FRP GRATING

- A. Manufacture: Grating shall be of a one piece molded construction with tops and bottoms of bearing bars and cross bars in the same plane. Grating shall have (a square mesh pattern providing bidirectional strength. Grating shall be reinforced with continuous rovings of equal number of layers in each direction. The top layer of reinforcement shall be no more than 1/8" below the top surface of the grating so as to provide maximum stiffness and prevent resin chipping of unreinforced surfaces. Percentage of glass (by weight) shall not exceed 35% so as to achieve maximum corrosion resistance, and as required to maintain the structural requirements of the CONTRACT.

After molding, no dry glass fibers shall be visible on any surface of bearing bars or cross bars. All bars shall be smooth and uniform with no evidence of fiber orientation irregularities, interlaminar voids, porosity, resin rich or resin starved areas.

- B. Non-slip surface: Grating shall be manufactured with an integrally applied grit to the top surface of each bar providing maximum slip resistance.
- C. Grating bar intersections are to be filleted to a minimum radius of 1/16" to eliminate local stress concentrations and the possibility of resin cracking at these locations.
- D. Fire rating: Grating shall be fire retardant with a tested flame spread rating of 25 or less when tested in accordance with ASTM E 84. Data performed only on the resin shall not be acceptable.
- E. Resin system: The resin system used in the manufacture of the grating shall be Vi-Corr®; grating supplier shall provide documentation demonstrating that the grating and pedestal products are compatible with 12.5% Sodium Hypochlorite and 29% Orthophosphate (Phosphoric Acid) solutions (certifications shall be for occasional/spill environment applications, not continual contact or continuous submergence conditions).

- F. Manufacturer may be required to submit corrosion data from tests performed on actual grating products in standard chemical environments. Corrosion resistance data of the base resin from the manufacturer is not a true indicator of grating product corrosion resistance and shall not be accepted.
- G. Color: Chem Room 101 (Hypochlorite) grating shall be green; Chem Room 102 (Orthophosphate) grating shall be Orange.
- H. G. Depth: 1-1/2" with a tolerance of plus or minus 1/16".
- I. H. Mesh Configuration: 1-1/2" x 1-1/2" with a tolerance of plus or minus 1/16" mesh centerline to centerline.
- J. Load/Deflection: Grating design loads shall be less than manufacturers published maximum recommended loads. Maximum recommended loads shall be determined by acoustic emission testing. Grating shall be designed for a uniform load of 100 psf or concentrated load of 300 lb. Deflection is not to exceed 0.375" or $L/D = 120$, whichever is less.
- K. The manufacturer shall certify that the stiffness of all panels manufactured are never more than 2.5% below the published load-deflection values.
- L. Substitutions: Other products of equal strength, stiffness, corrosion resistance and overall quality may be submitted with the proper supporting data to the engineer for approval.

2.4 GRATING FABRICATION

- A. Measurements: Grating supplied shall meet the dimensional requirements and tolerances as shown or specified. The Contractor shall provide and/or verify measurements in field for work fabricated to fit field conditions as required by grating manufacturer to complete the work. When field dimensions are not required, contractor shall determine correct size and locations of required holes or cutouts from field dimensions before grating fabrication. Note that removable panels of 12" x 12" up to 36" x 36" are required for regular operations; all removable panel cutouts shall be bordered with 4-post pedestal heads for ease of removal and replacement.
- B. Layout: Each grating section shall be readily removable, except where indicated on drawings. Manufacturer to provide openings and holes where located on the contract drawings. Grating openings which fit around protrusions (pipes, cables, machinery, etc.) shall be discontinuous at approximately the centerline of opening so each section of grating is readily removable.
- C. Sealing: All shop fabricated grating cuts shall be coated with vinyl ester resin to provide maximum corrosion resistance. All field fabricated grating cuts shall be coated similarly by the contractor in accordance with the manufacturer's instructions.
- D. Hardware: Type 316 stainless steel hold-down clips shall be provided and spaced at maximum of four feet apart with a minimum of four per piece of grating, or as recommended by the manufacturer. Pedestal supports shall be anchored to the concrete floor with 316 SS anchor bolts.

2.5 GRATING PEDESTALS and GRATING EDGE SUPPORT

- A. Pedestals shall be provided for support of the grating subfloor, consisting of a pedestal base,

adjustable rider, and pedestal head. Pedestals shall have similar chemical resistance and load properties to create a complete subfloor system. Pedestal heads shall include single post heads for intermediate pedestal support and 4-post heads for locations where removable panels and/or panel section joints occur. Grating subfloor shall be approximately 15" above the concrete floor.

- B. The grating subfloor shall be enclosed and surrounded at the Chem Room walls with 3" Fiberglass angle bracket structural shapes continuously around the grating perimeter. Angle structures shall be anchored to the concrete room sidewall with 316 SS anchor bolts and hardware.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Shop inspection is authorized as required by the Owner and shall be at Owner's expense. The fabricator shall give ample notice to Contractor prior to the beginning of any fabrication work so that inspection may be provided. The grating shall be as free, as commercially possible, from visual defects such as foreign inclusions, delamination, blisters, resin burns, air bubbles and pits. The surface shall have a smooth finish (except for grit top surfaces).

3.2 INSTALLATION

- A. Contractor shall install gratings, pedestals, and edge support angle structural shapes in accordance with manufacturer's assembly drawings. Fasten grating panels securely in place with hold-down fasteners as specified herein. Field cut and drill fiberglass reinforced plastic products with carbide or diamond tipped bits and blades. Seal cut or drilled surfaces in accordance with manufacturer's instructions. Follow manufacturer's instructions when cutting or drilling fiberglass products or using resin products; provide adequate ventilation.

END OF SECTION 066100

SECTION 072413

EXTERIOR INSULATION AND FINISH SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. EIFS-clad barrier-wall assemblies that are field applied over substrate.

1.2 DEFINITIONS

- A. Definitions in ASTM E 2110 apply to Work of this Section.
- B. EIFS: Exterior insulation and finish system(s).
- C. Polymer-Based Exterior Insulation and Finish System: Class PB EIFS, as defined in ASTM E 2568.

1.3 QUALITY ASSURANCE

- A. Mockups: Build mockups to demonstrate aesthetic effects, to set quality standards for materials and execution, and to set quality standards for fabrication and installation.

1.4 FIELD CONDITIONS

- A. Weather Limitations: Maintain ambient temperatures above 40 deg F (4.4 deg C) for a minimum of 24 hours before, during, and after adhesives or coatings are applied. Do not apply EIFS adhesives or coatings during rainfall. Proceed with installation only when existing and forecasted weather conditions and ambient outdoor air, humidity, and substrate temperatures permit EIFS to be applied, dried, and cured according to manufacturers' written instructions and warranty requirements.

PART 2 - PRODUCTS

- A. Obtain EIFS patching materials from sources approved by an EIFS manufacturer as tested and compatible with EIFS components.

2.2 PERFORMANCE REQUIREMENTS

- A. EIFS Patching Performance: Comply with ASTM E 2568[**and ICC-ES AC219**] and with the following:
 - 1. Weathertightness: Resistant to water penetration from exterior.
- B. Flexible-Membrane Flashing: Cold-applied, self-adhering, self-healing, rubberized-asphalt and polyethylene-film composite sheet or tape and primer; EIFS manufacturer's standard or product recommended in writing by EIFS manufacturer.
- C. Molded, (Expanded) Rigid Cellular Polystyrene Board Insulation (EPS): Comply with ASTM C 578, Type I, as needed for patching operations.
- D. Reinforcing Mesh: Balanced, alkali-resistant, open-weave, glass-fiber mesh treated for compatibility with other EIFS materials.
- E. Waterproof Adhesive/Base-Coat Material:
 - 1. Job-mixed formulation of portland cement complying with ASTM C 150/C 150M, Type I.
- F. Primer: Factory-mixed, elastomeric-polymer primer for preparing base-coat surface for application of finish coat.
- G. Finish-Coat Materials: EIFS standard acrylic-based coating.
- H. Water: Potable.
- I. Trim Accessories: Type as designated or required to suit conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Begin coating application only after surfaces are dry.
 - 2. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Prepare and clean substrates to to obtain optimum bond between substrate and patching materials.

3.3 EIFS INSTALLATION, GENERAL

- A. Comply with ASTM C 1397, ASTM E 2511.

3.4 SUBSTRATE PROTECTION APPLICATION

- A. Flexible-Membrane Flashing: Apply and lap to shed water; seal at openings, penetrations, terminations.

3.5 TRIM INSTALLATION

- A. Trim: Apply trim accessories if applicable; coordinate with installation of insulation.

3.6 INSULATION PATCHING INSTALLATION

- A. Board Insulation: Adhesively and mechanically attach insulation to substrate in compliance with ASTM C 1397.

3.7 BASE-COAT INSTALLATION

- A. Waterproof Adhesive/Base Coat: To exposed surfaces of insulation, apply in STANDARD thickness.
- B. Reinforcing Mesh: Embed reinforcing mesh in wet base coat to produce wrinkle-free installation.

3.8 FINISH-COAT INSTALLATION

- A. Primer: Apply over dry base coat according to EIFS manufacturer's written instructions.
- B. Finish Coat: Plaster finish coat.

3.9 CLEANING AND PROTECTION

- A. Remove temporary covering and protection of other work.

END OF SECTION 072413

SECTION 072500

WEATHER BARRIERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Flexible flashing.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. For building wrap, include data on air and water-vapor permeance based on testing according to referenced standards.

PART 2 - PRODUCTS

2.1 WATER-RESISTIVE BARRIERS

- A. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, rubberized-asphalt 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).
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Fortifiber Building Systems Group; Fortiflash 25.
 - b. Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Vycor Plus Self-Adhered Flashing.
- B. Primer for Flexible Flashing: Product recommended by manufacturer of flexible flashing for substrate.

PART 3 - EXECUTION

3.1 FLEXIBLE FLASHING INSTALLATION

- A. Apply flexible flashing where indicated to comply with manufacturer's written instructions.

1. Prime substrates as recommended by flashing manufacturer.
2. Lap seams and junctures with other materials at least 4 inches (100 mm) except that at flashing flanges of other construction, laps need not exceed flange width.
3. Lap flashing over water-resistive barrier at bottom and sides of openings.
4. Lap water-resistive barrier over flashing at heads of openings.
5. After flashing has been applied, roll surfaces with a hard rubber or metal roller to ensure that flashing is completely adhered to substrates.

END OF SECTION 072500

SECTION 073213

CLAY ROOF TILES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Clay roof tiles.
 - 2. Underlayment.

1.3 DEFINITIONS

- A. Roofing Terminology: See ASTM D 1079, glossaries in TRI/WSRCA's "Concrete and Clay Roof Tile Design Criteria Installation Manual for Moderate Climate Regions," and NRCA's "NRCA Roofing and Waterproofing Manual" for definitions of terms related to roofing work in this Section.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified.
 - 1. Clay Roof Tiles: Full size, showing full range of values and blends.
 - 2. Accessory Tiles: Full size.
 - 3. Fastenings: Wire-tie system components, 12 inches (305 mm) long.

1.5 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For manufacturer's materials warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For roofing to include in maintenance manuals.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store underlayment rolls in a dry, well-ventilated location protected from weather, sunlight, and moisture according to manufacturer's written instructions.
 - 1. Store on end, on pallets or other raised surfaces. Do not double stack rolls.
- B. Protect unused underlayment from weather, sunlight, and moisture when left overnight or when roofing work is not in progress.
- C. Handle, store, and place roofing materials in a manner to prevent damage to roof deck or structural supporting members.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing to be installed according to manufacturer's written instructions and warranty requirements.
 - 1. Install self-adhering sheet underlayment within the range of ambient and substrate temperatures recommended by manufacturer.

1.9 WARRANTY

- A. Roofing Installer's Warranty: On warranty form at end of this Section, signed by Installer, in which Installer agrees to repair or replace components of clay-tile roofing that fail in materials or workmanship within specified warranty period: 2 years.

PART 2 - PRODUCTS

2.1 CLAY ROOF TILES

- A. Clay Roof Tiles: ASTM C 1167, molded- or extruded-clay roof tile units of shape and configuration indicated, kiln fired, and free of surface imperfections. Provide with fastening holes prepunched at factory before firing.
 - 1. Durability: **Grade 1**
 - 2. Finish and Texture and Color Blend: Match existing building.

2.2 UNDERLAYMENT MATERIALS

- A. Self-Adhering Sheet Underlayment, cold applied.
- B. Mortar: ASTM C 270, Type M, color matching existing building.
- C. Wood Nailers: Comply with requirements for pressure-preservative-treated wood in **Section 061000 "Rough Carpentry"**.

2.3 FASTENERS

- A. Roofing Fasteners: Stainless-steel.
- B. Wire Ties: **Stainless steel**.

2.4 METAL FLASHING AND TRIM

- A. General: Comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."
 - 1. Sheet Metal: **Copper**.
- B. Fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for design, dimensions, metal, and other characteristics of the item.
 - 1. Rake Pan Flashings: Fabricate with vertical surface extending over fasciae and **6 inches** beneath the tile roofing, with a min. **1-inch** high vertical return to form a runoff channel.
 - 2. Drip Edges: Fabricate with min. 4-inch roof-deck flange and min. 2-inch fascia flange.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - 1. Examine roof sheathing to verify that sheathing joints are supported by framing and blocking or metal clips and that installation is within flatness tolerances.
 - 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and completely anchored and that provision has been made for flashings and penetrations through roofing.
- B. 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.

3.2 UNDERLAYMENT INSTALLATION

- A. Self-Adhering Sheet Underlayment: Install wrinkle free; comply with low-temperature installation restrictions of underlayment manufacturer if applicable. Install lapped in direction that sheds water. Lap sides and ends staggered between succeeding courses. Roll laps with roller. Cover underlayment within seven days.
 - 1. Extend self-adhering sheet underlayment over entire roof deck.

3.3 METAL FLASHING INSTALLATION

- A. General: Install metal flashings and other sheet metal to comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."

1. Install metal flashings according to clay roof tile manufacturer's written instructions and recommendations in NRCA's "NRCA Roofing Manual: Steep-Slope Roof Systems."

3.4 WOOD NAILERS

- A. Install wood nailers securely fastened to roof deck at the following locations:
 1. Hips.
 2. Ridges.
 3. Rakes.
- B. Install beveled wood cant at eaves and securely fasten to roof deck.

3.5 CLAY ROOF TILE INSTALLATION

- A. General: Install clay roof tiles according to manufacturer's written instructions and recommendations in TRI/WSRCA's "Concrete and Clay Roof Tile Design Criteria Installation Manual for Moderate Climate Regions" and NRCA's "NRCA Roofing Manual: Steep-Slope Roof Systems" unless more stringent requirements are indicated.
 1. Maintain uniform exposure and coursing of clay roof tiles throughout roof.
 2. Extend tiles 2 inches (51 mm) over eave fasciae.

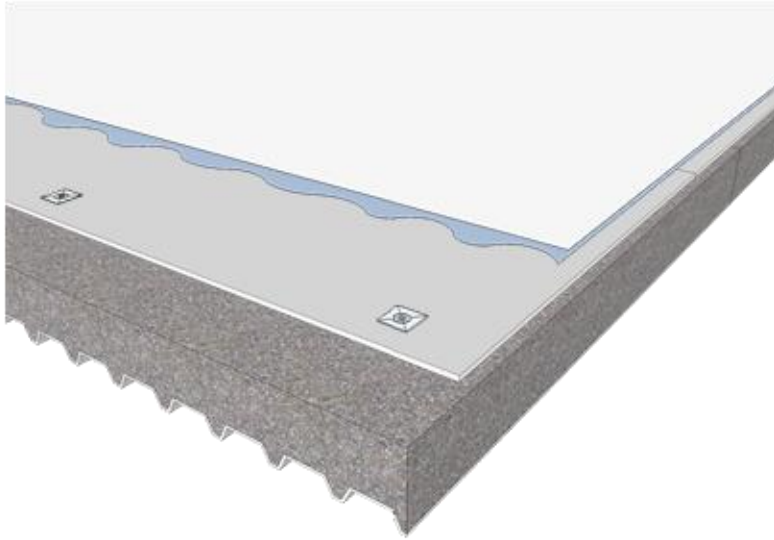
3.6 ADJUSTING AND CLEANING

- A. Remove and replace damaged or broken clay roof tiles.
- B. Remove excess clay roof tiles and debris from Project site.

END OF SECTION 073213

SECTION 075419

PVC ROOFING



Duro-Last Roof Assembly Description

- **Duro-Last® PVC thermoplastic membrane**
Membrane Thickness: 60 mil
Color: White
Attachment: Adhered with water-based adhesive
- **DensDeck® Prime Roof Board**
Thickness: ½ inch
Attachment: Attached with mechanical fasteners
- **Poured Concrete Roof Deck**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Duro-Last® PVC thermoplastic membrane adhered with water-based adhesive.
- B. DensDeck® Prime Roof Board, attached with mechanical fasteners.
- C. Prefabricated flashings, corners, parapets, stacks, vents, and related details.
- D. Fasteners, adhesives, and other accessories required for a complete roofing installation.
- E. Traffic Protection.

1.2 REFERENCES

- A. NRCA - The NRCA Roofing and Waterproofing Manual.
- B. ASCE 7 - Minimum Design Loads For Buildings And Other Structures.
- C. UL - Roofing Materials and Systems Directory, Roofing Systems (TGFU.R10128).
- D. ASTM C 1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
- E. ASTM D 751 - Standard Test Methods for Coated Fabrics.
- F. ASTM D 4434 - Standard Specification for Poly(Vinyl Chloride) Sheet Roofing.
- G. ASTM E 108 - Standard Test Methods for Fire Tests of Roof Coverings.
- H. ASTM E 119 - Standard Test Methods for Fire Tests of Building Construction and Materials.

1.3 SYSTEM DESCRIPTION

- A. General: Provide installed roofing membrane and base flashings that remain watertight; do not permit the passage of water; and resist specified uplift pressures, thermally induced movement, and exposure to weather without failure.
- B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing membrane manufacturer based on testing and field experience.
- C. Physical Properties:
 - 1. Roof product must meet the requirements of Type III PVC sheet roofing as defined by ASTM D 4434 and must meet or exceed the following physical properties.
 - 2. Thickness: 60 mil, nominal, in accordance with ASTM D 751.
 - 3. Thickness Over Scrim: ≥ 28 mil in accordance with ASTM D 751.
 - 4. Breaking Strengths: ≥ 390 lbf. (MD) and ≥ 438 lbf. (XMD) in accordance with ASTM D 751, Grab Method.
 - 5. Elongation at Break: $\geq 31\%$ (MD) and $\geq 31\%$ (XMD) in accordance with ASTM D 751, Grab Method.
 - 6. Heat Aging in accordance with ASTM D 3045: 176 °F for 56 days. No sign of cracking, chipping or crazing. (In accordance with ASTM D 4434).
 - 7. Factory Seam Strength: ≥ 431 lbf. in accordance with ASTM D 751, Grab Method.
 - 8. Tearing Strength: ≥ 132 lbf. (MD) and ≥ 163 lbf. (XMD) in accordance with ASTM D 751, Procedure B.

9. Low Temperature Bend (Flexibility): Pass at -40 °F in accordance with ASTM D 2136.
10. Accelerated Weathering: No cracking, checking, crazing, erosion or chalking after 5,000 hours in accordance with ASTM G 154.
11. Linear Dimensional Change: < 0.5% in accordance with ASTM D 1204 at 176 ± 2 °F for 6 hours.
12. Water Absorption: < 2.6% in accordance with ASTM D 570 at 158 °F for 166 hours.
13. Static Puncture Resistance: ≥ 56 lbs. in accordance with ASTM D 5602.
14. Dynamic Puncture Resistance: ≥ 14.7 ft-lbf. in accordance with ASTM D 5635.

D. Cool Roof Rating Council (CRRC):

1. Membrane must be listed on CRRC website.
 - a. Initial Solar Reflectance: ≥ 88%
 - b. Initial Solar Reflective Index (SRI): ≥ 111
 - c. 3-Year Aged Solar Reflectance: ≥ 68%
 - d. 3-Year Aged Thermal Emittance: ≥ 84%
 - e. 3-Year Aged Solar Reflective Index (SRI): ≥ 82

1.4 SUBMITTALS

- A. Submit under provisions of Section 013000.
- B. Duro-Last data sheets on each product to be used, including:
 1. Preparation instructions and recommendations.
 2. Storage and handling requirements and recommendations.
 3. Installation methods.
 4. Maintenance requirements.
- C. Shop Drawings: Indicate insulation pattern, overall membrane layout, field seam locations, joint or termination detail conditions, and location of fasteners.

- D. Verification Samples: For each product specified, two samples, representing actual product, color, and finish.
 - 1. 4 inch by 6 inch sample of roofing membrane, of color specified.
 - 2. 4 inch by 6 inch sample of walkway pad.
 - 3. Termination bar, fascia bar with cover, drip edge and gravel stop if to be used.
 - 4. Each fastener type to be used for installing membrane, insulation/recover board, termination bar and edge details.
- E. Installer Certification: Certification from the roofing system manufacturer that Installer is approved, authorized, or licensed by manufacturer to install roofing system.
- F. Manufacturer's warranties.

1.5 QUALITY ASSURANCE

- A. Perform work in accordance with manufacturer's installation instructions.
- B. Manufacturer Qualifications: A manufacturer specializing in the production of PVC membranes systems and utilizing a Quality Control Manual during the production of the membrane roofing system that has been approved by and is inspected by Underwriters Laboratories.
- C. Installer Qualifications: Company specializing in installation of roofing systems similar to those specified in this project and approved by the roofing system manufacturer.
- D. Source Limitations: Obtain components for membrane roofing system from roofing membrane manufacturer.
- E. There shall be no deviations from the roof membrane manufacturer's specifications or the approved shop drawings without the prior written approval of the manufacturer.

1.6 REGULATORY REQUIREMENTS

- A. Conform to applicable code for roof assembly wind uplift and fire hazard requirements.
- B. Fire Exposure: Provide membrane roofing materials with the following fire-test-response characteristics. Materials shall be identified with appropriate markings of applicable testing and inspecting agency.
 - 1. Exterior Fire-Test Exposure:
 - a. Class A; ASTM E 108, for application and roof slopes indicated.

2. Fire-Resistance Ratings: Comply with ASTM E 119 for fire-resistance-rated roof assemblies of which roofing system is a part.
3. Conform to applicable code for roof assembly fire hazard requirements.

C. Wind Uplift:

1. Roofing System Design: Provide a roofing system designed to resist uplift pressures calculated according to the current edition of the ASCE-7 Specification *Minimum Design Loads for Buildings And Other Structures*.

1.7 PRE-INSTALLATION MEETING

- A. Convene meeting not less than one week before starting work of this section.
- B. Review methods and procedures related to roof deck construction and roofing system including, but not limited to, the following.
 1. Meet with Owner, Architect, 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 and finalize construction schedule and verify availability of materials, installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 3. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
 4. Review structural loading limitations of roof deck during and after roofing.
 5. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
 6. Review governing regulations and requirements for insurance and certificates if applicable.
 7. Review temporary protection requirements for roofing system during and after installation.
 8. Review roof observation and repair procedures after roofing installation.

1.8 DELIVERY, STORAGE AND HANDLING

- A. 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, and directions for storing and mixing with other components.
- B. 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.

- C. 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.
- D. Store roof materials and place equipment in a manner to avoid permanent deflection of deck.
- E. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.9 WARRANTY

- A. Contractor's Warranty: The contractor shall warrant the roof application with respect to workmanship and proper application for two (2) years from the effective date of the warranty issued by the manufacturer.
- B. Manufacturer's Warranty: Must warrant that the product membrane, material and accessories are free from manufacturing defects at the time of delivery and will not become defective during the term of the warranty. In addition the warranty must meet the following criteria:
 - 1. Warranty Period: 15 years from date issued by the manufacturer.
 - 2. Must provide positive drainage.
 - 3. No exclusion for damage caused by biological growth.
 - 4. Issued direct from the roof membrane manufacturer.
 - 5. Transferable for the full term of the warranty.
 - 6. No additional charge for the warranty.

PART 2 PRODUCTS

2.1 MANUFACTURER

- A. Manufacturer: Duro-Last Roofing, Inc., which is located at: 525 Morley Drive, Saginaw, MI 48601. Telephone: 800-248-0280.
- B. All roofing system components to be provided or approved by Duro-Last Roofing, Inc.
- C. Substitutions: Not permitted.

2.2 ROOFING SYSTEM COMPONENTS

- A. Roofing Membrane: Duro-Last® PVC thermoplastic membrane conforming to ASTM D 4434, type III, fabric-reinforced, PVC, NSF/ANSI 347 Gold or Platinum Certification, and a product-specific third-party verified Environmental Product Declaration. Membrane properties as follows:

1. Thickness:
 - a. 60 mil.
 2. Exposed Face Color:
 - a. White.
 3. Minimum recycle content 7% post-industrial and 0% post-consumer.
 4. Recycled at end of life into resilient flooring or concrete expansion joints.
- B. Accessory Materials: Provide accessory materials supplied by or approved for use by Duro-Last Roofing, Inc.
1. Sheet Flashing: Manufacturer's standard reinforced PVC sheet flashing.
 2. Duro-Last Factory Prefabricated Flashings: manufactured using Manufacturer's standard reinforced PVC membrane.
 - a. Curb Flashings.
 - b. Inside and Outside Corners.
 - c. Drain Boots, Composite Drain Rings (CDR) and Dome Strainers.
 3. Sealants and Adhesives: Compatible with roofing system and supplied by Duro-Last Roofing, Inc.
 - a. Duro-Caulk® Plus.
 - b. Strip Mastic.
 4. Slip Sheet: Compatible with roofing system and supplied by Duro-Last Roofing, Inc.
 5. Fasteners and Plates: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening membrane and insulation to substrate. Supplied by Duro-Last Roofing, Inc.
 - a. Concrete Screws.
 - b. 3 inch Metal Plates.
 6. PV Anchors
 7. Termination and Edge Details: Supplied by Duro-Last Roofing, Inc.
 8. Vinyl Coated Metal: Supplied by Duro-Last Roofing, Inc. 24 gauge, hot-dipped galvanized, grade 90 metal with a minimum of 17 mil of Duro-Last membrane laminated to one side.
- C. Substrate Board:

1. Glass-mat-faced, water-resistant gypsum substrate conforming to ASTM C 1177/C 1177M, DensDeck® Prime Roof Board as manufactured by Georgia-Pacific Corporation.

- a. ½ inch thick.

D. Walkways:

1. Provide non-skid, maintenance-free walkway pads in areas of heavy foot traffic and around mechanical equipment.

- a. Duro-Last Roof Trak® III Walkway Pad.

- 1.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that the surfaces and site conditions are ready to receive work.
- B. Verify that the deck is supported and secured.
- C. Verify that the deck is clean and smooth, free of depressions, waves, or projections, and properly sloped to drains, valleys, eaves, scuppers or gutters.
- D. Verify that the deck surfaces are dry and free of standing water, ice or snow.
- E. Verify that all roof openings or penetrations through the roof are solidly set.
- F. If substrate preparation is the responsibility of another contractor, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Surfaces shall be clean, smooth, free of fins, sharp edges, loose and foreign material, oil, grease, and bitumen.

3.3 INSTALLATION

- A. Install insulation in accordance with the roof manufacturer's requirements.
- B. Separation Board: DensDeck® Prime Roof Board.

1. Use only fasteners, stress plates and fastening patterns accepted for use by the roof manufacturer. Fastening patterns must meet applicable design requirements.
 - a. Install fasteners in accordance with the roof manufacturer's requirements. Fasteners that are improperly installed must be replaced or corrected.
 - b. Attach boards in parallel courses with end joints staggered 50% and adjacent boards butted together with no gaps greater than ¼ inch.
- C. Roof Membrane: 60 mil, Duro-Last® PVC thermoplastic membrane.
1. Use only membrane adhesive acceptable to the roof manufacturer's that meets the applicable design requirements.
 - a. Water-based membrane adhesive.
 2. Cut membrane to fit neatly around all penetrations and roof projections.
 3. Unroll roofing membrane and positioned with a minimum 6 inch overlap.
 4. Apply adhesive in accordance with the roof manufacturer's requirements.
 - a. Apply at the required rate in smooth, even coatings without voids, globs, puddles or similar irregularities. Use care not to contaminate the area of the membrane where hot air welding will occur.
 5. Follow guidelines outlined in the adhesive's Product Data Sheet.
 6. Read the adhesive's Material Safety Data Sheet (MSDS) prior to using the adhesive.
- D. Seaming:
1. Weld overlapping sheets together using hot air. Minimum weld width is 1-1/2 inches.
 2. Check field welded seams for continuity and integrity and repair all imperfections by the end of each work day.
- E. Membrane Termination/Securement: All membrane terminations shall be completed in accordance with the membrane manufacturer's requirements.
1. Provide securement at all membrane terminations at the perimeter of each roof level, roof section, curb flashing, skylight, expansion joint, interior wall, penthouse, and other similar condition.
 2. Provide securement at any angle change where the slope or combined slopes exceeds two inches in one horizontal foot.
- F. Flashings: Complete all flashings and terminations as indicated on the drawings and in accordance with the membrane manufacturer's requirements.
1. Provide securement at all membrane terminations at the perimeter of each roof level, roof section, curb flashing, skylight, expansion joint, interior wall, penthouse, and other similar condition.

- a. Do not apply flashing over existing thru-wall flashings or weep holes.
 - b. Secure flashing on a vertical surface before the seam between the flashing and the main roof sheet is completed.
 - c. Extend flashing membrane a minimum of 6 inches (152 mm) onto the main roof sheet beyond the mechanical securement.
 - d. Use care to ensure that the flashing does not bridge locations where there is a change in direction (e.g. where the parapet meets the roof deck).
2. Penetrations:
- a. Flash all pipes, supports, soil stacks, cold vents, and other penetrations passing through the roofing membrane as indicated on the Drawings and in accordance with the membrane manufacturer's requirements.
 - b. Utilize custom prefabricated flashings supplied by the membrane manufacturer.
 - c. Existing Flashings: Remove when necessary to allow new flashing to terminate directly to the penetration.
3. Pipe Clusters and Unusual Shapes:
- a. Clusters of pipes or other penetrations which cannot be sealed with prefabricated membrane flashings shall be sealed by surrounding them with a prefabricated vinyl-coated metal pitch pan and sealant supplied by the membrane manufacturer.
 - b. Vinyl-coated metal pitch pans shall be installed, flashed and filled with sealant in accordance with the membrane manufacturer's requirements.
 - c. Pitch pans shall not be used where prefabricated or field fabricated flashings are possible.

G. Roof Drains:

1. Coordinate installation of roof drains and vents specified in Section 15146 - Plumbing Specialties.
2. Remove existing flashing and asphalt at existing drains in preparation for sealant and membrane.
3. Provide a smooth clean surface on the mating surface between the clamping ring and the drain base.

H. Edge Details:

1. Provide edge details as indicated on the Drawings. Install in accordance with the membrane manufacturer's requirements.
2. Join individual sections in accordance with the membrane manufacturer's requirements.

3. Coordinate installation of metal flashing and counter flashing specified in Section 07620.
4. Manufactured Roof Specialties: Coordinate installation of copings, counter flashing systems, gutters, downspouts, and roof expansion assemblies specified in Section 07710.

I. Walkways:

1. Install walkways in accordance with the membrane manufacturer's requirements.
2. Provide walkways where indicated on the Drawings.
3. Install walkway pads at roof hatches, access doors, rooftop ladders and all other traffic concentration points regardless of traffic frequency. Provided in areas receiving regular traffic to service rooftop units or where a passageway over the surface is required.
4. Do not install walkways over flashings or field seams until manufacturer's warranty inspection has been completed.

J. Water cut-offs:

1. Provide water cut-offs on a daily basis at the completion of work and at the onset of inclement weather.
2. Provide water cut-offs to ensure that water does not flow beneath the completed sections of the new roofing system.
3. Remove water cut-offs prior to the resumption of work.
4. The integrity of the water cut-off is the sole responsibility of the roofing contractor.
5. Any membrane contaminated by the cut-off material shall be cleaned or removed.

3.4 PROTECTION

- A. Protect installed roofing products from construction operations until completion of project.
- B. Where traffic is anticipated over completed roofing membrane, protect from damage using durable materials that are compatible with membrane.
- C. Repair or replace damaged products after work is completed.

END OF SECTION

**SECTION 076200
SHEET METAL FLASHING**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Formed Products:
 - a. Formed sheet metal fabrications.

1.3 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.

1.4 SUBMITTALS

- A. 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.
- B. 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 special conditions.
 - 6. Details of connections to adjoining work.
- C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Sheet Metal Flashing: 12 inches (300 mm) long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
 2. Trim, Metal Closures, Joint Intersections, and Miscellaneous Fabrications: 12 inches (300 mm) long and in required profile. Include fasteners and other exposed accessories.
 3. Accessories and Miscellaneous Materials: Full-size Sample.
- D. Qualification Data: For qualified fabricator.
- E. Maintenance Data: For sheet metal flashing, trim, and accessories to include in maintenance manuals.
- F. Warranty: Sample of special warranty.
- 1.5 QUALITY ASSURANCE
- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
- B. Sheet Metal Flashing and Trim Standard: Comply with SMACNA "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.
- 1.6 DELIVERY, STORAGE, AND HANDLING
- A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
- B. 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.

PART 2 - PRODUCTS

2.1 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.
- B. Copper Sheet: ASTM B 370, cold-rolled copper sheet, H00 or H01 temper.
1. Nonpatinated Exposed Finish: Mill.

2.2 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.

- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
 - 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating.
 - b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
 - 2. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329 or Series 300 stainless steel.
- C. Solder:
 - 1. For Zinc-Coated (Galvanized) Steel: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead or Grade Sn60, 60 percent tin and 40 percent lead.
- D. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, non-sag, nontoxic, non-staining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
- E. Elastomeric Sealant: ASTM C 920, elastomeric polymer sealant; low modulus; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- F. Bituminous Coating: Cold applied asphalt emulsion complying with ASTM D 1187.

2.3 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA "Architectural Sheet Metal Manual" that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the shop to greatest extent possible.
 - 1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
 - 2. Obtain field measurements for accurate fit before shop fabrication.
 - 3. Form sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
 - 4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.
- B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a 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.
- C. Sealed Joints: Form non-expansion but movable joints in metal to accommodate elastomeric sealant.

- D. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl sealant concealed within joints.
- E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, non-corrosive metal.
- F. Fabricate cleats and attachment devices of sizes as recommended by SMACNA "Architectural Sheet Metal Manual" for application, but not less than thickness of metal being secured.
- G. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
- H. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.
- I. Do not use graphite pencils to mark metal surfaces.

2.4 MANUFACTURED SHEET METAL FLASHING AND TRIM

- A. Copper Reglets: Units of type, material, and profile required, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated.

2.5 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.

2.6 ROOF-DRAINAGE SHEET METAL FABRICATIONS

- A. Copper Gutters: SMACNA designations as indicated.
- B. Copper Conductor Heads: Fabricate conductor heads with flanged back and stiffened top edge and of dimensions and shape as indicated.
- C. Copper Downspouts: SMACNA designations as indicated.

2.7 STEEP-SLOPE ROOF SHEET METAL FABRICATIONS

- A. See Clay Tile Roofing Section.

2.8 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.

- 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.
 - 1. Coat back side of uncoated aluminum sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.
 - 2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene sheet.
 - C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) 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.
 - D. Fastener Sizes: Use fasteners of sizes that will penetrate wood sheathing not less than 1-1/4 inches (32 mm) for nails and not less than 3/4 inch (19 mm) for wood screws.
 - E. Seal joints as shown and as required for watertight construction.
 - 1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch (25 mm) into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F (4 deg C).
 - 2. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."
 - F. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches (38 mm), except reduce pre-tinning where pre-tinned surface would show in completed Work.
 - 1. Do not solder metallic-coated steel and aluminum sheet.
 - 2. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.
 - G. Rivets: Rivet joints in uncoated aluminum where indicated and where necessary for strength.
- 2.9 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. Opening Flashings in Frame Construction: Install continuous head, sill, and similar flashings to extend 4 inches (100 mm) beyond openings.

2.10 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.

2.11 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.

END OF SECTION 076200

SECTION 079200 JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes joint sealants for the following applications, including those specified by reference to this Section:
 - 1. Exterior and Interior joints in vertical and horizontal surfaces:
 - a. Perimeter joints of exterior openings.
 - b. Other Openings

1.3 PERFORMANCE REQUIREMENTS

- A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

1.4 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. 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.
- C. Samples for Verification: For each type and color of joint sealant required, provide Samples with joint sealants in **1/2-inch** wide joints formed between two **6-inch** long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- D. Product Certificates: For each type of joint sealant and accessory, signed by product manufacturer.
- E. SWRI Validation Certificate: For each elastomeric sealant specified to be validated by SWRI's Sealant Validation Program.
- F. Qualification Data: For Installer.
- G. 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.
- H. Field Test Report Log: For each elastomeric sealant application.
- I. Product Test Reports: Based on comprehensive testing of product formulations performed by a qualified testing agency, indicating that sealants comply with requirements.
- J. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized Installer who is approved or licensed for installation of elastomeric sealants required for this Project.
- B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.
- C. 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 C 1087 or manufacturer's standard test method 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 type 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 of current sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.
- D. Product Testing: Obtain test results for "Product Test Reports" Paragraph in "Submittals" Article from a qualified testing agency based on testing current sealant formulations within a 36-month period preceding the Notice to Proceed with the Work.
1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated, as documented according to ASTM E 548.
 2. Test elastomeric joint sealants for compliance with requirements specified by reference to ASTM C 920, and where applicable, to other standard test methods.
 3. Test elastomeric joint sealants according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in-peel, and indentation hardness.
 4. Test other joint sealants for compliance with requirements indicated by referencing standard specifications and test methods.

1.6 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 or are below 40 deg F.
 - 2. When joint substrates are wet.
 - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 - 4. Contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.7 WARRANTY

- A. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.
- B. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.

2.2 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 sealant manufacturer, based on testing and field experience.

2.3 ELASTOMERIC JOINT SEALANTS

- A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
- B. Stain-Test-Response Characteristics: Where elastomeric sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- C. Multicomponent Non-sag Urethane Sealant

1. Available Products:
 - a. Pecora Corporation; Dynatrol II.
 - b. Tremco; Dymeric 511.
2. Type and Grade: M (multi-component) and NS (non-sag).
3. Class: 50.
4. Use Related to Exposure: NT (nontraffic).
5. Uses Related to Joint Substrates: M, A, and, as applicable to joint substrates indicated, O.
 - a. Use O Joint Substrates: Color anodic aluminum, galvanized steel, wood and copper.

2.4 JOINT-SEALANT BACKING

- A. General: Provide sealant backings of material and type 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.

2.5 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

3.1 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.

3.2 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, blast cleaning, 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.
 3. Remove laitance and form-release agents from concrete.
 4. Clean nonporous 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. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer, based on 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 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.

3.3 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 C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of type 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 Non-sag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified 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 configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.
 4. Provide flush joint configuration where indicated per Figure 5B in ASTM C 1193.
 5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 5C in ASTM C 1193.
- a. Use masking tape to protect surfaces adjacent to recessed tooled joints.
- G. Installation of Preformed Tapes: Install according to manufacturer's written instructions.

3.4 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.

3.7 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior perimeter joints between wood or metal and frames of louvers.
1. Joint-Sealant: Multicomponent nonsag urethane sealant.
- B. Joint-Sealant Application: Interior perimeter joints of exterior openings.
1. Joint-Sealant: Single-component nonsag urethane sealant.

END OF SECTION 079200

**SECTION 081113
HOLLOW METAL DOORS AND FRAMES**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

- 1. Standard hollow metal doors and frames.

B. Related Sections:

- 1. Division 04 Section "Unit Masonry" for embedding anchors for hollow metal work into masonry construction.
- 2. Division 08 Section "Sound Control Door Assemblies" for packaged, acoustical hollow metal door and frame assemblies with STC ratings of 35 or more.
- 3. Division 08 Section "Door Hardware" for door hardware for hollow metal doors.
- 4. Division 09 Sections "Exterior Painting" and "Interior Painting" for field painting hollow metal doors and frames.

1.3 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings.
- B. Standard Hollow Metal Work: Hollow metal work fabricated according to ANSI/SDI A250.8.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, fire-resistance rating, temperature-rise ratings, and finishes.
- B. Shop Drawings: Include the following:
 - 1. Elevations of each door design.
 - 2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
 - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 - 4. Locations of reinforcement and preparations for hardware.
 - 5. Details of each different wall opening condition.
 - 6. Details of anchorages, joints, field splices, and connections.
 - 7. Details of accessories.
 - 8. Details of moldings, removable stops, and glazing.

- C. Samples for Verification:
 - 1. For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches (75 by 125 mm).
 - D. Other Action Submittals:
 - 1. Schedule: Provide a schedule of hollow metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with door hardware schedule.
- 1.5 QUALITY ASSURANCE
- A. Source Limitations: Obtain hollow metal work from single source from single manufacturer.
- 1.6 DELIVERY, STORAGE, AND HANDLING
- A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
 - B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
 - C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch- (102-mm-) high wood blocking. Do not store in a manner that traps excess humidity.
 - 1. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.
- 1.7 PROJECT CONDITIONS
- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.
- 1.8 COORDINATION
- A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ceco Door Products; an Assa Abloy Group company.
2. Curries Company; an Assa Abloy Group company.
3. Deansteel Manufacturing Company, Inc.
4. Security Metal Products Corp.
5. Steelcraft; an Ingersoll-Rand company.

2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum **A40 (ZF120)** metallic coating.
- D. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), **40Z (12G)** coating designation; mill phosphatized.
 1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- F. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with **6- to 12-lb/cu. ft. (96- to 192-kg/cu. m)** density; with maximum flame-spread and smoke-development indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
- G. Glazing: Comply with requirements in Division 08 Section "Glazing."

2.3 STANDARD HOLLOW METAL DOORS

- A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8.
 1. Design: Flush panel.
 2. Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyisocyanurate, mineral-board.
 - a. Thermal-Rated (Insulated) Doors: Where indicated, provide doors fabricated with thermal-resistance value (R-value) of not less than **4.0 deg F x h x sq. ft./Btu (0.704 K x sq. m/W)** when tested according to ASTM C 1363.
 - 1) Locations: Exterior doors.
 3. Vertical Edges for Single-Acting Doors: Beveled edge.

- a. Beveled Edge: 1/8 inch in 2 inches (3 mm in 50 mm).
 - 4. Top and Bottom Edges: Closed with flush or inverted 0.042-inch- (1.0-mm-) thick, end closures or channels of same material as face sheets.
 - 5. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."
 - B. Exterior Doors: Face sheets fabricated from metallic-coated steel sheet. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
 - 1. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 2 (Seamless).
 - C. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.
 - D. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.
- 2.4 STANDARD HOLLOW METAL FRAMES
- A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.
 - B. Exterior Frames: Fabricated from metallic-coated steel sheet.
 - 1. Fabricate frames with mitered or coped corners.
 - 2. Fabricate frames as full profile welded frame..
 - 3. Frames for Level 3 Steel Doors: 0.053-inch- (1.3-mm-) thick steel sheet.
 - C. Interior Frames: Fabricated from cold-rolled steel sheet.
 - 1. Fabricate frames with mitered or coped corners.
 - 2. Fabricate frames as full profile welded.
 - 3. Fabricate frames with minimum 1 1/2" wide nail fins at frame perimeter.
 - 4. Fabricate drywall slip-on frames for in-place gypsum board partitions.
 - 5. Frames for Level 3 Steel Doors: 0.053-inch- (1.3-mm-) thick steel sheet.
 - 6. Frames for Wood Doors: 0.053-inch- (1.3-mm-) thick steel sheet.
 - 7. Frames for Borrowed Lights: Same as adjacent door frame.
 - D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same material as frames.
- 2.5 FRAME ANCHORS
- A. Jamb Anchors:
 - 1. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.0 mm) thick.

2.6 HOLLOW METAL PANELS

- A. Provide hollow metal panels of same materials, construction, and finish as specified for adjoining hollow metal work.

2.7 STOPS AND MOLDINGS

- A. Moldings for Glazed Lites in Doors: Minimum **0.032 inch (0.8 mm)** thick, fabricated from same material as door face sheet in which they are installed.
- B. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of **5/8 inch (16 mm)** high unless otherwise indicated.
- C. Loose Stops for Glazed Lites in Frames: Minimum **0.032 inch (0.8 mm)** thick, fabricated from same material as frames in which they are installed.

2.8 FABRICATION

- A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.
- C. Hollow Metal Doors:
 - 1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
 - 2. Glazed Lites: Factory cut openings in doors.
- D. Hollow Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
 - 1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
 - 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 - 3. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
 - 4. Jamb Anchors: Provide number and spacing of anchors.
 - a. Stud-Wall Type: Locate anchors not more than **18 inches (457 mm)** from top and bottom of frame. Space anchors not more than **32 inches (813 mm)** o.c. and as follows:
 - 1) Three anchors per jamb up to **60 inches (1524 mm)** high.
 - 2) Four anchors per jamb from **60 to 90 inches (1524 to 2286 mm)** high.
 - 3) Five anchors per jamb from **90 to 96 inches (2286 to 2438 mm)** high.

- 4) Two anchors per head for frames above 42 inches (1066 mm) wide and mounted in metal-stud partitions.
- E. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.
- F. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."
 - 1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
 - 2. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.
 - 3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
- G. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
 - 1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow metal work.
 - 2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
 - 3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
 - 4. Provide loose stops and moldings on inside of hollow metal work.
 - 5. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

2.9 STEEL FINISHES

- A. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pre-treating.
 - 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

- C. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness to the following tolerances:
 - 1. Squareness: Plus or minus **1/16 inch (1.6 mm)**, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - 2. Alignment: Plus or minus **1/16 inch (1.6 mm)**, measured at jambs on a horizontal line parallel to plane of wall.
 - 3. Twist: Plus or minus **1/16 inch (1.6 mm)**, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - 4. Plumbness: Plus or minus **1/16 inch (1.6 mm)**, measured at jambs on a perpendicular line from head to floor.
- C. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

- A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.
- B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11.
 - 1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - b. Install frames with removable glazing stops located on secure side of opening.
 - c. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - d. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.

- a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
- 3. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
- 4. In-Place Studwall Construction: Secure frames in place with fasteners through continuous perimeter nail fin. over solid wall framing.
- 5. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus **1/16 inch (1.6 mm)**, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus **1/16 inch (1.6 mm)**, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus **1/16 inch (1.6 mm)**, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus **1/16 inch (1.6 mm)**, measured at jambs at floor.
- C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.
 - 1. Non-Fire-Rated Standard Steel Doors:
 - a. Jambs and Head: **1/8 inch (3 mm)** plus or minus **1/16 inch (1.6 mm)**.
 - b. Between Edges of Pairs of Doors: **1/8 inch (3 mm)** plus or minus **1/16 inch (1.6 mm)**.
 - c. Between Bottom of Door and Top of Threshold: Maximum **3/8 inch (9.5 mm)**.
 - d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum **3/4 inch (19 mm)**.
- D. Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.
 - 1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than **9 inches (230 mm)** o.c. and not more than **2 inches (50 mm)** o.c. from each corner.

3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow metal work immediately after installation.
- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

END OF SECTION 081113

**SECTION 085113
ALUMINUM WINDOWS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes fixed and operable aluminum-framed windows for exterior locations.
- B. Related Sections include the following:

1.3 DEFINITIONS

- A. Performance class designations according to AAMA/WDMA 101/I.S.2/NAFS:
 - 1. AW: Architectural.
 - 2. HC: Heavy Commercial.
 - 3. C: Commercial.
 - 4. LC: Light Commercial.
 - 5. R: Residential.
- B. Performance grade number according to AAMA/WDMA 101/I.S.2/NAFS:
 - 1. Design pressure number in pounds force per square foot (pascals) used to determine the structural test pressure and water test pressure.
- C. Structural Test Pressure: For uniform load structural test, is equivalent to 150 percent of the design pressure.
- D. Minimum Test Size: Smallest size permitted for performance class (gateway test size). Products must be tested at minimum test size or at a size larger than minimum test size to comply with requirements for performance class.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Provide aluminum windows capable of complying with performance requirements indicated, based on testing manufacturer's windows that are representative of those specified, and that are of minimum test size indicated below:
 - 1. Size indicated on Drawings.
- B. Thermal Movements: Provide aluminum windows, including anchorage, that allow for thermal movements resulting from the following maximum change (range) in ambient and surface

temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

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

1.5 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, fabrication methods, dimensions of individual components and profiles, hardware, finishes, and operating instructions for each type of aluminum window indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, hardware, attachments to other work, operational clearances, installation details, and the following:
 1. Mullion details, including reinforcement and stiffeners.
 2. Joinery details.
 3. Expansion provisions.
 4. Flashing and drainage details.
 5. Weather-stripping details.
 6. Thermal-break details.
 7. Glazing details.
 8. Window cleaning provisions.
- C. Product Schedule: For aluminum windows. Use same designations indicated on Drawings.
- D. Qualification Data: For Installer.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed within the last four years by a qualified testing agency for each type, class, grade, and size of aluminum window. Test results based on use of downsized test units will not be accepted.
- F. Maintenance Data: For operable window sash, operating hardware, weather stripping, window system operators and finishes to include in maintenance manuals.
- G. Warranty: Special warranty specified in this Section.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An installer acceptable to aluminum window manufacturer for installation of units required for this Project.
- B. Manufacturer Qualifications: A manufacturer capable of fabricating aluminum windows that meet or exceed performance requirements indicated and of documenting this performance by inclusion in lists and by labels, test reports, and calculations.
- C. Source Limitations: Obtain aluminum windows through one source from a single manufacturer.

- D. Product Options: Drawings indicate size, profiles, and dimensional requirements of aluminum windows and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements." Do not modify size and dimensional requirements.
 - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- E. Fenestration Standard: Comply with AAMA/WDMA 101/I.S.2/NAFS, "North American Fenestration Standard Voluntary Performance Specification for Windows, Skylights and Glass Doors," for definitions and minimum standards of performance, materials, components, accessories, and fabrication. Comply with more stringent requirements if indicated.
 - 1. Provide AAMA-certified aluminum windows with an attached label.
 - 2. Provide labels on all windows listing U-factor, Solar Heat Gain Coefficient, and Air Infiltration rate. Label to be in accordance with NFRC Rating Procedure. Do not remove labels prior to inspection by enforcement agency.
- F. Glazing Publications: Comply with published recommendations of glass manufacturers and with GANA's "Glazing Manual" unless more stringent requirements are indicated.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify aluminum window openings by field measurements before fabrication and indicate measurements on Shop Drawings.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating aluminum windows without field measurements. Coordinate wall construction to ensure that actual opening dimensions correspond to established dimensions.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure to meet performance requirements.
 - b. Structural failures including excessive deflection, water leakage, air infiltration, or condensation.
 - c. Faulty operation of movable sash and hardware.
 - d. Deterioration of metals, other materials, and metal finishes beyond normal weathering.
 - e. Failure of insulating glass.
 - 2. Warranty Period:
 - a. Window: One year from date of Substantial Completion.

- b. Glazing: Five years from date of Substantial Completion.
- c. Metal Finish: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide All Weather Windows, Series 5000 Nail Fin or a comparable product by one of the following:
 - 1. All Weather Architectural Aluminum, Inc.
 - 2. Fleetwood Aluminum Products, Inc.
 - 3. Kawneer; an Alcoa Company.
 - 4. TRACO.
 - 5. YKK AP America Inc.

2.2 WINDOW

- A. Window Type: As indicated on Drawings.
- B. Frame Width: 2-1/4"
- C. AAMA/WDMA Performance Requirements: Provide aluminum windows of performance indicated that comply with AAMA/WDMA 101/I.S.2/NAFS.
 - 1. Performance Class: HC for fixed windows, C for operable windows.
- D. Condensation-Resistance Factor (CRF): Provide aluminum windows tested for thermal performance according to AAMA 1503, showing a CRF of 45.
- E. Thermal Transmittance: Provide aluminum windows with a whole-window, U-factor maximum indicated at 15-mph (24-km/h) exterior wind velocity and winter condition temperatures when tested according to AAMA 1503.
 - 1. U-Factor: 0.129 Btu/sq. ft. x h x deg F (3.4 W/sq. m x K) or less.
- F. Sound Transmission Class (STC): Provide glazed windows rated for not less than 26 STC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 413.
- G. Air Infiltration: Maximum rate not more than indicated when tested according to AAMA/WDMA 101/I.S.2/NAFS, Air Infiltration Test.
 - 1. Maximum Rate: 0.3 cfm/sq. ft. (5 cu. m/h x sq. m) of area at an inward test pressure of 1.57 lbf/sq. ft. (75 Pa).
- H. Water Resistance: No water leakage as defined in AAMA/WDMA referenced test methods at a water test pressure equaling that indicated, when tested according to AAMA/WDMA 101/I.S.2/NAFS, Water Resistance Test.

1. Test Pressure: 15 percent of positive design pressure, but not less than 2.86 lbf/sq. ft. (140 Pa) or more than 15 lbf/sq. ft. (720 Pa).
 - I. Forced-Entry Resistance: Comply with Performance Grade 20 requirements when tested according to ASTM F 588.
 - J. Operating Force and Auxiliary (Durability) Tests: Comply with AAMA/WDMA 101/I.S.2/NAFS for operating window types indicated.
- 2.3 GLAZING
- A. Glass and Glazing Materials: Refer to Division 08 Section "Glazing" for glass units and glazing requirements applicable to glazed aluminum window units.
 - B. Glass: Clear or tinted, insulating-glass units complying with Division 08 Section "Glazing."
 - C. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal.
- 2.4 HARDWARE
- A. General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or other corrosion-resistant material compatible with aluminum; designed to smoothly operate, tightly close, and securely lock aluminum windows, and sized to accommodate sash or ventilator weight and dimensions. Do not use aluminum in frictional contact with other metals. Where exposed, provide die-cast zinc with special coating finish.
 1. Operator: Gear-type rotary operator located on jamb at sill. Concealed manual operator (Basis of Design: Clearline Inc., North Wales, PA., 215/ 699-9292) with crank operated rotary control box delivering forward and backward motion to steel flexible cable traveling through a suitable plastic lined steel conduit which is formed to proper radii bends on the job site.
 - a. Handle: removable handle, pole loop for removable pole crank where indicated.
 - B. Four- or Six-Bar Friction Hinges: Comply with AAMA 904.
 1. Locking mechanism and handles for manual operation.
 2. Friction Shoes: Provide friction shoes of nylon or other nonabrasive, nonstaining, noncorrosive, durable material.
 - C. Pole Operators: Tubular-shaped anodized aluminum; with rubber-capped lower end and top to match hardware design; of sufficient length to operate window without reaching more than 60 inches (1500 mm) above floor; 1 pole operator and pole hanger per room that has operable windows more than 72 inches (1800 mm) above floor. Provide extensions on window hardware at upper windows to make hardware visible. Extension to be operated by pole crank.
 - D. Gear-Type Rotary Operators: Comply with AAMA 901 when tested according to ASTM E 405, Method A.

- E. Projected Awning Windows: Provide the following operating hardware:
 - 1. Hinge: Concealed four- or six-bar friction hinge located on each jamb near top rail; two per ventilator.

2.5 FABRICATION

- A. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.
- B. Fabricate aluminum windows that are reglazable without dismantling sash or ventilator framing.
- C. Thermally Improved Construction: Fabricate aluminum windows with an integral, concealed, low-conductance thermal barrier; located between exterior materials and window members exposed on interior side; in a manner that eliminates direct metal-to-metal contact.
 - 1. Provide thermal barriers tested according to AAMA 505; determine the allowable design shear flow per the appendix in AAMA 505.
- D. Weather Stripping: Provide full-perimeter weather stripping for each operable sash and ventilator.
- E. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.
- F. Mullions: Provide mullions and cover plates as shown, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections, as indicated. Provide mullions and cover plates capable of withstanding design loads of window units.
- G. Factory-Glazed Fabrication: Glaze aluminum windows in the factory where practical and possible for applications indicated. Comply with requirements in Division 08 Section "Glazing" and with AAMA/WDMA 101/I.S.2/NAFS.

2.6 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Class II, Color Anodic Finish: AA-M12C22A32/A34 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, integrally colored or electrolytically deposited color coating 0.010 mm or thicker) complying with AAMA 611.
 - 1. Color: Medium bronze.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work. Verify rough opening dimensions, levelness of sill plate, and operational clearances. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure a coordinated, weathertight window installation.
 - 1. Wood Frame Walls: Dry, clean, sound, well nailed, free of voids, and without offsets at joints. Ensure that nail heads are driven flush with surfaces in opening and within 3 inches (76 mm) of opening.
 - 2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing windows, hardware, accessories, and other components.
- B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.
- C. Set sill members in bed of sealant or with gaskets, as indicated, for weathertight construction.
- D. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.
- E. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

3.3 ADJUSTING, CLEANING, AND PROTECTION

- A. Adjust operating sashes and ventilators, screens, hardware, and accessories for a tight fit at contact points and weather stripping for smooth operation and weathertight closure. Lubricate hardware and moving parts.

- B. Clean aluminum surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
- C. Clean factory-glazed glass immediately after installing windows. Comply with manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels, and clean surfaces.
- D. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
- E. Protect window surfaces from contact with contaminating substances resulting from construction operations. In addition, monitor window surfaces adjacent to and below exterior concrete and masonry surfaces during construction for presence of dirt, scum, alkaline deposits, stains, or other contaminants. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written recommendations.

END OF SECTION 085113

**SECTION 087100
DOOR HARDWARE**

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. Furnish all necessary Architectural finish hardware to complete the project except those items specifically mentioned to be furnished elsewhere. All hardware shall meet the requirements of CBC 1133B.2.1, 113B.7.5.1 and 1003.3.1.8.

1.2 QUALITY ASSURANCE:

- A. Finish hardware supplier shall have in his employment a member of the American Society of Architectural Hardware Consultants (AHC) who shall be made available for consultation during construction.

1.3 SUBMITTALS:

- A. Hardware Schedule. Prepare complete schedule of finish hardware and submit to the Architect/Engineer for review. Reference items clearly to groups specified, door-type designations shown, location and other pertinent data. List manufacturer's names or suitable abbreviation to facilitate reviewing, opposite each item scheduled.
- B. Do not deliver hardware until schedule has been accepted. Acceptance is not to be construed as certifying each item scheduled.

1.5 GUARANTEE:

- A. Guarantee door hardware against mechanical failure as follows:
 - 1. Locksets seven (7) years.
 - 2. Door closers ten (10) years.
 - 3. Panic or Exit Hardware three (3) years.
 - 4. All other hardware two (2) years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

	<u>Item</u>	<u>Manufacturer</u>	<u>Acceptable Substitutes</u>
A.	Hinges	Ives	Hager, Stanley, Select
B.	Locks, Latches & Cylinders	Schlage	District standard, no substitute
C.	Closers	LCN	Dorma
D.	Kick Plates	Ives	Quality, Trimco
E.	Stops	Ives, Glynn-Johnson	Quality, Trimco

F.	Thresholds	Pemko	National Guard, Zero
G.	Seals & Bottoms	Pemko	National Guard, Zero

2.2 MATERIALS

- A. Hinges: Exterior out-swinging door butts shall be non-ferrous material and shall have stainless steel hinge pins. All doors to have non-rising pins.
1. Hinges shall be sized in accordance with the following:
 - a. Height:
 - 1) Doors up to 41" wide: 4-1/2" inches.
 - 2) Doors 42" to 48" wide: 5 inches.
 - b. Width: Sufficient to clear frame and trim when door swings 180 degrees.
 - c. Number of Hinges: Furnish 3 hinges per leaf to 7'-5" in height. Add one for each additional 2 feet in height.
 2. Furnish non-removable pins (NRP) at all exterior out-swing doors and interior key lock doors with reverse bevels.
- B. Heavy Duty Cylindrical Locks and Latches: Schlage "ND" Series. Fastened with through-bolts and threaded chassis hubs. Lever Design shall be "Rhodes" (RHO).
1. Locksets to comply with ANSI A156.2, Series 4000, Grade 1; tested to exceed 3,000,000 cycles. Locksets shall meet ANSI A117.1, Accessible Code.
 2. Chassis: One piece modular assembly and multi-functional allowing function interchange without disassembly of lockset.
 3. Spindle shall be deep-draw manufactured not stamped. Spindle and spring cage to be one-piece integrated assembly.
 4. Anti-rotation plate to be interlocking to the lock chassis. Lock design utilizing bit-tabs are not acceptable.
 5. Lever Trim: Accessible design, bi-directional, independent assemblies.
 6. Locks shall be of such construction that when locked, the door may be opened from within by using lever and without the use of a key or special knowledge.
 7. Thru-bolts to secure anti-rotation plate without sheer line. Fully threaded thru-bolts are not acceptable.
 8. Spring cage to have double compression springs. Manufacturers utilizing torsion springs are not acceptable.
 9. Latchbolt to be steel with minimum 1/2" throw deadlatch on keyed and exterior functions; 3/4" throw anti-friction latchbolt on pairs of doors.
 10. Strikes: ANSI curved lip, 1-1/4" x 4-7/8", with 1" deep dust box (K510-066). Lips shall be of sufficient length to clear trim and protect clothing.
- C. Exit devices: Von Duprin as scheduled.
1. Provide certificate by independent testing laboratory that device has completed over 1,000,000 cycles and can still meet ANSI/BHMA A156.3 - 2001 standards.
 2. All internal parts shall be of cold-rolled steel with zinc dichromate coating.
 3. Mechanism case shall have an average thickness of .140".
 4. Compression spring engineering.
 5. Non-handed basic device design with center case interchangeable with all functions.
 6. All devices shall have quiet return fluid dampeners.

7. All latchbolts shall be deadlocking with $\frac{3}{4}$ " throw and have a self-lubricating coating to reduce friction and wear.
 8. Device shall bear UL label for fire and or panic as may be required.
 9. All surface strikes shall be roller type and utilize a plate underneath to prevent movement.
 10. Lever Trim: "Breakaway" design, forged brass or bronze escutcheon with a minimum of .130" thickness, match lockset lever design.
 11. Removable Mullions: Removable with single turn of building key. Securely reinstalled without need for key.
 12. Furnish glass bead kits for vision lites where required.
 13. All Exit Devices to be sex-bolted to the doors.
 14. Panic Hardware shall comply with CBC Section 1008.1.8.2 and 1008.1.9 and shall be mounted between 34" and 48" above the finished floor surface. The unlatching force shall not exceed 15 lbs. applied in the direction of travel.
- D. Closers: LCN. All door closers shall be of one manufacturer to provide for proper installation and servicing after installation. All closers shall be inspected after installation by a representative to ensure proper adjustment and operation. Closers shall carry a manufacturers twenty-five year warranty against manufacturing defects and workmanship.
1. All closers shall be non-sized to provide a full range of Size I through V closing power for all door sizes according to BHMA Product Standards (ANSI 156.4-1986 Table I) and shall be listed in the BHMA Certified Products Directory and tested by an independent testing laboratory to provide minimum closing force required to properly latch the doors, to overcome potential friction and resistance from movement of air or latching and hinging hardware. The closer spring power shall be adjustable to the proper tension by a simple winding action.
 2. Closers for fire-rated doors shall be provided with a temperature stabilizing fluid that complies with standards UBC 7-2 (1997) and UL10C.
 3. Maximum effort to operate closers shall not exceed 5 lbs., such pull or push effort being applied at right angles to hinged doors. Compensating devices or automatic door operators may be utilized to meet the above standards. When fire doors are required, the maximum effort to operate the closer may be increased but shall not exceed 15 lbs. when specifically approved by fire marshal. All closers shall be adjusted to operate with the minimum amount of opening force and still close and latch the door. These forces do not apply to the force required to retract latch bolts or disengage other devices that hold the door in a closed position. Door shall take at least 5 seconds to move from an open position of 70 degrees to a point of 3 inches from the latch jamb. Reference CBC Sections 1133B.2.1, 1133B.2.5, 1133B.2.5.1 & 1008.1.8.
- E. Door Stops: Glynn-Johnson & Ives.
1. Unless otherwise noted in Hardware Sets, provide wall type with appropriate fasteners. Where wall type cannot be used, provide floor type. If neither can be used, provide overhead type.
 2. Overhead stops shall be made of stainless steel and non-plastic mechanisms and finished metal end caps. Field-changeable hold-open, friction and stop-only functions.
3. Floor Stops shall not be located in the path of travel and at a maximum of 4" from walls.
- F. Protection Plates: Fabricate either kick, armor, or mop plates with four beveled edges. Provide kick plates 10" high and 2" LDW. Furnish with machine or wood screws of bronze or stainless to match other hardware.

- G. Lock Protectors: Lock astragals shall be provided with internally threaded fasteners for flat head machine screws. No hex head or carriage bolt fasteners will be permitted. Must be through bolted to door.
- H. Thresholds: As Scheduled and per details.
 - 1. Thresholds shall not exceed 1/2" in height, with a beveled surface of 1:2 maximum slope.
 - 2. Set thresholds in a full bed of butyl-rubber or polyisobutylene mastic sealant complying with requirements in Division 7 "Thermal and Moisture Protection".
 - 5. Use 1/4" fasteners, red-head flat-head sleeve anchors (SS/FHSL).
 - 4. Thresholds shall comply with CBC Section 1133B.2.4.1.
- I. Miscellaneous hardware items shall be as listed. All fasteners for all finish hardware shall harmonize with hardware material and finish.

2.3 KEYING

- A. All exterior cylinders will be provided by the School District. The District will provide Schlage "Primus" cylinders. The interior cylinders shall be provided in this section and be "C" section keyway. The District will perform their own master keying.
- B. Provide a means of construction keying for doors requiring locking during the construction period. Provide temporary cylinders at exterior doors and interior doors requiring locking as required. Temporary cylinders to be returned to supplier.
- C. Supply 3 blank keys per lock and cylinder.

2.4 FINISHES

- A. Generally to be bronze US10 unless otherwise noted.
- C. Door closers shall be powder-coated (691) to match other hardware, unless otherwise noted.
- D. Aluminum items to be finished clear anodized 628, except thresholds shall be furnished as standard mill finish.

PART 3 - EXECUTION

3.1 INSTALLATION / EXAMINATION

- A. Examine doors, frames and related items for conditions that would prevent the proper application of finish hardware. Do not proceed until all defects are corrected.
- B. Contractor shall inspect and direct the method of application and adjustment of all finished hardware required to be installed under work of other Sections. Work of this Section shall include technical assistance provided upon request by the supplier.
- C. All mounting heights shall be coordinated with local, state and federal codes unless other wise indicated. All operating or hand activated hardware shall be mounted between 30" and 44" AFF per CBC Section 1133B.2.5.1.
- D. All Thresholds will be set in a bed of sealant to ensure against any water penetration.

3.2 PROTECTION / ADJUSTMENT

- A. All finish hardware shall be protected from damage during and after application and until Substantial Completion of building.
- B. Shortages of items and/or incorrect items (based on Drawings and Specifications in effect at time of bidding shall be furnished and/or replaced with correct material. Unit prices and credits shall be furnished for approval prior to delivery of these goods.
- C. Adjustments and inspection:
 - 1. During the installation of hardware, a periodic inspection, in company with the Inspector, will be made by the Architectural Hardware Supplier, or his Agent.
 - 2. Any hardware improperly installed shall be removed and reinstalled at the Contractor s expense.
 - 3. At the completion of the work, a final inspection shall be made by the Architectural Hardware Supplier, or his Agent.
- D. Protect all finish hardware during field finishing. Clean and restore all finish hardware to original factory condition. Replace all damaged items, as result of finishing processes, for final acceptance by Architect / Owner.

END OF SECTION

SECTION 088000 GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:

- 1. Windows.

1.3 DEFINITIONS

- A. Manufacturers of Glass Products: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.
- C. Interspace: Space between lites of an insulating-glass unit that contains dehydrated air or a specified gas.
- D. Deterioration of Coated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in metallic coating.
- E. Deterioration of Insulating Glass: Failure of hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
- F. Deterioration of Laminated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Glass Design: Glass thickness designations indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites in the thickness designations indicated for various size openings, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:
 - 1. Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E 1300, according to the following requirements:
 - a. Design Wind Loads: Determine design wind loads applicable to Project from basic wind speed indicated in **miles per hour** at **33 feet** above grade, according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 6.5, "Method 2-Analytical Procedure," based on mean roof heights above grade indicated on Drawings.
 - 1) Basic Wind Speed: 70 m.p.h..
 - 2) Importance Factor: II.
 - 3) Exposure Category: C.
 - b. Probability of Breakage for Vertical Glazing: 8 lites per 1000 for lites set vertically or not more than 15 degrees off vertical and under wind action.
 - 1) Load Duration: 3 seconds.
 - c. Maximum Lateral Deflection: For the following types of glass supported on all 4 edges, provide thickness required that limits center deflection at design wind pressure to 1/50 times the short side length or **1 inch**, whichever is less.
 - 1) For insulating glass.
 - d. Minimum Glass Thickness for Exterior Lites: Not less than 6.0 mm.
 - e. Thickness of Tinted and Heat-Absorbing Glass: Provide the same thickness for each tint color indicated throughout Project.
- C. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): **120 deg F**, ambient; **180 deg F**, material surfaces.
- D. Thermal and Optical Performance Properties: Provide glass with performance properties specified based on manufacturer's published test data, as determined according to procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites 6.0 mm thick.
2. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
3. Center-of-Glass Values: Based on using LBL-44789 WINDOW 5.0 computer program for the following methodologies:
 - a. U-Factors: NFRC 100 expressed as **Btu/ sq. ft. x h x deg F.**
 - b. Solar Heat Gain Coefficient: NFRC 200.
 - c. Solar Optical Properties: NFRC 300.

1.5 SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated.
- B. Samples: For the following products, in the form of **12-inch-** square Samples for glass and of **12-inch-** long Samples for sealants. Install sealant Samples between two strips of material representative in color of the adjoining framing system.
 1. Each color of tinted float glass.
 2. Coated vision glass.
 3. Insulating glass for each designation indicated.
 4. For each color (except black) of exposed glazing sealant indicated.
- C. Glazing Schedule: Use same designations indicated on Drawings for glazed openings in preparing a schedule listing glass types and thicknesses for each size opening and location.
- D. Product Certificates: Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.
 1. For solar-control low-e-coated glass, provide documentation demonstrating that manufacturer of coated glass is certified by coating manufacturer.
- E. Qualification Data: For installers.
- F. Preconstruction Adhesion and Compatibility Test Report: From glazing sealant manufacturer indicating glazing sealants were tested for adhesion to glass and glazing channel substrates and for compatibility with glass and other glazing materials.
- G. Product Test Reports: For each of the following types of glazing products:
 1. Tinted float glass.
 2. Coated float glass.
 3. Insulating glass.
 4. Glazing sealants.
 5. Glazing gaskets.
- H. Warranties: Special warranties specified in this Section.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance; and who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
- B. Source Limitations for Glass: Obtain the following through one source from a single manufacturer for each glass type: clear float glass and insulating glass.
- C. Source Limitations for Glass Sputter-Coated with Solar-Control Low-E Coatings: Where solar-control low-e coatings of a primary glass manufacturer that has established a certified fabricator program is specified, obtain sputter-coated solar-control low-e-coated glass in fabricated units from a manufacturer that is certified by coated-glass manufacturer.
- D. Source Limitations for Glazing Accessories: Obtain glazing accessories through one source from a single manufacturer for each product and installation method indicated.
- E. Glass Product Testing: Obtain glass test results for product test reports in "Submittals" Article from a qualified testing agency based on testing glass products.
 - 1. Glass Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.
 - 2. Glass Testing Agency Qualifications: An independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.
- F. Elastomeric Glazing Sealant Product Testing: Obtain sealant test results for product test reports in "Submittals" Article from a qualified testing agency based on testing current sealant formulations within a 36-month period.
 - 1. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated, as documented according to ASTM E 548.
 - 2. Test elastomeric glazing sealants for compliance with requirements specified by reference to ASTM C 920, and where applicable, to other standard test methods.
- G. Preconstruction Adhesion and Compatibility Testing: Submit to elastomeric glazing sealant manufacturers, for testing indicated below, samples of each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member that will contact or affect elastomeric glazing sealants:
 - 1. Use ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
 - 2. Submit not fewer than eight pieces of each type 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 sealant manufacturer's written instructions for corrective measures, including the use of specially formulated primers.
 - 5. Testing will not be required if elastomeric glazing sealant manufacturers submit data based on previous testing of current sealant products for adhesion to, and compatibility with, glazing materials matching those submitted.

- H. Safety Glazing Products: Comply with testing requirements in 16 CFR 1201.
 - 1. Subject to compliance with requirements, obtain safety glazing products permanently marked with certification label of the Safety Glazing Certification Council or another certification agency or manufacturer acceptable to authorities having jurisdiction.
 - 2. Where glazing units, including Kind FT glass and laminated glass, are specified in Part 2 articles for glazing lites more than 9 sq. ft. in exposed surface area of one side, provide glazing products that comply with Category II materials, for lites 9 sq. ft. or less in exposed surface area of one side, provide glazing products that comply with Category I or II materials, except for hazardous locations where Category II materials are required by 16 CFR 1201 and regulations of authorities having jurisdiction.
- I. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. GANA Publications: GANA "Glazing Manual."
 - 2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "Glazing Guidelines for Sealed Insulating Glass Units."
- J. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the following testing and inspecting agency:
 - 1. Insulating Glass Certification Council.
 - 2. Associated Laboratories, Inc.
- K. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. For insulating-glass units that will be exposed to substantial altitude changes, comply with insulating-glass manufacturer's written recommendations for venting and sealing to avoid hermetic seal ruptures.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
 - 1. Do not install liquid glazing sealants when ambient and substrate temperature conditions are outside limits permitted by glazing sealant manufacturer or below 40 deg F.

1.9 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form, made out to Owner and signed by coated-glass manufacturer agreeing to replace coated-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: 10 years from date of Substantial Completion.

- B. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form, made out to Owner and signed by insulating-glass manufacturer agreeing to replace insulating-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 GLASS PRODUCTS

- A. Ceramic-Coated Spandrel Glass: ASTM C 1048, Type I, Condition B, Quality-Q3.
- B. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- C. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- D. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- E. Spacers: Elastomeric blocks or continuous extrusions with a Shore, Type A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- F. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

- G. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.3 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

2.4 INSULATING-GLASS UNITS

- A. **Ceramic** coated, insulating spandrel glass.
 - 1. Coating Color: Black
 - 2. Outdoor Lite: **Clear fully tempered.**
 - 3. Indoor Lite: **Clear, fully tempered.**
 - 4. Coating Location: Fourth surface.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing glazing, with Installer present, for compliance with the following:
 - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 - 2. Presence and functioning of weep system.
 - 3. Minimum required face or edge clearances.
 - 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Glazing channel dimensions, as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.

- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass lites where length plus width is larger than **50 inches** as follows:
 - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 - 2. Provide **1/8-inch** minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

3.4 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.5 CLEANING AND PROTECTION

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do

come into contact with glass, remove substances immediately as recommended by glass manufacturer.

- C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.
- D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.
- E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 088000

SECTION 089000

LOUVERS AND VENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Fixed, formed-metal louvers.
- B. Related Sections:
 - 1. Division 09 Section "Exterior Painting" for field painting louvers.
 - 2. Division 23 Sections for louvers that are a part of mechanical equipment.

1.3 DEFINITIONS

- A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.
- B. Horizontal Louver: Louver with horizontal blades; i.e., the axes of the blades are horizontal.
- C. Vertical Louver: Louver with vertical blades; i.e., the axes of the blades are vertical.
- D. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.
- E. Storm-Resistant Louver: Louver that provides specified wind-driven rain performance, as determined by testing according to AMCA 500-L.

1.4 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.
 - 1. Wind Loads: Determine loads based on a uniform pressure of 20 lbf/sq. ft., acting inward or outward.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.
- B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.
 - 1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
 - 2. Show mullion profiles and locations.
- C. Samples for Verification: For each type of metal finish required.

1.6 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.

1.7 QUALITY ASSURANCE

- A. Source Limitations: Obtain louvers and vents from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.
- B. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

1.8 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Galvanized-Steel Sheet: ASTM A 653/A 653M, [G60] [G90] zinc coating, mill phosphatized.
- B. Fasteners: Use types and sizes to suit unit installation conditions.
 - 1. Use Phillips flat-head screws for exposed fasteners unless otherwise indicated.
 - 2. For fastening galvanized steel, use hot-dip-galvanized steel or 300 series stainless-steel fasteners.
 - 3. For fastening stainless steel, use 300 series stainless-steel fasteners.
 - 4. For color-finished louvers, use fasteners with heads that match color of louvers.

2.2 FABRICATION, GENERAL

- A. Assemble louvers in factory to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- B. Maintain equal louver blade spacing to produce uniform appearance.
- C. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
 - 1. Frame Type: Channel unless otherwise indicated.
- D. Include supports, anchorages, and accessories required for complete assembly.
- E. Provide vertical mullions of type and at spacings indicated, but not more than recommended by manufacturer, or 72 inches o.c., whichever is less.
 - 1. Exposed Mullions: Where indicated, provide units with exposed mullions of same width and depth as louver frame. Where length of louver exceeds fabrication and handling limitations, provide interlocking split mullions designed to permit expansion and contraction.
- F. Join frame members to each other and to fixed louver blades with fillet welds, threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.3 FIXED, FORMED-METAL LOUVERS

- A. Horizontal, Nondrainable-Blade Louver:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Wonder Metals L-430 or comparable product by one of the following:
 - a. Air Balance Inc.; a Mestek company.
 - b. Air Flow Company, Inc.
 - c. Airolite Company, LLC (The).
 - d. Cesco Products; a division of Mestek, Inc.
 - e. Construction Specialties, Inc.
 - f. Metal Form Manufacturing Inc.
 - g. NCA Manufacturing, Inc.
 - h. United Enertech Corp.
 - i. Vent Products Company, Inc.
 - 2. Louver Depth: 4 inches.
 - 3. Blade Profile: Plain blade without center baffle.
 - 4. Frame and Blade Material and Nominal Thickness: Galvanized-steel sheet, not less than 0.052 inch.
 - 5. Mullion Type: Exposed.
 - 6. Louver Performance Ratings:
 - a. Free Area: Not less than 8.0 sq. ft. for 48-inch- wide by 48-inch- high louver.
 - b. Point of Beginning Water Penetration: Not less than 600 fpm.
 - c. Air Performance: Not more than 0.10-inch wg static pressure drop at 600-fpm free-area velocity.

2.4 LOUVER SCREENS

- A. General: Provide screen at each exterior louver.
 - 1. Screen Location for Fixed Louvers: Interior face.
 - 2. Screening Type: Bird screening.
- B. Secure screen frames to louver frames with machine screws with heads finished to match louver, spaced a maximum of 6 inches from each corner and at 12 inches o.c.
- C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.
 - 1. Metal: Same kind and form of metal as indicated for louver to which screens are attached.
 - 2. Finish: Same finish as louver frames to which louver screens are attached.
 - 3. Type: Non-rewirable, U-shaped frames.
- D. Louver Screening for Galvanized-Steel Louvers:
 - 1. Bird Screening: Galvanized steel, 1/2-inch- square mesh, 0.041-inch wire.

2.5 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

2.6 GALVANIZED-STEEL SHEET FINISHES

- A. Finish louvers after assembly.
- B. Surface Preparation: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas and repair according to ASTM A 780.
- C. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard 2-coat, baked-on finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil for topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils.
 - 1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

- A. Locate and place louvers and vents level, plumb, and at indicated alignment with adjacent work.
- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
- C. Form closely fitted joints with exposed connections accurately located and secured.
- D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- E. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.
- F. Protect unpainted galvanized and nonferrous-metal surfaces that will be in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.
- G. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Division 07 Section "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

- A. Clean exposed surfaces of louvers and vents that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.
- B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.
- C. Restore louvers and vents damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.
 - 1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 089000

SECTION 092216

NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Non-load-bearing steel framing systems for interior partitions.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Horizontal Deflection: For wall assemblies, limited to **1/240** of the wall height.

2.2 FRAMING SYSTEMS

- A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
 - 1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
 - 2. Protective Coating: **ASTM A 653/A**
- B. Studs and Runners: ASTM C 645, mi. 24 gauge.
- C. Slip-Type Head Joint:
Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch- (51-mm-) deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.
- D. Cold-Rolled Channel Bridging: Steel, 0.0538-inch (1.367-mm) minimum base-metal thickness, with minimum 1/2-inch- (13-mm-) wide flanges.

2.3 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
 1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754.
 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
- B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.
- C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- D. Install bracing at terminations in assemblies.
- E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components @ 16" o.c. maximum.
- B. Where studs are installed directly against exterior masonry walls install isolation strip between studs and wall.
- C. Install studs so flanges within framing system point in same direction.

- D. At door and window openings install at each jamb double back to back studs with a separate track piece facing the opening. Install a header assembly with min. 6" stud members at each side of wall nested in a track piece with a track piece over. Connect header assembly to each jamb with full stud depth angle clips at the top and bottom intersections of header tracks and jamb tracks.
- E. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates.
 - 1. Provide Slip-Type Head Joints at overhead structural supports installed to produce joints at tops of framing systems that prevent axial loading of finished assemblies.

END OF SECTION 092216

SECTION 092400
CEMENT PLASTERING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior plasterwork (stucco).

1.2 ACTION SUBMITTALS

- A. Product Data:** For each type of product.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Store materials inside under cover, and keep them dry and protected against damage from weather, moisture, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.**

1.4 FIELD CONDITIONS

- A. Comply with ASTM C 926 requirements.**

B. Exterior Plasterwork:

1. Apply and cure plaster to prevent plaster drying out during curing period. Use procedures required by climatic conditions, including moist curing, providing coverings, and providing barriers to deflect sunlight and wind.

PART 2 - PRODUCTS

2.1 ACCESSORIES

- A. General:** Comply with ASTM C 1063, and coordinate depth of trim and accessories with thicknesses and number of plaster coats required.

- B. Metal Accessories:** See Drawings

2.2 MISCELLANEOUS MATERIALS

- A. Water for Mixing and Finishing Plaster: Potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories.
- B. Fasteners for Attaching Metal Lath to Substrates: ASTM C 1063.

2.3 PLASTER MATERIALS

- A. Portland Cement: ASTM C 150/C 150M, **Type I**.
- B. Masonry Cement: ASTM C 91, Type N.
- C. Lime: ASTM C 206, Type S; or ASTM C 207, Type S.
- D. Sand Aggregate: ASTM C 897.

2.4 PLASTER MIXES

- A. Comply with ASTM C 926 for applications indicated.
- B. Base-Coat Mixes for Use over **Unit Masonry and Concrete**: Single base (scratch) coat for two-coat plasterwork on low-absorption plaster bases as follows:
 - 1. Portland Cement Mix: For cementitious material, mix 1 part portland cement and 0 to 3/4 part lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
 - 2. Portland and Masonry Cement Mix: For cementitious material, mix 1 part portland cement and 1 part masonry cement. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
 - 3. Plastic Cement Mix: Use 1 part plastic cement and 2-1/2 to 4 parts aggregate.
- C. Base-Coat Mixes for Use over **Unit Masonry and Concrete**: Single base (scratch) coat for two-coat plasterwork on high-absorption plaster bases as follows:
 - 1. Portland Cement Mix: For cementitious material, mix 1 part portland cement and 3/4 to 1-1/2 parts lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
 - 2. Masonry Cement Mix: Use 1 part masonry cement and 2-1/2 to 4 parts aggregate.
 - 3. Portland and Masonry Cement Mix: For cementitious material, mix 1 part portland cement and 1 part masonry cement. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
 - 4. Plastic Cement Mix: Use 1 part plastic cement and 2-1/2 to 4 parts aggregate.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates 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.
- 3.2 PREPARATION
- A. Protect adjacent work from soiling, spattering, moisture deterioration, and other harmful effects caused by plastering.
 - B. Prepare smooth, solid substrates for plaster according to ASTM C 926.
- 3.3 INSTALLING ACCESSORIES
- A. Install according to ASTM C 1063 and at locations indicated on Drawings.
- 3.4 PLASTER APPLICATION
- A. General: Comply with ASTM C 926.
- 3.5 PLASTER APPLICATION
- A. General: Comply with ASTM C 926.
 - 1. Do not deviate more than plus or minus 1/4 inch in 10 feet (6 mm in 3 m) from a true plane in finished plaster surfaces when measured by a 10-foot (3-m) straightedge placed on surface.
 - 2. Finish plaster flush with metal frames and other built-in metal items or accessories that act as a plaster ground unless otherwise indicated. Where casing bead does not terminate plaster at metal frame, cut base coat free from metal frame before plaster sets and groove finish coat at junctures with metal.
 - 3. Provide plaster surfaces that are ready to receive field-applied finishes indicated.
 - B. Bonding Compound: Apply on **unit masonry and concrete** substrates for direct application of plaster.
 - C. Walls; Base-Coat Mix: For base (scratch) coat, for two-coat plasterwork and having **5/8-inch (1 1/2 inches) thickness on masonry** as follows:
 - 1. Portland cement mix.
 - 2. Masonry cement mix.
 - 3. Portland and masonry cement mix.
 - 4. Plastic cement mix.
 - 5. Portland and plastic cement mix.
- 3.6 PLASTER REPAIRS
- A. Repair or replace work to eliminate cracks, dents, blisters, buckles, crazing and check cracking, dry outs, efflorescence, sweat outs, and similar defects and where bond to substrate has failed.

3.7 CLEANING AND PROTECTION

- A. Remove temporary protection and enclosure of other work after plastering is complete. Promptly remove plaster from door frames, windows, and other surfaces not indicated to be plastered. Repair floors, walls, and other surfaces stained, marred, or otherwise damaged during plastering.

END OF SECTION 092400

SECTION 092900

GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, CBC 2503, 2504, 2506, 2508, 2509, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Interior gypsum board.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes. Stack panels flat to prevent sagging.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Do not install interior products 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

2.1 PANELS, GENERAL

- A. Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.2 INTERIOR GYPSUM BOARD

- A. General: Complying with ASTM C 36/C 36M or ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Gypsum Co.
 - b. G-P Gypsum.
 - c. National Gypsum Company.
 - d. PABCO Gypsum.
 - e. USG Corporation.
- B. Type X:

2.3 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
 - 1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.
 - 2. Shapes:
 - a. Cornerbead.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - c. L-Bead: L-shaped; exposed long flange receives joint compound.
 - d. Expansion (control) joint.

2.4 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
 - 1. Interior Gypsum Wallboard: Paper.
- C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
3. Fill Coat: For second coat, use setting-type, sandable topping compound.
4. Finish Coat: For third coat, use setting-type, sandable topping compound.

2.5 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
- C. Thermal Insulation: As specified in Division 07 Section "Thermal Insulation."
- D. Vapor Retarder: As specified in Division 07 Section "Thermal Insulation."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames and framing, 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.

3.2 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- 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- (6.4- to 9.5-mm-)** wide joints to install sealant.
- G. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

3.3 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 - 1. Type X: As indicated on Drawings.
 - 2. Moisture- and Mold-Resistant Type: As indicated on Drawings.
- B. Single-Layer Application:
 - 1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing, unless otherwise indicated.
 - 2. On partitions/walls, apply gypsum panels vertically (parallel to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
 - b. At high walls, install panels horizontally, unless otherwise indicated or required by fire-resistance-rated assembly.
 - 3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
 - 4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- C. Multilayer Application:
 - 1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints 1 framing member, **16 inches (400 mm)** minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
 - 2. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

3.4 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
 - 1. Cornerbead: Use at outside corners.
 - 2. LC-Bead: Use at exposed panel edges.
 - 3. L-Bead: Use where indicated.

3.5 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, rounded or beveled edges, and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
 - 1. 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.

3.6 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. 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.

END OF SECTION 092900

SECTION 096513

RESILIENT BASE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Resilient base.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12 inches (300 mm) long, of each resilient product color, texture, and pattern required.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Furnish not less than 10 linear feet (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.5 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

1.7 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive resilient products during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 RESILIENT BASE

- A. Resilient Base:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
- B. Resilient Base Standard: ASTM F 1861.
 - 1. Material Requirement: Type TP (rubber, thermoplastic).
 - 2. Manufacturing Method: Group I (solid, homogeneous).
 - 3. Style: Cove (base with toe).
- C. Minimum Thickness: 0.125 inch (3.2 mm).
- D. Height: 6 inches (102 mm).
- E. Lengths: Coils in manufacturer's standard length.
- F. Finish: Satin.
- G. Colors and Patterns: Black.

2.2 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.
 - 1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), except that adhesive for rubber stair treads shall have a VOC content of 60 g/L or less.
 - 2. Adhesives 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."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install resilient products until they are same temperature as the space where they are to be installed.
 - 1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- D. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.

- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.
- B. Perform the following operations immediately after completing resilient product installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.
- C. Protect resilient products from marks, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover resilient products until Substantial Completion.

END OF SECTION 096513

SECTION 096519

RESILIENT FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Marmoleum composition tile.
- B. Related Sections:
 - 1. Division 09 Section "Resilient Base and Accessories" for resilient base, reducer strips, and other accessories installed with resilient floor coverings.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: Full-size units of each color and pattern of floor tile required.
- C. Product Schedule: For floor tile. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor tile installation indicated.
 - 1. Engage an installer who employs workers for this Project who are trained or certified by manufacturer for installation techniques required. Engage installer certified as a Forbo "Master Mechanic."

2. Proof of Certification; provide proof of certification as Forbo “Master Mechanic” before start of work.

- B. Comply with the following as a minimum requirement:
 1. ASTM E 84: Class A Flame Spread Rating of 25 or less.
 2. Fire Test Data: ASTM E 648, NFPA 253, ASTM E 662, NFPA 258.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C). Store floor tiles on flat surfaces.

1.8 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive floor tile during the following time periods:
 1. 48 hours before installation.
 2. During installation.
 3. 48 hours after installation.
- B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- C. Close spaces to traffic during floor tile installation.
- D. Close spaces to traffic for 48 hours after floor tile installation.
- E. Install floor tile after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. A. Resilient Linoleum Tile: Manufactured from natural materials consisting of linseed oil, wood flour, and rosin binders mixed and calendered onto a polyglass backing. No asbestos is permitted in the material. Static loads limit to be 1500 pounds per square inch (per ASTM F970), (Non-modified psi per ASTM test No.
- B. 1. Size: 13"x13" 0.80" thickness.
- C. B. Slip-resistance: Minimum coefficient of 0.6

2.2 MARMOLEUM COMPOSITION FLOOR TILE

- A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 1. Forbo Marmoleum Composition Tiles (MCT) with Topshield.

SECTION 098000

PROTECTIVE COATINGS FOR PIPING AND METALWORK

PART 1 - GENERAL

1.1 REQUIREMENTS

A. The CONTRACTOR shall provide Protective Coatings, complete and in place, in accordance with the Contract Documents.

B. Definitions

1. The term "paint," "coatings," or "finishes" as used herein, shall include surface treatments, emulsions, enamels, paints, epoxy resins, tape wraps, and all other Protective Coatings, excepting galvanizing or anodizing, whether used as a pretreatment, primer, intermediate coat, or finish coat.

2. The term "DFT" means minimum dry film thickness, without any negative tolerance.

C. The following surfaces shall not be protective coated:

1. Concrete, unless specifically indicated to be coated.
2. Brass fittings, Stainless Steel, and Copper.
3. Machined surfaces.
4. Grease fittings.
5. Glass.
6. Equipment nameplates.
7. Platform gratings, stair treads, door thresholds, and other walk surfaces, unless specifically indicated to be coated.

D. The coating system schedules summarize the surfaces to be coated, the required surface preparation, and the coating systems to be applied. Coating notes on the Construction Drawings are used to show the limits of coating requirements, to show exceptions to the requirements, or to clarify or show details for application of the coating systems.

E. Where Protective Coatings are to be performed by a subcontractor, the subcontractor shall possess a valid state license as required for performance of the painting and coating work called for in this specification and shall provide 2 references which show that the painting subcontractor has previous successful experience with the indicated or comparable coating systems. Include the name, address, and the telephone number for the OWNER of each installation for which the painting subcontractor provided the Protective Coatings.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section 05500 – Miscellaneous Metalwork

1.3 CONTRACTOR SUBMITTALS

A. **General:** Submittals shall be furnished in accordance with Section 01300 - Contractor Submittals, unless indicated otherwise below.

B. Submittals shall include the following information and be submitted at least 21 calendar days prior to Protective Coatings work:

1. Coating Materials List: Four copies of a coating materials list showing the Manufacturer and the coating number, keyed to the coating systems herein. The list shall be submitted prior to or at the time of submittal of samples.
2. Paint Manufacturer's Information: For each coating system to be used, the following data:
 - a. Paint Manufacturer's data sheet for each product proposed, including statements on the suitability of the material for the intended use.
 - b. Technical and performance information that demonstrates compliance with the system performance and material requirements.
 - c. Paint Manufacturer's instructions and recommendations on surface preparation and application.
 - d. Colors available for each product (where applicable).
 - e. Compatibility of shop and field applied coatings (where applicable).
 - f. Material Safety Data Sheet for each product used.

1.4 SPECIAL CORRECTION OF DEFECTS REQUIREMENTS

A. **Warranty Inspection:** A warranty inspection will be conducted during the eleventh month following completion of all coating and painting work. The CONTRACTOR and a representative of the coating material Manufacturer may attend this inspection. All defective work shall be repaired in accordance with these specifications and to the satisfaction of the OWNER.

PART 2 - PRODUCTS

2.1 GENERAL

A. **Suitability:** The CONTRACTOR shall use suitable coating materials as recommended by the Manufacturer.

B. **Compatibility:** In any coating system only compatible materials from a single Manufacturer shall be used in the work. Particular attention shall be directed to compatibility of primers and finish coats. If necessary, a barrier coat shall be applied between existing prime coat and subsequent field coats to ensure compatibility.

C. **Containers:** Coating materials shall be sealed in containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, and name of manufacturer, all of which shall be plainly legible at the time of use.

D. **Colors:** All colors and shades of colors of all coats of paint shall be as indicated or selected by the PROJECT ENGINEER and approved by the OWNER. Each coat shall be of a different shade, to facilitate inspection of surface coverage of each coat. Colors for exterior (visible) surfaces shall be as follows unless specified otherwise. Finish color shall be ICI Devoe Car Blue, or equal, for all piping and isolation valves. Finish color shall be ICI Devoe Safety Blue, or equal, for all automatic control valves, pumps, and motors. Finish color shall be ICI Devoe Safety Yellow, or equal, for fire hydrants, and bollards.

E. Substitute or "Or-Equal" Products

1. To establish equality under Section 01600 - Products, Materials, Equipment and Substitutions, the CONTRACTOR shall furnish satisfactory documentation from the manufacturer of the proposed substitute or "or-equal" product that the material meets the indicated requirements and is equivalent or better than the specified product.
2. Protective Coatings Materials shall be standard products produced by recognized manufacturers who are regularly engaged in production of such materials for essentially identical service conditions.
3. If a proposed substitution requires changes in the WORK, the CONTRACTOR shall bear all such costs involved.

2.2 MATERIAL SOURCES

A. Each of the following manufacturers is capable of supplying many of the industrial coating materials indicated herein. Proposed substitute materials will be considered as indicated above. All industrial coating materials shall be materials that have a record of satisfactory performance in water and wastewater treatment plants, and under the service conditions to which they will be subjected.

ICI Devco Coatings
Tnemec Company
Ameron
Carboline Coatings Company
Polyken Technologies

2.3 INDUSTRIAL COATING SYSTEMS

A. **System 1 – Epoxy/Aliphatic Polyurethane:** Two component aliphatic acrylic polyurethane coating material shall provide superior color and gloss retention, resistance to splash from acid and alkaline chemicals, resistance to chemical fumes and severe weathering and with a minimum solids content of 63 percent by volume. Primer and intermediate coats shall be a two component rust inhibitive epoxy coating material with a minimum solids content of 65 percent by volume.

1. Prime coat (field or shop applied) DFT = 4 mils, Devco 224HS, Tnemec N69, Ameron 385, or equal.
2. Intermediate coat DFT = 4 mils, Devco 224HS, Tnemec N69, Ameron 385, or equal.
3. Finish coats (one or two coats, DFT = 3 mils), Devco 379UVA, Tnemec 74, Ameron Amershield, or equal.
4. Total system DFT = 11 mils.
5. More than one finish coat shall be applied as necessary to produce a finish with uniform color and texture.

B. **System 2 - Inorganic Zinc/Epoxy/Aliphatic Polyurethane:** The inorganic zinc primer shall be a water or solvent based, self-curing, two-component zinc silicate inorganic coating material containing at least 65 percent of metallic zinc by weight in the dried film. This coating material shall be recommended by the coating manufacturer as a primer for this system. The intermediate coat shall be a two component high-build epoxy coating material with a minimum solids content of 56 percent by volume. Finish coats shall be a 2-component aliphatic acrylic or polyester polyurethane

coating material that provides superior color and gloss retention, resistance to chemical fumes and severe weathering, and a minimum solids content of 63 percent by volume.

1. Prime coat DFT = 3 mils, Devoe 302H, Tnemec 90-96, Ameron 21-5, or equal.
2. Intermediate coat DFT = 4 mils, Devoe 224HS, Tnemec N69, Ameron 385, or equal.
3. Finish coats (one or two coats, DFT = 3 mils), Devoe 379UVA, Tnemec 74, Ameron Amershield, or equal.
4. Total system DFT = 10 mils.
5. Intermediate coat shall be applied in excess of 4 mils DFT or in more than one coat as necessary to completely cover the inorganic zinc primer and prevent application bubbling of the polyurethane finish coat.
6. More than one finish coat shall be applied as necessary to produce a finish with uniform color and texture.
7. If the inorganic zinc primer is used as a pre-construction or shop applied primer, all damaged and uncoated areas shall be spot abrasive blasted and coated after construction using the indicated material.

C. **System 3 – Epoxy(x3):** Two component, rust inhibitive polyamide cured epoxy coating material shall provide a recoatable finish that is available in a wide selection of colors. The coating material shall have a minimum solids content of 65 percent by volume and be resistant to service conditions of condensing moisture, splash and spillage of lubricating oils, and frequent washdown and cleaning.

1. Prime coat (field or shop applied) DFT = 4 mils, Devoe 224HS, Tnemec N69, Ameron 385, or equal.
2. Intermediate and finish coats (2 coats, DFT = 8 mils), Devoe 224HS, Tnemec N69, Ameron 385, or equal.
3. Total system DFT = 12 mils.

2.4 SUBMERGED AND SEVERE SERVICE COATING SYSTEMS

A. **System 101 - Amine Cured Epoxy(x3):** High build, amine cured, epoxy coating material shall have a minimum solids content of 80 percent by volume, and shall be suitable for long-term immersion service in potable water and municipal wastewater. For potable water service, the coating material shall be listed by the NSF International as in compliance with NSF Standard 61 - Drinking Water System Components - Health Effects.

1. Prime, intermediate, and finish coats (three coats, DFT = 18 mils), Devoe 233H, Tnemec 141, Ameron 395FD, or equal.

B. **System 102 - Polyamide Cured Epoxy(x3):** High build, polyamide cured epoxy coating material shall have a minimum solids content of 64 percent by volume, and shall be suitable for long-term immersion service in potable water and municipal wastewater. For potable water service, the coating material shall be listed by the NSF International as in compliance with NSF Standard 61.

1. Prime, intermediate, and finish coats (three coats, DFT = 12 mils), Devoe 233H, Tnemec N140, Ameron 90HS, or equal.

C. **System 103 - Fusion Bonded Epoxy:** The coating material shall be a 100 percent powder epoxy, certified as compliant with NSF Standard 61, applied in accordance with the ANSI/AWWA C213 - Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines, except that the surface preparation shall be as specified in the coating system schedule of this Section. The coating shall be applied using the electrostatic spray or fluidized bed process.

1. Powder coat DFT = 16 mils, Scotchkote 134 or 206N, or equal.
2. For coating of valves, DFT = 12 mils.
3. Liquid Epoxy: For field repairs, the use of a liquid epoxy will be permitted, applied to provide a DFT of 15 mils. The liquid epoxy shall be a 100 percent solids epoxy, ScotchKote 323, or equal.
4. For indoors or covered conditions, or inside hydraulic structures and vaults: Field applied finish coat DFT = 4 mils, Devoe 224HS, Tnemec N69, Ameron 385, or equal.
5. For outdoors or exposed conditions: Field applied finish coats (one or two coats, DFT = 3 mils), Devoe 379UVA, Tnemec 74, Ameron Amershield, or equal. More than one finish coat shall be applied as necessary to produce a finish with uniform color and texture.
6. Total system DFT = 16-20 mils.

2.5 SPECIAL COATING SYSTEMS

A. **System 201 – Joint Wrap:** Prior to wrapping the pipe, nuts and bolts, fittings, flanges or other surfaces with heavy duty joint wrap, the items or surface shall be coated with a liquid adhesive primer. The items or surface shall be wrapped with a 35-mil adhesive joint wrap, half-lapped, to achieve a total thickness of 70 mils. Joint wrap shall be Polyken Technologies, Heavy Duty Joint Wrap, Product No. 930-35, or approved equal. Liquid adhesive primer shall be Polyken Technologies, Liquid Adhesive No. 1027, or approved equal.

B. **System 202 - Cement Mortar Coating:** A 1-1/2-inch minimum thickness mortar coating reinforced with 3/4-inch galvanized welded wire fabric shall be provided. The cement mortar shall contain no less than one part Type V cement to 3 parts sand. The cement mortar shall be cured by a curing compound meeting the requirements of "Liquid Membrane Forming Compounds for Curing Concrete," ASTM C 309, Type II, white pigmented, or by enclosure in an 8-mil thick polyethylene sheet with all edges and joints lapped by at least 6 inches.

C. **System 203 - Polyethylene Encasement:** Application of polyethylene encasement shall be in accordance with ANSI/AWWA C105 using Method C.

PART 3 - EXECUTION

3.1 MANUFACTURER'S SERVICES

- A. The CONTRACTOR shall require the Protective Coatings manufacturer to furnish a

qualified technical representative to visit the project site for technical support as may be necessary to resolve field problems attributable or associated with the manufacturer's products.

3.2 WORKMANSHIP

A. Skilled craftsmen and experienced supervision shall be used on all WORK.

B. Coating shall be done in a workmanlike manner so as to produce an even film of uniform thickness. Edges, corners, crevices, and joints shall receive special attention to insure thorough cleaning and an adequate thickness of coating material. The finished surfaces shall be free from runs, drops, ridges, waves, laps, brush marks, and variations in color, texture, and finish. The hiding shall be so complete that the addition of another coat would not increase the hiding. Special attention shall be given to insure that edges, corners, crevices, welds, and similar areas receive a film thickness equivalent to adjacent areas, and installations shall be protected by the use of drop cloths or other precautionary measures.

3.3 STORAGE, MIXING, AND THINNING OF MATERIALS

A. Unless otherwise indicated, the coating manufacturer's printed recommendations and instructions for thinning, mixing, handling, applying, and protecting its coating materials, for preparation of surfaces for coating, and for all other procedures relative to coating shall be strictly observed. Coating materials shall be stored under the conditions recommended by the Material Safety Data Sheets, and shall be thoroughly stirred, strained, and kept at a uniform consistency during application. Coatings of different manufacturers shall not be mixed together. All Protective Coatings materials shall be used within the manufacturer's recommended shelf life.

3.4 PREPARATION FOR COATING

A. **General:** All surfaces to receive Protective Coatings shall be cleaned as indicated prior to application of coatings. The CONTRACTOR shall examine all surfaces to be coated, and shall correct all surface defects before application of any coating material. All marred or abraded spots on shop-primed and on factory-finished surfaces shall receive touch-up restoration prior to any coating application. Surfaces to be coated shall be dry and free of visible dust.

B. **Protection of Surfaces Not to be Coated:** Surfaces which are not to receive Protective Coatings shall be protected during surface preparation, cleaning, and coating operations.

C. All hardware, lighting fixtures, switchplates, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not to be painted shall be removed, masked or otherwise protected. Drop cloths shall be provided to prevent coating materials from falling on or marring adjacent surfaces. The working parts of all mechanical and electrical equipment shall be protected from damage during surface preparation and coating operations. Openings in motors shall be masked to prevent entry of coating or other materials.

D. Care shall be exercised not to damage adjacent work during blast cleaning operations. Spray painting shall be conducted under carefully controlled conditions. The CONTRACTOR shall be fully responsible for and shall promptly repair any and all damage to adjacent work or adjoining property occurring from blast cleaning or coating operations.

E. **Protection of Painted Surfaces:** Cleaning and coating shall be coordinated so that dust and other contaminants from the cleaning process will not fall on wet, newly-coated surfaces.

3.5 SURFACE PREPARATION STANDARDS

A. The following referenced surface preparation specifications of the Steel Structures Painting Council shall form a part of this specification:

1. Solvent Cleaning (SSPC-SP1): Removal of oil, grease, soil, salts, and other soluble contaminants by cleaning with solvent, vapor, alkali, emulsion, or steam.
2. White Metal Blast Cleaning (SSPC-SP5): Removal of all visible rust, oil, grease, soil, dust, mill scale, paint, oxides, corrosion products and foreign matter by blast cleaning.
3. Commercial Blast Cleaning (SSPC-SP6): Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 33 percent of each square inch of surface area.
4. Brush-Off Blast Cleaning (SSPC-SP7): Removal of all visible oil, grease, soil, dust, loose mill scale, loose rust, and loose paint.
5. Near-White Blast Cleaning (SSPC-SP10): Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 5 percent of each square inch of surface area.

3.6 METAL SURFACE PREPARATION

A. The minimum abrasive blasting surface preparation shall be as indicated in the coating system schedules included at the end of this Section. Where there is a conflict between these specifications and the coating manufacturer's printed recommendations for the intended service, the higher degree of cleaning shall apply.

B. Workmanship for metal surface preparation shall be in conformance with the current SSPC Standards and this Section. Blast cleaned surfaces shall match the standard samples available from the National Association of Corrosion ENGINEERS, NACE Standard TM-01-70 - Visual Standard for Surfaces of New Steel Airblast Cleaned with Sand Abrasive and TM-01-75 - Visual Standard for Surfaces of New Steel Centrifugally Blast Cleaned with Steel Grit.

C. All oil, grease, welding fluxes, and other surface contaminants shall be removed by solvent cleaning per SSPC-SP1 - Solvent Cleaning prior to blast cleaning.

D. All sharp edges shall be rounded or chamfered and all burrs, and surface defects and weld splatter shall be ground smooth prior to blast cleaning.

E. The type and size of abrasive shall be selected to produce a surface profile that meets the coating manufacturer's recommendation for the particular coating and service conditions.

F. The CONTRACTOR shall comply with the applicable federal, state, and local air pollution control regulations for blast cleaning.

G. Surfaces shall be cleaned of all dust and residual particles of the cleaning operation by dry air blast cleaning, vacuuming, or another approved method prior to painting.

H. Damaged or defective coating shall be removed by the specified blast cleaning to meet the

clean surface requirements before recoating.

I. If the specified abrasive blast cleaning will damage adjacent work, the area to be cleaned is less than 100 square feet, and the coated surface will not be submerged in service, then SSPC-SP2 or SSPC-SP3 shall be used.

J. Shop primed equipment shall be solvent cleaned in the field before finish coats are applied.

3.7 SURFACE PREPARATION AND APPLICATION OF JOINT WRAP

A. Nuts and bolts, couplings, valves, fittings, flanges, and steel pipe to receive heavy duty joint wrap shall be cleaned to remove all visible oil, grease, soil, dust, rust, and other foreign matter. Surfaces to receive joint wrap shall be coated with liquid adhesive primer in accordance with the manufacturers recommendations, prior to application of joint wrap.

B. After being primed, the items or surface to be protected shall be wrapped with the 35-mil joint wrap, half-lapped, to achieve a total thickness of 70 mils. Care shall be taken to completely encapsulate all nuts and bolts.

3.8 SHOP COATING REQUIREMENTS

A. Unless otherwise indicated, all items of equipment, or parts of equipment which are not submerged in service, shall be shop primed and then finish coated in the field after installation with the indicated or selected color. The methods, materials, application equipment and all other details of shop painting shall comply with this section. If the shop primer requires top-coating within a specified period of time, the equipment shall be finish coated in the shop and then touch-up painted after installation.

B. For certain pieces of equipment it may be undesirable or impractical to apply finish coatings in the field. Such equipment may include engine generator sets, equipment such as electrical control panels, switch-gear or main control boards, submerged parts of pumps, ferrous metal passages in valves, or other items where it is not possible to obtain the indicated quality in the field. Such equipment shall be primed and finish coated in the shop and touched up in the field with the identical material after installation. The coating material data sheet shall be submitted with the shop drawings for the equipment.

C. For certain small pieces of equipment the manufacturer may have a standard coating system which is suitable for the intended service conditions. In such cases, the final determination of suitability will be made during review of the shop drawing submittals.

D. Shop painted surfaces shall be protected during shipment and handling by suitable provisions including padding, blocking, and the use of canvas or nylon slings. Primed surfaces shall not be exposed to the weather for more than 2 months before being top-coated, or less time if recommended by the coating manufacturer. Damage to shop-applied coatings shall be repaired in accordance with this Section and the coating manufacturer's printed instructions.

E. The CONTRACTOR shall make certain that the shop primers and field topcoats are compatible and meet the requirements of this Section. Copies of applicable coating manufacturer's data sheets shall be submitted with equipment shop drawings.

3.9 APPLICATION OF COATINGS

- A. The application of Protective Coatings to steel substrates shall be in accordance with SSPC-PA1 - Paint Application Specification No. 1.
- B. Cleaned surfaces and all coats shall be inspected prior to each succeeding coat. The CONTRACTOR shall schedule such inspection with the OWNER in advance.
- C. Blast cleaned ferrous metal surfaces shall be painted before any rusting or other deterioration of the surface occurs. Blast cleaning shall be limited to only those surfaces that can be coated in the same working day.
- D. Coatings shall be applied in accordance with the manufacturer's instructions and recommendations, and this Section, whichever has the most stringent requirements.
- E. Special attention shall be given to edges, angles, weld seams, flanges, nuts and bolts, and other places where insufficient film thicknesses are likely to be present. Use stripe painting for these areas.
- F. Special attention shall be given to materials which will be joined so closely that proper surface preparation and application are not possible. Such contact surfaces shall be coated prior to assembly or installation.
- G. Finish coats, including touch-up and damage repair coats shall be applied in a manner which will present a uniform texture and color matched appearance.
- H. Coatings shall not be applied under the following conditions:
1. Temperature exceeding the manufacturer's recommended maximum and minimum allowable.
 2. Dust or smoke laden atmosphere.
 3. Damp or humid weather.
 4. When the substrate or air temperature is less than 5 degrees F above dewpoint.
 5. When air temperature is expected to drop below 40 degrees F or less than 5 degrees F above the dewpoint within 8 hours after application of coating.
 6. When wind conditions are not calm.
- I. Dewpoint shall be determined by use of a sling psychrometer in conjunction with U.S. Dept. of Commerce, Weather Bureau psychrometric tables.
- J. Unburied steel piping shall be abrasive blast cleaned and primed before installation.
- K. The finish coat on all work shall be applied after all concrete, masonry, and equipment installation is complete and the work areas are clean and dust free.

3.10 CURING OF COATINGS

- A. The CONTRACTOR shall maintain curing conditions in accordance with the conditions recommended by the coating material manufacturer or by this Section, whichever is the most stringent, prior to placing the completed coating system into service. In the case of enclosed areas, forced air ventilation, using heated air if necessary, may be required until the coatings have fully cured.

3.11 FIELD INSPECTION AND TESTING

A. **General:** The CONTRACTOR shall give the OWNER a minimum of 3 days advance notice of the start of any field surface preparation work or coating application work.

B. Inspection by the OWNER, or the waiver of inspection of any particular portion of the WORK, shall not relieve the CONTRACTOR of its responsibility to perform the work in accordance with these Specifications.

C. **Inspection Devices:** The CONTRACTOR shall furnish, until final acceptance of such coatings, inspection devices in good working condition for the detection of holidays and measurement of dry-film thicknesses of Protective Coatings. Dry-film thickness gages shall be made available for the OWNER'S use at all times while coating is being done, until final acceptance of such coatings. The CONTRACTOR shall furnish the services of a trained operator of the holiday detection devices until the final acceptance of such coatings. Holiday detection devices shall be operated only in the presence of the OWNER.

D. **Holiday Testing:** The CONTRACTOR shall holiday test all coated surfaces which will be submerged in water or other liquids, or surfaces which are enclosed in a vapor space in such structures and surfaces coated with any of the submerged and severe service coating systems. Areas which contain holidays shall be marked and repaired or recoated in accordance with the coating manufacturer's printed instructions and then retested.

1. **Coatings With Thickness Exceeding 20 Mils:** For surfaces having a total dry film coating thickness exceeding 20 mils: pulse-type holiday detector such as Tinker & Rasor Model AP-W, D.E. Stearns Co. Model 14/20, or equal shall be used. The unit shall be adjusted to operate at the voltage required to cause a spark jump across an air gap equal to twice the specified coating thickness.
2. **Coatings With Thickness of 20 Mils or Less:** For surfaces having a total dry film coating thickness of 20 mils or less: Tinker & Rasor Model M1 non-destructive type holiday detector, K-D Bird Dog, or equal shall be used. The unit shall operate at less than 75-volts. For thicknesses between 10 and 20 mils, a non-sudsing type wetting agent, such as Kodak Photo-Flo, or equal, shall be added to the water prior to wetting the detector sponge.

E. **Film Thickness Testing:** On ferrous metals, the dry film coating thickness shall be measured in accordance with the SSPC "Paint Application Specification No. 2" using a magnetic-type dry film thickness gage such as Mikrotest model FM, Elcometer model 111/1EZ, or equal. Each coat shall be tested for the correct thickness. No measurements shall be made until at least 8 hours after application of the coating. On non-ferrous metals and other substrates, the coating thicknesses shall be measured at the time of application using a wet film gage.

F. **Surface Preparation:** Evaluation of blast cleaned surface preparation work will be based upon comparison of the blasted surfaces with the standard samples available from the NACE, using NACE standards TM-01-70 and TM-01-75.

3.12 COATING SYSTEM SCHEDULES

A. **Coating System Schedule, Ferrous Metal - Not Galvanized:**

Item	Surface Prep.	System No.
MPWMD Santa Margarita ASR Facility		PROTECTIVE COATINGS
Santa Margarita Chlorination Facility		SECTION 098000
		PAGE-10

FM-1	Piping and miscellaneous surfaces indoors or covered, except those included below.	Commercial Blast Cleaning SSPC-SP6	(3) Epoxy(x3)
FM-2	Miscellaneous surfaces outdoors or exposed, except those included below.	Commercial Blast Cleaning SSPC-SP6	(1) Epoxy/Aliphatic Polyurethane
FM-3	Piping outdoors or exposed, except as indicated below.	Near White Metal Blast Cleaning SSPC-SP10	(2) Inorganic Zinc/Epoxy/Aliphatic Polyurethane
FM-4	Piping and miscellaneous surfaces inside hydraulic structures and vaults.	Near White Metal Blast Cleaning SSPC-SP10	(3) Epoxy(x3)
FM-5	Piping and miscellaneous surfaces inside hydraulic structures and vaults where subject to frequent immersion.	Solvent Cleaning SSPC-SP1 followed by Near White Metal Blast Cleaning SSPC-SP10	(103) Fusion Bonded Epoxy
FM-6	Buried ductile iron pipe.	Removal of oil, grease, soil and salts	(203) Polyethylene Encasement
FM-7	Buried steel pipe where not mortar-coated, or coal-tar enamel coated.	Removal of oil, grease, soil and salts	(201) Joint Wrap
FM-8	Ferrous surfaces of valves and couplings.	Solvent Cleaning SSPC-SP1 followed by Near White Metal Blast Cleaning SSPC-SP10	(103) Fusion Bonded Epoxy
FM-9	Buried valves, couplings, fittings, and joints, including epoxy-coated surfaces (where piping is mortar-coated steel).	Removal of oil, grease, soil and salts	(202) Cement Mortar Coating
FM-10	Buried nuts and bolts, valves, couplings, fittings, and flanged joints (where piping is not mortar-coated steel).	Removal of oil, grease, soil and salts	(201) Joint Wrap
FM-11	Buried surfaces that are not indicated to be coated elsewhere.	Near White Metal Blast Cleaning SSPC-SP10	(101) Amine Cured Epoxy(x3)
FM-12	Piping and miscellaneous surfaces submerged in water (excluding shop coated valves, couplings, and pumps).	Near White Metal Blast Cleaning SSPC-SP10	(102) Polyamide Cured Epoxy(x3)
FM-13	Ferrous surfaces in water passages and submerged surfaces of pumps.	Near White Metal Blast Cleaning SSPC-SP10	(101) Amine Cured Epoxy(x3)

B. Coating System Schedule, Ferrous Metal - Galvanized: Pretreatment coatings, barrier coatings, or washes shall be applied as recommended by the coating manufacturer. All galvanized surfaces shall be coated except for the following items which shall be coated only if required by other Sections: Floor Gratings and Frames, Ladders, Handrails, Stair Treads, and Chain Link Fencing and Hardware.

	Item	Surface Prep.	System No.
FMG-1	Miscellaneous surfaces indoors or covered, except those included below.	Solvent Cleaning SSPC-SP1	(3) Epoxy(x3)
FMG-2	Miscellaneous surfaces outdoors or exposed, except those included below.	Solvent Cleaning SSPC-SP1	(1) Epoxy/Aliphatic Polyurethane
FMG-3	Buried steel piping.	Removal of oil, grease, soil and salts	(201) Joint Wrap
FMG-4	Miscellaneous buried surfaces.	Solvent Cleaning SSPC-SP1 followed by Brush-Off Blast Cleaning SSPC-SP7	(3) Epoxy(x3)
FMG-5	Surfaces submerged in water.	Solvent Cleaning SSPC-SP1 followed by Brush-Off Blast Cleaning SSPC-SP7	(102) Polyamide Cured Epoxy(x3)

C. Coating System Schedule, Fire Hydrants, and Combination Air Valves:

	Item	Surface Prep.	System No.
FH-1	Fire Hydrants.	Solvent Cleaning SSPC-SP1	(1) Epoxy/Aliphatic Polyurethane
FAV-1	Combination Air Valves.	Commercial Blast Cleaning SSPC-SP6	(1) Epoxy/Aliphatic Polyurethane

END OF SECTION

SECTION 098790

CHEMICAL RESISTANT EPOXY COATING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Chemical-resistant, two-component epoxy resin seamless coating and membrane system for application on floor and wall surfaces of secondary containment spill areas for Chemical Rooms 101, 102, and 103. Coatings shall be applied to the waste sump, lower floors and walls up to and including the concrete deck in the lower double containment area; in the upper deck areas, coatings shall be applied to the upper deck floor, and chemical pump skid containment area. Coating is not required for the walls in the upper deck area.

B. Related Sections:

1. Section 033000: Cast-In-Place Concrete
2. Section 071900: Water Repellent Sealer

1.02 REFERENCES

A. American Society for Testing Materials:

1. C321 Test Method for Bond Strength of Chemical-Resistant Mortars
2. D638 Test Method for Tensile Properties of Plastic
3. D695 Test Method for Compressive Strength of Rigid Plastics
4. D822 Standard Practice for Conducting Tests on Paint and Related Coatings and Materials
5. D4060 Test Method for Abrasion Resistance of Organic Coatings
6. E162 Test Method for Surface Flammabilities of Materials Using a Radiant Heat Energy Source

B. Federal Specifications:

1. MS-D-3134F Indentation of Synthetic Coatings

1.03 SUBMITTALS

A. Submit in accordance with Section 013300:

1. Product Data: Fully describe all products proposed for use.
2. Samples: Finished flooring and standard line of colors and textures.
3. Test Reports: Independent laboratory test results of specified physical characteristics.
4. Installer's Qualifications: Material manufacturer's written approval of installer and a list of at least five similar installations completed by installer within last two years.

1.04 QUALITY ASSURANCE

- A. Qualifications: The coating work shall be performed by a licensed specialty contractor who is engaged exclusively in the installation of chemical resistant epoxy coating, has satisfactorily completed at least five similar installations within the last two years, and approved by the chemical resistant epoxy coating material manufacturer. All work shall be performed by qualified journeymen proficient in epoxy coating application.

B. Comply with the following referenced standards:

1. Manufacturer's Recommendations: Installation instructions of the coating material manufacturer.

1.05 PRODUCT DELIVERY

- A. Deliver materials in manufacturer's labeled, unopened containers.

1.06 PROJECT CONDITIONS

- A. Do not use admixtures in concrete slabs to receive epoxy coating, which might interfere with bond or cure of epoxy coating. Do not use concrete curing compounds.
- B. Maintain substrate temperature at 70°F for at least 48 hours before and after installation.

1.07 GUARANTEE

- A. Provide a written two (2) year guarantee signed by the installer, material manufacturer and Contractor covering the repair or replacement of the entire coating system to correct shrinkage cracks, bond failure or surface deterioration resulting from causes other than abuse.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Crack filler: Tnemec Series 218 or Series 219.
- B. CMU base coat: Tnemec Series 84 Ceramlon ENVIRONMENTAL
- C. Secondary containment lining: Tnemec Series 61 Tneme-Liner

PART 3 - EXECUTION

3.01 INSPECTION

- A. Allow concrete to cure for at least 28 days before applying epoxy coating.
- B. Verify that concrete surfaces are dry. Test concrete with 4-hour rubber mat test.
- C. Examine substrates for defects that will adversely affect the execution and quality of the work.
- D. Do not start the work until all unsatisfactory conditions are corrected.

3.02 PREPARATION

- A. Abrade and pressure wash clean the CMU and concrete surface per ASTM D4259. Remove the entire as-cast surface of the concrete substrate. Surface preparation shall conform to the coating manufacturers requirements.
- B. Mask or protect adjacent surfaces not intended to receive coating.

3.03 CMU SURFACE APPLICATION

- A. Route cracks and fill with crack filler.
- B. Apply 1 coat of Tnemec Series 84 at 6 to 8 mils DFT.
- C. Apply 2 coats of Tnemec Series 61 at 6 to 8 mils DFT per coat.
- D. Apply in strict conformance with coating manufacturer's requirements.

3.04 CONCRETE SURFACE APPLICATION

- A. Route cracks and fill with crack filler.
- B. Apply 2 coats of Tnemec Series 61 at 6 to 8 mils DFT per coat.
- C. Apply in strict conformance with coating manufacturer's requirements.

3.05 PROTECTION

- A. Protect epoxy coating from damage by subsequent construction operations. Prohibit all foot and wheel traffic for at least seven (7) days. Cover horizontal and vertical surfaces with heavy-duty, nonstaining construction paper, taped in place for at least 7 days.
- B. Just before final acceptance, remove paper and wipe surfaces clean with damp cloths.

END OF SECTION

- B. Thickness: 0.80 inch.
- C. Size: 13 by 13 inches.
- D. Colors and Patterns: As selected by Architect from full range of industry colors.

2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated. Durabond's Webcrete # 95, Ardex SD-F, or as recommended by flooring manufacturer
- B. Adhesives: Water-resistant type recommended by manufacturer to suit floor tile and substrate conditions indicated. Adhesive Forbo T-940
Fully warranted, when used in conjunction with Forbo Marmoleum, to withstand concrete moisture vapor emissions up to 5 pounds per 1,000 sq. ft. in 24 hours.
 - 1. Adhesives shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - a. VCT and Asphalt Tile Adhesives: Not more than 50 g/L.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F 710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
 - 3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
 - 4. Moisture Testing: Perform tests recommended by manufacturer and as follows. Proceed with installation only after substrates pass testing.

- a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 5 lb of water/1000 sq. ft. in 24 hours. Use Forbo Linoleum's Moisture Limitor if moisture limits exceed the moisture vapor emissions of 5 pounds per 1,000 sq. ft. in 24 hours and do not exceed 8 pounds per 1,000 sq. ft. in 24 hours.
 - C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
 - D. Do not install floor tiles until they are same temperature as space where they are to be installed.
 - 1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
 - E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.
- 3.3 FLOOR TILE INSTALLATION
- A. Comply with manufacturer's written instructions for installing floor tile.
 - B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
 - 1. Lay tiles square with room axis.
 - C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
 - 1. Lay tiles with grain direction alternating in adjacent tiles (basket-weave pattern).
 - D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
 - E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
 - F. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 CLEANING AND FINISHING

- A. Upon completion, clean exposed surfaces soiled by Work and repair damage caused by Work.
- B. Cover floor tile until Substantial Completion.

END OF SECTION 096519

SECTION 099113
EXTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes surface preparation and the application of paint systems on the following exterior substrates:
 - 1. Metal.
 - 2. Plaster

1.3 SUBMITTALS

- A. Samples for Verification: For each type of paint system and each color and gloss of topcoat indicated.
 - 1. Submit Samples on rigid backing.
 - 2. Label each coat of each Sample.

1.4 QUALITY ASSURANCE

- A. MPI Standards:
 - 1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
 - 2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.6 PROJECT CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between **50 and 95 deg F** (**10 and 35 deg C**).
- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than **5 deg F** (**3 deg C**) above the dew point; or to damp or wet surfaces.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
 - 1. Quantity: Furnish an additional 5 percent, but not less than **1 gal.** (**3.8 L**) of each material and color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Dunn Edwards
 - 2. Sherwin-Williams
 - 3. Benjamin Moore

2.2 PAINT, GENERAL

- A. Material Compatibility:
 - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- B. Colors: As selected by Architect from manufacturer's full range.

2.3 PRIMERS/SEALERS

2.4 METAL PRIMERS

- A. Waterborne Galvanized-Metal Primer: MPI #134.

2.5 EXTERIOR LATEX PAINTS

- A. Exterior Latex (Semigloss): MPI #11 (Gloss Level 5).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
- B. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- C. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
 - 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
 - 2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.
- D. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.
- E. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions.
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Electrical Work: Paint all exposed new work items including, but not limited to, the following:
 - 1. Exposed Electrical Work:
 - a. Metal piping.
 - b. Pipe hangers and supports.
 - c. Mechanical equipment that is indicated to have a factory-primed finish for field painting.

3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 EXTERIOR PAINTING SCHEDULE

- A. Metal Substrates:
 - 1. Latex System:

- a. Prime Coat: ENDURAPRIME, Interior/Exterior Acrylic Rust Preventative Metal Primer
- b. Intermediate Coat: Match topcoat.
- c. Topcoat: Endura Coat Interior/Exterior Semi-Gloss Industrial Maintenance Coating

B. Plaster Substrates:

- 1. Latex System:
 - a. Prime Coat: Eff Stop Premium Masonry Primer Sealer
 - b. Intermediate Coat: Match topcoat.
 - c. Topcoat: Evershield Flat Paint.

END OF SECTION 099113

SECTION 099123
INTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes surface preparation and the application of paint systems on the following interior substrates:
 - 1. Metals, including exposed Mechanical Ductwork and exposed Electrical Conduit.
 - 2. Wood.
 - 3. Gypsum board.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: For each type of paint system and in each color and gloss of topcoat indicated.
 - 1. Submit Samples on rigid backing.
 - 2. Label each coat of each Sample.
 - 3. Label each Sample for location and application area.
- C. Product List: For each product indicated, include the following:
 - 1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
 - 2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

1.4 QUALITY ASSURANCE

- A. MPI Standards:
 - 1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
 - 2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.6 PROJECT CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Dunn-Edwards
 - 2. Benjamin Moore
 - 3. Sherwin-Williams

2.2 PAINT, GENERAL

- A. Material Compatibility:
 - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- B. Colors: As selected by Architect from manufacturer's full range

2.3 PRIMERS/SEALERS

- A. Interior Latex Primer/Sealer: MPI #50.

2.4 METAL PRIMERS

- A. Rust-Inhibitive Primer (Water Based): MPI #107.

2.5 WOOD PRIMERS

- A. Interior Latex-Based Wood Primer: MPI #39.

2.6 LATEX PAINTS

- A. Interior Latex (Semigloss): MPI #54 (Gloss Level 5).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Concrete: 12 percent.
 - 2. Wood: 15 percent.
 - 3. Gypsum Board: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
 - 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
 - 2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

- C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.
 - D. Wood Substrates:
 - 1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
 - 2. Sand surfaces that will be exposed to view, and dust off.
 - 3. Prime edges, ends, faces, undersides, and backsides of wood.
 - 4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.
 - E. Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth.
- 3.3 APPLICATION
- A. Apply paints according to manufacturer's written instructions.
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
 - C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
 - D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
 - E. Painting Mechanical and Electrical Work: Paint exposed new work items in all interior spaces including, but not limited to, the following:
 - 1. Exposed Mechanical Work:
 - a. Metal piping.
 - b. Pipe hangers and supports.
 - c. Duct, equipment.
 - d. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
 - e. Mechanical equipment that is indicated to have a factory-primed finish for field painting.

2. Electrical Work:

- a. Switchgear, Junction Boxes and Panelboards except where Stainless Steel.
- b. Conduit piping.
- c. Pipe hangers and supports.
- d. Electrical equipment that is indicated to have a factory-primed finish for field painting.

3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 INTERIOR PAINTING SCHEDULE - Dunn Edwards Product listing

- A. Dressed Lumber Substrates: Including architectural woodwork.
 - 1. Latex System:
 - a. Prime Coat: UGPR00 Ultra-grip. Prime coat not required at factory primed surfaces.
 - b. Intermediate Coat: Match topcoat.
 - c. Topcoat: SPMA50.
- B. Metal Substrates:
 - 1. Latex System:
 - a. Prime Coat: Bare Metal, BRPR00-2-RO Red Oxide, Bloc-rust; Galvanized, GAPR00-1 Galv-alum. Prime coat not required at factory primed surfaces.
 - b. Intermediate Coat: Match topcoat.
 - c. Topcoat: SPMA50 Suprema.
- C. Gypsum Board Substrates:
 - 1. Latex System:
 - a. Prime Coat: VNPL00
 - b. Intermediate Coat: Match topcoat.
 - c. Topcoat: SPMA50.

END OF SECTION 099123

SECTION 104400
IDENTIFYING DEVICES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Signs, decals, tags, and pipe and equipment identification.
- B. Related Sections:
 - 1. Section 098000: Protective Coatings
 - 2. Section 100500: Building Specialties
 - 3. Section 013416: Chemical Storage Tanks

1.02 REFERENCES

- A. American National Standard Specifications, ANSI A13.1, "Scheme for the Identification of Piping Systems."
- B. National Fire Protection Association (NFPA) No. 704, System for the identification of the fire hazards of materials.

1.03 SUBMITTALS

- A. Submit in accordance with Section 013000.
- B. Product Data: Fully describe all items proposed for use.
- C. Shop Drawings: Scaled drawings or graphics of all standard and custom-made signs, showing style and size of lettering and colors.
- D. List of pipe and equipment identification names.
- E. Samples: Manufacturer's standard color palette for selection.

1.04 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with the following:
 - 1. California Code of Regulations, CCR Title 8, CAL/OSHA.
 - 2. Federal Occupational Safety and Health Act (OSHA): Referenced sections, specifications for accident prevention signs and tags.
 - 3. Porcelain Enamel Institute Sign Division of the PEI:S-103, recommended standards for porcelain enamel signs.
- B. Comply with the manufacturer's published recommendation for installation of materials used.

PART 2 - PRODUCTS

2.01 SIGNS

- A. Building Room Identifications Signs:
 - 1. Vomar Products, Inc.; Apco Graphics; or equal.
 - 2. Sign characteristics:
 - a. Material: Integral color acrylic plastic sheets 1/16-inch thick, cemented together.
 - b. Background plastic, white, 10 x 14 inch, for permanent adhesive back mounting.

- c. Plastic, black, 3-inch-high, dimensional cutout letters, Helvetica Bold letter style, as shown below.

3. Schedule of signs required:

Quantity	Text	Locations
3	Electrical Room	East and West doors of Electrical room, East door of Analyzer Room
1	Analyzer Room	East door
1	Sodium Hypochlorite Storage & Dispensing	West door
1	Orthophosphate Storage and Dispensing	West door

B. Fire Equipment Location Signs:

1. Seton Nameplate Company; W.H. Brady Company; or equal.
2. Size: 4 inches wide by 18 inches (approximate size).
3. Material: Vinyl with adhesive back.
4. Text: Bright, fade-resistant red on white downward facing directional arrow on red field.
Text is shown on schedule below.
5. Schedule of signs required:

Quantity	Text	Seton	Brady or Equal
One for each existing Fire Extinguisher.	"FIRE EXTINGUISHER"	FSM33	95343

C. Caution Signs:

1. Size: 14 inches wide by 10 inches high
2. Material: Porcelain Enamel, 18-gauge
3. Text, format, and color:
 - a. Conforming to OSHA 1910.145(d)(4), Specifications for Caution Signs.
 - b. Text as scheduled below.
4. Provide eyelet holes at each corner for mounting.
5. Schedule of signs required:

Quantity	Text
3	CAUTION THIS EQUIPMENT STARTS AUTOMATICALLY
4	CAUTION WEAR EYE PROTECTION, RUBBER GLOVES AND APRONS WHEN HANDLING CHEMICALS

D. Danger Signs:

1. Size: 14 inches wide by 10 inches high, unless otherwise scheduled.
2. Material: Porcelain Enamel, 18-gauge.
3. Text, format, and color:
 - a. Conforming to OSHA 1910.145(d)(2), Specifications for Danger Signs.
 - b. Text as scheduled below.
4. Provide eyelet holes at each corner for mounting.
5. Schedule of signs required:

Quantity	Text
2	DANGER HIGH VOLTAGE

E. Informational Signs:

1. Size: 14 inches wide by 10 inches high.
2. Material: Porcelain Enamel, 18-gauge.
3. Text, format, and color:
 - a. Conforming to OSHA 1910.145 (d)(9), Specifications for Informational Signs.
 - b. Text as scheduled below.
4. Provide eyelet holes at each corner for mounting.
5. Where scheduled, provide AB Marine grade plywood backing and wood post, sealed and painted.
6. Schedule of signs required:

Quantity	Text
7	Safety Shower / Eyewash Station
5	NOTICE NO TRESPASSING

F. Chemical Signs:

1. Seton Nameplate Company; Style SCS; Legi-Sign; or equal.
2. Size: 10 inches wide by 14 inches high.
3. Material: Semi-rigid plastic with adhesive back.
4. Characteristics: Red text on white background. Text shall include chemical name, precautionary measures, signal word, statement of hazards, and antidote. Sign shall include NFPA No. 704, Hazard Identification System.
5. Mount chemical signs on or near chemical storage tanks. Eyelet holes at corners for mounting.
6. Schedule of signs required:

Quantity	Chemical Name
4	12.5% Sodium Hypochlorite
3	Sodium Hypochlorite Waste
4	29% Orthophosphate
3	Orthophosphate Waste

2.02 TAGS

A. Accident Prevention Tags:

1. Seton Nameplate Company; W.H. Brady Company; or equal.
2. Size: Approximately 3 inches by 6 inches.
3. Material: Write-on matte finish plastic laminate, metal reinforced eyelet.
4. Conform to OSHA 1910.145(F), Specifications for Accident Prevention Tags.
5. Text as scheduled below:

Quantity	Text
6	EMPTY (red colored tag)
6	FULL (green colored tag)
16	DANGER - DO NOT OPERATE
6	OUT OF ORDER

2.03 PIPE MARKERS

- A. Seton Nameplate Company; SetMark, W.H. Brady Company; Piper Marker System 1; or equal.
- B. Pipe Markers conforming to ANSI A13.1. See paragraph 3.03 for required locations.
- C. Material: Acrylic plastic snap-around type or pressure sensitive vinyl, temperature tolerance range of -40°F to 250°F, non-fade, colored fields, lengths as shown below.
- D. Text: Non-fade ink, lettering size, as shown below:

Outside Diameter of Pipe (Inches)	Length of Color Field (Inches)	Size of Letters (Inches)
3/4 to 1-1/4	8	1/2
1-1/2 to 2	8	3/4
2-1/2 to 6	12	1-1/4
8 to 10	24	2-1/2
Over 10	36	3-1/2

- E. Provide directional arrows to indicate flow direction. See paragraph 3.03.
- F. Pipe Marker Schedule:

Text	Field Color	Letter Color
Hypochlorite Vent	Yellow	Black
Orthophosphate Vent	Orange	Black
30" Blowoff Line	Yellow	Black
12.5% Hypochlorite Fill	Yellow	Black
Daytank Bypass	Red	Black
29% Orthophosphate Fill	Orange	Black
Sump Waste Discharge	Green	Black
Drain	Yellow	Black
Overflow	Red	Black
Chemical Waste	Yellow	Black
Injection	Yellow	Black
Potable Water	Blue	Black
Treated Water	Blue	Black
Sodium Hypochlorite	Yellow	Black
Orthophosphate	Orange	Black

PART 3 - EXECUTION

3.01 SIGN INSTALLATION

- A. Install signs to pipes, doors, walls, etc. where they apply, and as directed by the Owner.

- B. Install signs after painting or sealing surfaces to receive signs. Follow manufacturer's written installation instructions.
- C. Use fasteners as follows:
 - 1. To concrete and masonry materials: 4-1/4-inches diameter expansion anchors.
 - 2. To sheet metal (gauges 28 to 6) #10 sheet metal screws.
 - 3. To gypsum board: Adhesive backing tape.
 - 4. To chain link fencing: Wire ties at each corner.
 - 5. To plywood backing boards: #10 wood screws.
 - 6. To machinery: Fasteners as suitable.

3.02 TAGS

- A. Deliver to the Owner in properly identified boxes or envelopes.

3.03 PIPE MARKERS

- A. Pipe Markers shall be applied where piping enters or leaves the wall or floor of a structure, adjacent to tanks or other hydraulic containments, at each valve, at each piping change in direction, and shall be applied along piping runs not exceeding 16 feet on center. Provide lettering size as follows:

<u>Pipe Diameter</u>	<u>Lettering Size (Height)</u>
1-1/4" or less	1/2"
1-1/2" to 2"	3/4"
2-1/2" to 6"	1-1/4"
8" to 10"	2"
Over 10"	3-1/2"

- B. Paint all exposed pipes with the appropriate color and coating system as specified in Section 098000.
- C. Directional Arrows: Point in the direction of flow. Directional arrows are to be in black and be proportional to lettering.
- D. Locate pipe markers for easy reading. Where pipes are located above normal line of vision, the lettering and directional arrows shall be placed below the horizontal centerline of the pipe. Where pipes are below normal line of vision, lettering and directional arrows shall be above the horizontal centerline of the pipe.

3.04 EQUIPMENT IDENTIFICATION

- A. Paint all exposed equipment with the appropriate color and coating system as specified in Section 098000. Identify all equipment exposed to the atmosphere, both interior and exterior by a combination of stenciling or pressure-sensitive tape and direction arrows. Provide equipment identification names as listed on the Drawings, except that names exceeding 20 characters shall be abbreviated.

END OF SECTION

SECTION 111220
AIR COMPRESSORS

PART 1 – GENERAL

1.01 SCOPE

This section describes the materials, fabrication, and installation of the facility air compressor and appurtenances.

1.02 RELATED WORK SPECIFIED ELSEWHERE

Trenching, Backfilling, and Compacting [022230]
Water Pipeline Testing and Disinfection [026430]
General Electrical Requirements [160100]
General Instrument Requirements [170100]
Cable [160200]
Electrical Installations
Coatings [098000]

1.03 CONTRACTOR SUBMITTALS

The Contractor shall submit shop drawings of compressor in accordance with the requirements in Section 013300 - Contractor Submittals.

PART 2 – MATERIALS

- A. Air Compressor: Air compressor shall be of the Rotary Screw type, capable of continuous duty performance of 32 cfm , and shall include a refrigerated type air dryer capable of handling full compressed air output., with features as follows:

Rotary Screw Air Compressor w/ Air Dryer
10 Hp, 460v, 13Amp, 3450 rpm
Continuous Duty
80 Gallon Horizontal Air Tank
Output 32 cfm @ 150 psi
Noise Level 68 dBA @ 3 feet
Grainger Item # 1ZPT4
Ingersoll Rand Model # UP6TAS-10-150/80-460-3

PART 3 – EXECUTION

- A. General: Handle, store, and install in accordance with the manufacturer's printed recommendations. Mount compressor as shown on the Plans, include solenoid valve and 1-1/2" of underground galvanized steel piping (up to 50') from the compressor to the loading pad area.

END OF SECTION

SECTION 112120
CENTRIFUGAL PUMPS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Provide complete, tested and operating backwash reclaim pumps as shown on the Drawings and as specified herein.

1.02 REFERENCES

- A. Hydraulic Institute.

1.03 SUBMITTALS

- A. Shop Drawings and Product Data: Submit the following as a single complete initial submittal in accordance with Section 01300, Submittals:
 - 1. Product data to demonstrate that the equipment conforms to the Specifications.
 - 2. Motor data.
 - 3. Seismic anchorage certification and related sketch.
 - 4. Pump layouts and dimensions.
 - 5. Pump performance curves.
 - 6. Bearing life calculations.
- B. Performance Testing: Submit certified non-witnessed factory performance test results. Receive favorable review of test results prior to shipping the equipment.
- C. Manuals: Furnish manufacturer's installation, lubrication, operation and maintenance manuals, bulletins, and spare parts lists.
- D. Affidavits: Submit affidavit from the manufacturer stating that the equipment has been properly installed, adjusted, and tested and is ready for full time operation.

1.04 QUALITY ASSURANCE

- A. Equipment furnished under this Section shall be supplied by a single manufacturer who has been regularly engaged in the design and manufacture of the equipment for at least five years. Demonstrate to the satisfaction of the Owner that the quality is equal to equipment made by those manufacturers named herein (No substitutions allowed for transfer pumps or Chemical Room sump pumps).

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Pumps: See Pump Schedule.

2.02 PERFORMANCE AND DESIGN REQUIREMENTS

- A. Pump Schedule:

Item	Hypochlorite Transfer Pump
Identification	PMP-110 A/B
Quantity of Pumps	2
Pump Type	Magnetic Drive End Suction Centrifugal
Primary Point	40 GPM @ 30 ft. TDH @ 1.2 SG
Motor	3,450 RPM, 480 Volt, TEFC
Motor Horsepower	1.0 HP
Manufacturer/Model	March Pump Co; Model TE-7K-MD 3ph
Minimum Size (Suct. x Disch.)	1-1/2-inch x 1-inch (Flanged)
Gauge Range: Discharge	0 - 60 psi
Accessories	March Co. Ryton small pump base

Item	Orthophosphate Transfer Pump
Identification	PMP-310 A/B
Quantity of Pumps	2
Pump Type	Magnetic Drive End Suction Centrifugal
Primary Point	40 GPM @ 30 ft. TDH @ 1.2 SG
Motor	3,450 RPM, 480 Volt, TEFC
Motor Horsepower	1.0 HP
Manufacturer/Model	March Pump Co; Model TE-7K-MD 3 ph
Minimum Size (Suct. x Disch.)	1-1/2-inch x 1-inch (Flanged)
Gauge Range: Discharge	0 - 60 psi
Accessories	March Co. Ryton small pump base

Item	Chemical Waste Sump Pump
Identification	PMP-150 / PMP-350 / PMP-650
Quantity of Pumps	3
Pump Type	Submersible Centrifugal
Primary Operating Point	25 GPM @ 17 ft. TDH @ 1.2 SG
Wetted Materials	Noryl/Titanium/Viton
Motor	3,450 RPM, 120 Volt, TEFC
Motor Horsepower	0.4 HP
Manufacturer/Model	BJM Pumps Model TIGF 32-9NL also Cole Parmer GH-75500-88
Minimum Size (Disch.)	1-1/2-inch (hose)
Gauge Range: Discharge	0 - 60 psi

Item	Loading Rack Sump Pump
Identification	PMP-1000 A/B
Quantity of Pumps	2
Pump Type	Submersible Centrifugal
Primary Point	40 GPM @ 20 ft. TDH @ 1.0 SG
Motor	3,450 RPM, 120 Volt, TEFC
Motor Horsepower	0.75 HP
Manufacturer/Model	Tsurumi Pump Model HSD2.55S-63
Minimum Size (Disch.)	2-inch (NPT)
Gauge Range: Discharge	None required

2.03 EQUIPMENT

- A. No substitutions will be allowed for the transfer pumps nor the Chemical Room sump pumps. Mount each pump / motor assembly in accordance with Manufacturer's recommendations.
- B. Provide pumps as indicated in the Pump Schedule. Mount each pump and motor assembly as shown on the Drawings..
 - 1. Suction and discharge connections for Transfer Pumps shall be ANSI Class 125 flanged connections.
 - 2. Discharge for submersible sump pumps shall be threaded NPT or hose connections with Titanium hose clamps.
- C. Construction:
 - 1. See Pump Schedule for wetted material requirements.
- F. Motor: Provide TEFC motors, suitable for, and conforming to requirements of Section 011002. Nameplate motor horsepower shall not be exceeded at any operating point in the Pump Schedule.

2.04 ACCESSORIES

- A. Provide discharge pressure gauges with diaphragm isolators and stopcock gauge for each pump with features and accessories in accordance with Section 015183. Gauge ranges shall conform to the listing in the Pump Schedule.

2.05 FINISHES

- A. Painting: Apply manufacturer's standard factory paint finish.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install the pump units in strict conformance with manufacturer's installation instructions. Check pump and motor alignment according to the Standards of the Hydraulic Institute after complete unit has been installed at the site.

3.02 FIELD PAINTING

- A. Apply a final color coat of paint to the pump units in accordance with Section 09800.

3.03 FIELD TESTING

- A. Field test each pump. Refer to Section 011001 for further requirements.

3.04 FIELD SERVICE

- A. The equipment manufacturer shall supply a competent field service engineer to thoroughly check and inspect the equipment after installation, place the equipment in operation, make necessary adjustments, calibrate instruments, and conduct field tests.

END OF SECTION 112120

SECTION 151220

PIPING SPECIALTIES (STATIC MIXERS, FLOW CONDITIONERS, STEEL COUPLINGS, TRANSITION COUPLINGS, AND FLANGED COUPLING ADAPTERS)

PART 1 – GENERAL

1.01 SCOPE

This section describes the materials, fabrication, and installation of various steel piping specialties, including static mixers, flow conditioners, steel couplings, transition couplings, and flanged coupling adapters for waterline construction.

1.02 RELATED WORK SPECIFIED ELSEWHERE

Trenching, Backfilling, and Compacting [022230]
Water Pipeline Testing and Disinfection [026430]
Connection to Existing Waterlines [150520]
Coatings [098000]

1.03 CONTRACTOR SUBMITTALS

The Contractor shall submit shop drawings of couplings and flanged coupling adapters in accordance with the requirements in Section 013300 - Contractor Submittals.

PART 2 – MATERIALS

- A. Static Mixers: Static mixers (4 required) shall be manufactured by Westfall Manufacturing, sold through Safe- T- Flow Water Services (714) 632-3013. No substitutions shall be allowed. Static mixers shall be Westfall Model 6000, size 16" (2 req'd) and 20" (2 req'd), with features as follows:
- STATIC MIXER MODEL 6000**
 - Sch 40 Carbon Steel Construction
 - (3) Carbon Steel Mixing fins
 - (2) 1" NPT Injection Ports
 - (2) Carbon Steel RFSO 150# Flanged Ends
 - Interior Coating 3M Scotchkote 134
 - Exterior Coating Rustoleum Primer
- B. Flow Conditioners: Flow Conditioners shall be manufactured by Westfall Manufacturing, sold through Safe- T- Flow Water Services (714) 632-3013. No substitutions shall be allowed. Flow Conditioners shall be Westfall Model 3000, size 16" (2 req'd) and 20" (2 req'd), with features as follows:
- FLOW CONDITIONER MODEL 3000**
 - Sch 40 Carbon Steel Construction
 - (2) Rows of (4) Carbon Steel conditioning fins
 - (2) Carbon Steel RFSO 150# Flanged Ends
 - Interior Coating 3M Scotchkote 134
 - Exterior Coating Rustoleum Primer
- C. Safe-T-Flow Chemical Injectors (4 required). Injection quill assemblies (2 ea.) for the 16" spool shall be **HC-100-H-T-7-B-V**. For the 20" Spools (2 ea.), **HC-100-H-T-9-B-V**. No substitutions shall be allowed.

- D. Steel Couplings: Sleeve type couplings shall be provided where shown and shall be manufactured by Smith-Blair, Dresser, or approved equal. The middle sleeve shall be not less than 0.25 inches thick and shall be a minimum 7 inches long for standard steel couplings. Longer couplings shall be provided where
- E. Steel Couplings: Sleeve type couplings shall be provided where shown and shall be manufactured by Smith-Blair, Dresser, or approved equal. The middle sleeve shall be not less than 0.25 inches thick and shall be a minimum 7 inches long for standard steel couplings. Longer couplings shall be provided where
- F. Transition Couplings: Sleeve type couplings shall be provided where shown and shall be manufactured by Smith-Blair, Dresser, or approved equal. The middle sleeve shall be not less than 0.25 inches thick and shall be a minimum 7 inches long for standard steel couplings. Bolts for exposed couplings shall be hot dip galvanized. Follower glands and middle sleeve shall be fusion bond epoxy coated as indicated in Section 09800 - Protective Coatings.
- G. Flanged Coupling Adapters: Flanged coupling adapters shall be provided where shown and shall be manufactured by Smith-Blair, Dresser, or approved equal. Bolts for exposed couplings shall be hot dip galvanized. Adapter body and follower gland shall be fusion bond epoxy coated as indicated in Section 09800 - Protective Coatings.
- H. Grooved Type Couplings: Where approved in advance by the District, grooved type couplings may be utilized and shall conform to the requirements of AWWA Std. C606 and shall be manufactured by Victaulic Company or approved equal.

PART 3 – EXECUTION

- A. General: Handle, store, and install in accordance with the pipe manufacturer's printed recommendations. Contractor shall remove all foreign matter from interior and ends of pipe and appurtenances before installing couplings and flanged coupling adapters. Pipe deflections are discouraged. Pipe deflections shall not exceed 50% of the joint deflection limits as recommended by coupling manufacturer.
- B. Flanged Coupling Adapters: Flanged coupling adapters shall be equipped and installed with pipe restraining systems wherever thrust restraint may be required unless directed otherwise by the Engineer. Pipe restraining systems shall be manufactured by Romac, EBAA Iron, or approved equal.
- C. Polyethylene Tape Wrap: Polyethylene tape wrap shall be applied to all buried couplings. Polyethylene tape wrap shall have butyl rubber, synthetic resin adhesive on one side. Prior to applying the tape, all surfaces shall be primed with butyle rubber based elastomers blend with polymeric resin as approved by the polyethylene tape manufacture. After primer application, all surfaces shall be wrapped with 35-mil polyethylene tape, half-lapped to achieve a total thickness of 70 mils. Polyethylene tape wrap shall be manufactured by Polyken, or approved equal.
- D. Coatings
Above ground piping and Specialties shall be coated in accordance with Section 098000 after installation. For the 16" and 20" metering and chemical injection manifolds and the 4" utility line and backflow preventer, use the System 3 Epoxy coating system in Section 098000. Coordinate with the OWNER with respect to final color selection. For the Chemical room interior metallic piping, Contractor may use the System 1 or System 2 coating procesure. Coordinate color selection with the OWNER.

END OF SECTION

SECTION 151830

GAUGES

PART 1 - GENERAL

1.1 REQUIREMENTS

A. The CONTRACTOR shall provide pressure and vacuum gauges and appurtenances, complete and operable, in accordance with the Contract Documents.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section 152180 – Modulating Valves

PART 2 - PRODUCTS

2.1 PRESSURE AND VACUUM GAUGES

A. **General:** Pressure gauges shall be provided on suction and discharge connections to pumps as indicated in the pump specifications; on discharge connections from blowers and compressors; each side of pressure reducing valves; and wherever indicated. Vacuum gauges shall be provided for vacuum pumps and wherever indicated. In all locations (such as certain pump suction connections) where pressures may vary from below to above atmospheric head, compound gauges shall be installed.

B. **Gauge Construction:** Gauges shall be industrial quality type with Type 316 stainless steel movement and stainless steel or alloy case. Unless otherwise indicated, gauges shall have a 3-1/2-inch dial, 1/4-inch threaded connection, a Type 316 stainless steel snubber adapter, and a shut-off valve. Gauges shall be calibrated to read in applicable units, with an accuracy of plus and minus 1 percent, to 150 percent of the working pressure or vacuum of the pipe or vessel to which they are connected. All gauges shall be vibration and shock resistant.

C. **Diaphragm Seal:** Gauges attached to systems involving chemical solutions, corrosive fluids, sludge, sewage, or other liquids containing solids at less than 1 percent dry solids shall be equipped with diaphragm seals, or equal protective pressure or vacuum sensing devices.

D. **Gauge Manufacturers, or Equal:** Marsh Instrument Company; Ashcroft Industrial Instruments (Dresser); Foxboro/Jordan, Inc.; Marshalltown Instruments, Inc.; and U.S. Gauge Div. of Ametek.

E. **Snubber Manufacturers, or Equal:** Cajon Company; and Weksler Instruments, Corp.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Gauges shall be installed with the face in the vertical position, at the locations indicated and in strict accordance with the manufacturer's printed instructions. Care shall be taken to minimize the effect of water hammer or vibrations on the gauges. In extreme cases, the gauges may have to be mounted independently, with flexible connectors.

END OF SECTION

SECTION 235000

HVAC EQUIPMENT

PART 1 GENERAL

This specification includes requirements for CONTRACTOR to provide, install, adjust, and test HVAC equipment for the Chlorination building. Equipment shall include Air Conditioner, Electric Heaters (for Rooms 101, 102, and 103), Ventilation exhaust fans (for Rooms 101, 102, and 103), ducting, and appurtenances to provide a complete and operable HVAC system. Details regarding equipment, materials, workmanship, installation, and testing are noted on the Plans.

1.1 SECTION INCLUDES

- A. Central Air Conditioners.
- B. Packaged Heating Units
- C. Exhaust Ventilation Systems

1.2 RELATED SECTIONS

- A. Section 22 1113 - Facility Water Distribution Piping.
- B. Section 26 0500 - Common Work Results for Electrical

1.3 REFERENCES

- A. NFPA - 70 - National Electric Code.
- B. UL 1995/CSA C22.2 No.236 - Standard for Heating and Cooling Equipment

1.4 SUBMITTALS

- A. Submit materials for approval as noted in the Plans and under provisions of Section 01 3300 .
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods. I
- C. Shop Drawings: Overall dimensions and required clearances including detail of architectural enclosing requirements. Detailed schematics of electrical control wiring and power rough-in.
- D. Manufacturer's Certificates: Certify products meet or exceed specified requirements.
- E. Closeout Submittals: Provide manufacturer's maintenance instructions that include recommendations for periodic checking and adjustment and periodic cleaning and maintenance of all components.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer with a minimum of 5 years documented

experience with the types of products specified.

- B. Installer Qualifications: Installer with a minimum 2 years documented experience with the type of products specified.
- C. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
 - 1. Finish areas designated by Architect.
 - 2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
 - 3. Refinish mock-up area as required to produce acceptable work.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store products in covered area, well protected from weather.

1.7 SEQUENCING

- A. Ensure that locating templates and other information required for installation of products of this section are furnished to affected trades in time to prevent interruption of construction progress.
- B. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.8 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.9 WARRANTY

- A. Provide equipment warranties as specified on the Plans.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Substitutions: Not permitted.
- B. Requests for substitutions will be considered in accordance with provisions of Section 01 6000 - Product Requirements.
- C. Requirements for all HVAC equipment and appurtenances are specified on the Plans.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until wall openings and rough-in have been properly prepared.
- B. If preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions and the requirements of authorities having jurisdiction.
- B. Use manufacturer's guidelines for minimum clearances to combustibles, walls, and finishes.
- C. Anchor all components firmly in position.
- D. Connect to power supply and control wiring in accordance with NFPA 70.
- E. Upon completion of installation, visually inspect all exposed surfaces. Touch up scratches and abrasions with touch up paint recommended by the manufacturer; make imperfections invisible to the unaided eye from a distance of 5 feet.
- F. Test for proper operation and adjust until satisfactory results are obtained.

3.4 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 160100 GENERAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 Description

- A. Work included: Provide all required labor, project equipment and materials, tools, construction equipment, safety equipment, transportation, and test equipment, and satisfactorily complete all electrical work shown on the Drawings, included in these Specifications, or required for a complete and fully operating facility. In addition, provide wiring for the equipment that will be provided under other Divisions of these Specifications. Work shall include, but not be limited to, the following items:
1. Accept any District supplied equipment as indicated below.
 - a. The Contractor shall inspect all District supplied equipment upon its arrival onsite or within 1 week of mobilization if the equipment is already onsite.
 - b. Contractor shall complete all items and information requested on the Acceptance form sample in Attachment 160100A and submit a signed and dated copy to the District, indicating their acceptance of responsibility for the equipment.
 - c. A separate Acceptance form shall be completed for each District supplied piece of equipment.
 - d. Any damage or items not in compliance with the approved manufacturer's drawings or these specifications shall be recorded on the Acceptance form.
 - e. Any physical damage or missing equipment found after submittal of the Acceptance forms shall be the responsibility of the Contractor to correct.
 2. Contractor furnished instruments to be installed into the PLC control panel shall be delivered to the District when received.
 - a. PLC control panel instruments will be installed in the PLC control panel by Others.
 3. Install the above District supplied equipment as shown on the Drawings.
 4. Furnish and install new 200AT/200AF, 480v, 3 pole, 60 hertz, 42kAIC, LSGI electronic trip, molded case circuit breaker into existing MCC.
 5. Furnish and install new feeder from existing MCC to the main breaker in the new Chemical building.
 6. Furnish & install conduit and wiring systems from the new MCC to all motor loads, equipment, lighting and receptacles, and all instrument loads as shown on the Drawings and required by these Specifications.
 7. Install District provided PLC Control panel enclosure as shown on the Drawings. The control panel back panel and PLC controls will be installed by the Control System Integrator.
 - a. Terminate conduits into the PLC control panel.
 - b. Un-terminated cables shall be pulled in and a minimum of eight (8) feet of wire shall be left above the floor for termination by Others. Each cable shall be tested and identified twice, at the cable end and 1'-0" from the conduit entry, per applicable requirements of these specifications.
 - i. Cable terminations will be by Control System Integrator.

8. Furnish & install instrument conduit systems and wiring for all instruments and devices as shown on the Drawings and required by these Specifications.
 - a. Contractor shall assist Control System Integrator with field wire integration and termination to the control panel.
9. Auxiliary Devices: Provide conduit and wire for power and control for all auxiliary devices such as solenoid valves, pressure switches, and instruments that are included as part of a manufacturers packaged system (i.e. all systems specified in Divisions 11 through 15). Contractor shall be responsible for conduit and wire to these auxiliary devices even if not specifically shown on the Drawings or specified herein.
10. Install lighting and receptacle systems as shown on the Drawings.
11. Install grounding systems as shown on the Drawings.
12. Install conduit from electrical room to roof as shown in the Drawings. Install roof penetrations as shown on the Drawings.
13. Provide system testing and commissioning as required by these specifications.
14. Provide clean-up of equipment and site as specified herein.
- B. Safety: Conduct operations in accordance with NFPA 70E, Standard for Electrical Safety Requirements for Employee Workspaces.

1.2 References

- A. Codes: All electrical equipment and materials, including installation and testing, shall conform to the following applicable codes:
 1. National Electrical Code (NEC), latest edition;
 2. National Electrical Safety Code (NESC), latest edition;
 3. Occupational Safety and Health Act (OSHA) standards;
 4. Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems, International Electrical Testing Association (NETA), latest edition.
- B. Variances: In instances where two or more codes are at variance, the most restrictive requirements shall apply.
- C. Standards: Equipment shall conform to applicable standards of American National Standards Institute (ANSI), Electronics Industries Association (EIA), Institute of Electrical and Electronics Engineers (IEEE), and National Electrical Manufacturers Association (NEMA). The revisions of these standards in effect on the date of issuance of the Contract Documents shall apply.
- D. Underwriters Laboratories (UL) listing is required for all equipment and materials where such listing is offered by the Underwriters Laboratories. Safety labeling and listing by other organizations, such as ETL Testing Laboratories, or other Nationally Recognized Testing Laboratories (NRTL) may be substituted for UL labeling and listing if acceptable to the authority having code enforcement jurisdiction. Provide service entrance labels for all equipment required by the NEC to have such labels.
- E. Contractor's Expense: Obtain and pay for all required bonds, insurance, licenses, permits and inspections, and pay all taxes, fees and utility charges that will be required for the electrical construction work.

1.3 Drawings

- A. Drawings: The Electrical Drawings are diagrammatic; exact locations of electrical products shall be verified in the field with the Engineer. Except where special details are used to illustrate the method of installation of a particular piece or type of equipment or material, the requirements or descriptions in this Specification shall take precedence in the event of conflict.
 - 1. Locations of equipment, inserts, anchors, motors, panels, pull boxes, conduits, and fittings, are approximate unless dimensioned; verify locations with the Engineer prior to installation.
 - 2. Field verify scaled dimensions on Drawings.
 - 3. Existing utilities are shown diagrammatically where known. Contractor shall field verify location of all existing utilities and facilities. Contractor shall be responsible for repair of any damage to existing equipment caused by his construction.
 - 4. Review the Drawings and Specification Divisions of other trades and perform the electrical work that will be required for the installations.
 - 5. Should there be a need to deviate from the Electrical Drawings and Specifications, submit written details and reasons for all changes to the Engineer for review and approval before proceeding.
 - 6. Resolution of conflicting interpretations of the Contract Documents shall be per the standard specifications.
- B. As-Built Drawings:
 - 1. Maintain a complete and accurate record set of Drawings for the electrical construction work.
 - 2. Record all work in red on the Drawings or by field sketches, "As-Built", on a monthly basis that is installed differently than shown on the Drawings.
 - a. The monthly record of "As-Built" shall be reviewed for substantiation of progress payments.
 - 3. Upon completion of the work, transfer all marked changes to a clean set of full-size Drawings with red ink. Mark the Drawings "AS-BUILT DRAWINGS" and submit them to the Engineer when the electrical work is completed.
 - 4. Upon completion of the work, provide the as-built cable/conductor numbering schedule as required in Section 161240. Provide hard copies of the schedule in accordance with the general specifications and on magnetic media satisfactory to the Engineer.

1.4 Submittals

- A. Shop Drawings:
 - 1. General: Submit Product Review or Product information shop drawings for materials and equipment as required by Section 013300 of these Specifications and under each of the individual specification sections.
- B. As-Built Shop Drawings: Revise manufacturer's shop drawings to show any construction changes. Prior to final acceptance, deliver one complete set to the Engineer for his favorable review. After such review, provide copies of all CAD produced drawings on magnetic media satisfactory to the Engineer in AutoCAD Drawing format.
- C. Manuals:

1. Furnish hardcopy manuals for equipment where Manuals are specified in the equipment Specifications. Submit manuals in accordance with the general specifications.
 2. In each manual, include equipment descriptions, record shop drawings, operation and maintenance instructions, parts ordering data and ratings for the equipment furnished for this project.
 3. Electronic PDF files shall be provided for each manual provided. PDF files shall be combined and organized in the same manner as the approved hardcopy manuals.
- D. Spare Parts: For each piece of equipment, submit a list of recommended spare parts with quantities. Include part numbers and the name, address, and telephone number of the supplier.
1. Spare parts lists shall be included in the appropriate equipment manual.

1.5 Factory Tests

Submit reports of factory tests and adjustments performed by equipment manufacturers to the Engineer prior to field testing and adjustment of the equipment. These reports shall identify the equipment and show dates, results of tests, measured values and final adjustment settings. Provide factory tests and adjustments for equipment where factory tests are specified in the equipment Specifications.

1.6 Inspections

- A. The Engineer may inspect the fabricated equipment at the factory before shipment to job site. Provide the Engineer with a minimum of 5 days prior notice so that an inspection can be arranged at the factory.
- B. Inspection of the equipment at the factory by the Engineer will be made after the manufacturer has performed satisfactory checks, adjustments, tests and operations.
- C. Favorable review of the equipment at the factory only allows the manufacturer to ship the equipment to the project site. The Contractor shall be responsible for the proper installation and satisfactory start-up operation of the equipment to the satisfaction of the manufacturer and the Engineer.

1.7 Coordination

- A. Coordinate the electrical work with the other trades, code authorities, utilities, and the District.
- B. Where connections must be made to existing installations, properly schedule all the required work, including the power shutdown periods. Schedule and carry out shutdowns with the Engineer so as to cause the least disruption to operation of the plant and privately owned facilities.
- C. When two trades join together in an area, make certain that no electrical work is omitted.

1.8 Job Conditions

- A. Construction Power:
 1. Make all arrangements for the required construction power.
 2. When required, provide all equipment, materials and wiring in accordance with the applicable codes and regulations.
 3. Upon completion of the project, remove all temporary construction power equipment, material and wiring from the site as the property of the Contractor.

- B. Storage: Provide weatherproof storage for all equipment and materials which will become part of the completed facility so that it is protected from weather, dust, water, or construction operations. Equipment space heaters shall be energized at all times during storage to prevent moisture from damaging the equipment.

1.9 Electrical Services

- A. Provide all the equipment and materials for permanent electrical service at the locations shown on the Drawings and described hereinafter. See Sections 1.1 A.1. & 2. above. All work shall meet the requirements of these specifications.
- B. Coordinate all work with the District, obtain the required inspections, and notify the District when service is required. The Engineer shall be notified a minimum of 24 hours prior for any requested inspections, and 48 hours prior to MCC modification, cable pulling and service connection.

1.10 Damaged Products

- A. Notify the Engineer in writing in the event that any equipment or material is damaged.
- B. Obtain prior favorable review by the Engineer before making repairs to damaged products.
- C. Any repairs done prior to favorable review may be rejected and shall be redone to the District's satisfaction.

1.11 Optional Equipment

- A. Optional or substituted equipment must be approved by the Engineer in writing prior to being ordered by the Contractor. Contractor shall submit detailed reasons for the substitution, cost impacts resulting from the substitution and impacts from the substitution.
- B. Any substituted or optional equipment ordered before written approval may be rejected by the Engineer at no cost to the District.
- C. Costs for any modifications to other equipment or the facility required and/or resulting from Contractor substituted equipment is the responsibility of the Contractor.
- D. Any re-design must be approved by the Engineer in writing prior to installation.

1.12 Locations

- A. General: Use equipment, materials and wiring methods U.L. or Nationally Recognized Testing Laboratory (NRTL) listed as suitable for the types of locations in which they are located, as defined in the NEC and Paragraph B, below.
- B. Definitions of Types of Locations:
 1. Dry Locations: Indoor locations such as MCC or control rooms
 2. Wet Locations: Outdoor locations exposed to the weather or with only a roof covering with no walls.
 3. Damp Locations: Outdoor locations with roofs and shielded on three sides, dry pit areas.
 4. Corrosive Locations: Hypochlorite storage or pump rooms or containment areas or where corrosive materials are handled, stored or present.

PART 2 - PRODUCTS

2.1 Standards of Quality

- A. Products that are specified by manufacturer, trade name or catalog number establish a standard of quality and do not prohibit the use of substitute products of other manufacturers, unless indicated no substitutions are allowed, provided they are favorably reviewed by the Engineer prior to the ordering of the equipment.
- B. It is the intent of these Specifications and Drawings to secure high quality in all materials and equipment in order to facilitate operation and maintenance of the facility. All equipment and materials shall be new and the products of reputable suppliers having more than five years' experience in the manufacture of these particular items. For uniformity, only one manufacturer will be accepted for each type of product. All equipment shall be designed for the service intended and shall be of rugged construction, of ample strength for all stresses which may occur during fabrication, transportation, erection, and continuous or intermittent operation. All equipment shall be adequately stayed, braced and anchored and shall be installed in a neat and workmanlike manner. Appearance and safety, as well as utility, shall be given consideration in the design of details.
- C. All components and devices installed shall be standard items of Industrial grade, unless otherwise noted, and shall be of sturdy and durable construction suitable for long, trouble-free service. Light-duty, fragile and competitive grade devices of doubtful durability shall not be used.

2.2 Nameplates

- A. For each piece of electrical equipment, provide a manufacturer's nameplate showing his name, location, the pertinent ratings and the model designation.
- B. Identify each piece of equipment and related controls with a rigid laminated engraved phenolic nameplate. Engrave nameplates with the equipment number and inscriptions indicated on the Drawings and, if not so indicated, with the equipment name. Securely fasten nameplates in place using two stainless steel screws. Where no Inscription is indicated on the Drawings, furnish nameplates with an appropriate inscription furnished by the Engineer upon prior request by the Contractor.
- C. Each control device, including pushbuttons, control switches, and indicating lights, shall have an integral legend plate or nameplate indicating the device function. These shall be inscribed as indicated on the Drawings or as favorably reviewed by the Engineer.

2.3 Fasteners

- A. Fasteners for securing equipment to walls, floors and the like shall be either hot-dip galvanized after fabrication or stainless steel. Provide stainless steel fasteners in Corrosive Locations. When fastening to existing walls, floors, and the like, provide capsule anchors, not expansion shields. Size capsule anchors to meet load requirements. Minimum size capsule anchor bolt is 3/8-inch.

2.4 Painting

- A. Equipment: Refer to each electrical equipment section of these Specifications for painting requirements of equipment enclosures. Repair any final paint finish that has been damaged or is otherwise unsatisfactory, to the satisfaction of the Engineer.

2.5 Enclosures

- A. Unless otherwise noted, provide enclosures as follows:
 - 1. Dry Locations: NEMA Type I with gaskets

2. Wet Locations: NEMA Type 4
3. Damp Locations: NEMA Type 12
4. Corrosive Locations: NEMA Type 4X

See additional requirements below In Paragraph 3.06, METAL PANELS.

PART 3 - EXECUTION

3.1 Requirements

- A. All electrical installations shall conform to the codes and standards outlined in this section.

3.2 Workmanship

- A. Assign a qualified representative who shall supervise the electrical construction work from beginning to completion and final acceptance.
- B. Perform all labor using qualified craftsmen, who have had a minimum of 3 years' experience on similar projects and are licensed by the State of California.
 1. Resumes and proof of license of personnel shall be available upon request.
- C. Provide first-class workmanship for all installations.
- D. Ensure that all equipment and materials fit properly in their installations. Conduit shall be installed perpendicular or parallel to structural members wherever possible.
- E. Perform any required work to correct improperly fit installations at no additional expense to the District.

3.3 Conductor Identification

- A. Identify all wires and cables in conformance with the requirements of Sections 161200, LOW VOLTAGE WIRE AND CABLE. This requirement applies to all equipment provided under this contract, regardless of Division, as well as to all conductors provided or worked on during this contract.

3.4 Installing Equipment

- A. Provide the required inserts, bolts and anchors, and securely attach all equipment and materials to their supports.
- B. Install all floor-mounted equipment on raised reinforced concrete pads. The Contractor, suppliers, and fabricators shall take this requirement into consideration when designing, fabricating, and installing panels, motor control centers, and other enclosures so that height above the floor of the operating handles of electrical devices meets the requirements of these Specifications and applicable codes.

3.5 Cutting, Drilling, and Welding

- A. Provide any cutting, drilling, and welding that is required for the electrical construction work.
- B. Structural members shall not be cut or drilled, except when favorably reviewed by the Engineer. Use a core drill wherever it is necessary to drill through concrete or masonry.
- C. Provide the required welding for equipment supports. Conduits and fittings shall not be welded to structural steel.
- D. Perform patch work with the same materials as the surrounding area and finish to match.

3.6 Metal Panels

- A. All metal panels which are mounted on or abutted to concrete walls in damp locations or mounted on any outside walls shall be mounted 1/4-Inch minimum from the wall, and the back sides of the panels shall be painted with a high build epoxy primer Film thickness shall be 10 mils minimum.

3.7 Field Tests

- A. Perform tests in accordance with applicable procedures as described in NETA Acceptance Testing Specifications.
- B. Contractor shall submit a testing procedure to the District for review and approval within 1 month of receipt of Contract.
 - 1. Procedure shall outline, in detail, the tests proposed for each piece of electrical equipment and the anticipated testing schedule.
 - 2. Test procedure shall reference the applicable NETA section specifying that test.
- C. Provide a minimum of 48 hours' notice to the Engineer prior to any test to permit witnessing the test.
- D. Provide the services of a testing contractor (TC) and pay all costs of performing the inspections and tests as specified herein.
- E. The TC shall provide all materials, equipment, labor and technical supervision to perform such tests and inspections. It is the intent of these tests to ensure that all electrical equipment is operational within industry and manufacturer's tolerances and is installed in accordance with the Contract Documents and manufacturer's instructions. The tests and inspections shall determine the suitability for energization.
 - 1. The TC shall have a calibration program which maintains all applicable test instrumentation within rated accuracy. Instruments shall be calibrated within the last 12 months from the date of the test.
 - 2. Date calibration labels shall be visible on all test equipment.
- F. Where testing pursuant to NETA requirements is required in these specifications, a copy of the raw test data compiled that day shall be submitted to the Engineer prior to leaving the work site.
- G. Where testing pursuant to NETA requirements is required in these specifications, submit a test report which includes the following:
 - 1. Name of project, name of person performing test, and date of test
 - 2. Description of equipment tested
 - 3. Description of test
 - 4. List of test equipment used and calibration date
 - 5. Test site temperature and humidity
 - 6. Test results
 - 7. Conclusions and recommendations
 - 8. Appendix, Including appropriate test forms
 - 9. The test report shall be bound and its contents certified.
 - 10. Submit the completed report directly to the Engineer no later than thirty (30) days after completion of the test unless directed otherwise.

11. Four reports shall be submitted for review.
- H. Safety practices shall include, but are not limited to, the following requirements:
1. Occupational Safety and Health Act, OSHA.
 2. Accident Prevention Manual for Industrial Operations, Latest Edition, National Safety Council.
 3. Applicable state and local safety operating procedures, including NFPA 70E, Standard for Electrical Safety in the Workplace.
 - a. TC shall use personal protective equipment (PPE), including arc flash protection as required by NFPA 70-E for all tests.
 4. District Safety Regulations.
- I. All field tests shall be performed with apparatus de-energized except where otherwise specifically required by Section 8 (or current section number, if changed) of the latest Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems published by NETA or by these specifications.
- J. The Contractor shall have a designated safety representative who shall be present on the project and supervise operations with respect to safety.
- K. Electrical equipment and materials furnished and installed by the Contractor, and the testing equipment listed below shall be tested in accordance with the "Inspection and Test Procedures" and "System Function Tests" (Section 8 or current section number, if changed) of the latest Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems published by NETA. Tests shall not include any tests listed as optional in the aforementioned NETA Specifications unless specifically noted in respective equipment specifications for this project.
- L. Retesting will be required for all unsatisfactory tests after the equipment or system has been repaired. Retest all related equipment and systems if required by the Engineer. Repair and retest equipment and systems which have been satisfactorily tested but later fail, until satisfactory performance is obtained.
- M. Putting Equipment and Cables into Service: Submittal and favorable review of the specified factory and field tests shall occur before the Contractor is permitted to place the respective equipment or cable into service.
- N. Notify the Engineer one day prior to when equipment becomes available for acceptance tests. Work shall be coordinated to expedite project scheduling.
- O. All testing shall be performed in the presence of the Engineer.
- P. The Contractor shall be responsible for implementing all final settings and adjustments on protective devices.
- Q. Any system material or workmanship which is found defective on the basis of acceptance tests shall be reported directly to the Engineer.
- R. The Contractor shall maintain a written record of all tests and upon completion of project, assemble and certify a final test report.
- S. Required Tests
1. Insulation Resistance, Continuity, Rotation: Perform routine insulation resistance, continuity and rotation tests for all distribution and utilization equipment including all motors 1/2 horsepower and larger prior and in addition to tests performed by the Contractor specified herein.

2. Motor Current: Measure and record current in each phase for each new motor. Include measurement of the motor terminal voltages (if motor terminals are inaccessible, i.e. submersible motors, take voltage reading at the motor controller) and motor currents when the motor is being operated at normal operating loads. For motors which are part of adjustable frequency use true-RMS-reading instruments in making the measurements.
3. All overcurrent protective devices rated 100A or greater shall calibrated and tested per the NETA standard reference in K. above.
4. Operational Tests: Operationally test all circuits to demonstrate that the circuits and equipment have been properly installed, adjusted and are ready for full time service. Demonstrate the proper functioning of circuits in all modes of operation, including alarm conditions, and demonstrate satisfactory interfacing with the control panel.

3.8 Equipment Protection

- A. Exercise care at all times after installation of equipment, motor control centers, etc., to keep out foreign matter, dust, dirt, debris, or moisture. Use protective sheet metal covers, canvas, heat lamps, etc., as needed to ensure equipment protection.

3.9 Cleaning Equipment

- A. Thoroughly clean all soiled surfaces of installed equipment and materials.
- B. Clean out and vacuum all construction debris from the bottom of all equipment.
- C. Provide and touch-up to original condition any factory painting that has been marred or scratched during shipment or installation, using paint furnished by the equipment manufacturer.

3.10 Cleanup

- A. During the course of construction and upon completion of the electrical work, remove all surplus materials, rubbish, and debris that accumulated during the construction work. Leave the entire area neat, clean, and acceptable to the Engineer.

ATTACHMENT 160100A

Equipment Acceptance Form

Equipment Description: _____

Contractor: _____ has reviewed and inspected the
above equipment and found it in conformance with the drawings supplied by the DISTRICT.

Check one of the following:

There is no damaged, missing or non-conforming equipment.

The following equipment was damaged, missing or non-conforming to the drawings. (List all
equipment damaged or missing or non-conforming.)

☐

☐

Contractor accepts the responsibility for maintaining the equipment, undamaged, in the condition
indicated above.

Signed by Contractor: _____

Title: _____ Date: _____

Accepted by DISTRICT Representative: _____ Date: _____

**** END OF SECTION ****

SECTION 161100 CONDUIT, RACEWAYS AND FITTINGS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Provision and installation of conduits, raceways and fittings.

1.2 REFERENCES

- A. Provisions: Applicable provisions of Section 160100 become a Part of this section as if repeated herein.
- B. American National Standards Institute (ANSI) Publications:
 - 1. C80.1 Specification for Zinc Coated Rigid Steel Conduit
 - 2. C80.3 Specifications for Zinc Coated Electrical Metallic Tubing
- C. National Electrical Manufacturers Association (NEMA) Publications:
 - 1. RN1 Polyvinyl Chloride Externally Coated Galvanized Rigid Steel Conduit and Electrical Metallic Tubing
 - 2. TC2 Electrical Polyvinyl Chloride (PVC) Tubing and Conduit
 - 3. TC3 PVC Fittings for Use with PVC Tubing and Conduit
- D. Underwriters Laboratories (UL) Standards:
 - 1. 6 Rigid Metal Electrical Conduit
 - 2. 360 Liquid-Tight Flexible Steel Electrical Conduit
 - 3. 541B Conduit, Tubing and Cable Fittings
 - 4. 651 Schedule 40, 80 Type EB and A Rigid PVC Conduit and Fittings

1.3 SUBMITTALS

- A. Submit material or equipment data in accordance with Section 013300 and Section 160100 of these Specifications.

1.4 LOCATIONS

- A. Refer to Section 160100, GENERAL ELECTRICAL REQUIREMENTS, for definitions of types of locations.

PART 2 - PRODUCTS

2.1 CONDUIT, RACEWAYS

- A. General: Galvanized rigid steel conduit shall be used in all conduit systems, except where otherwise shown on the Drawings, or where flexible conduit is required. The minimum size raceway shall be 3/4-inch unless indicated otherwise on the Drawings.
- B. Galvanized Rigid Steel Conduit (RGS) shall be hot-dip galvanized after fabrication, conforming to ANSI C80.1 and UL 6. Couplings shall be threaded type. Where PVC coated rigid steel conduit is called for, it shall be hot-dip galvanized, conforming to NEMA RN 1, with factory-applied PVC coating 40 mils thick, minimum.

- C. Flexible Conduit: Flexible metal conduit shall be liquid-tight, shall have a moisture- and oil-proof PVC jacket extruded over a galvanized, flexible steel conduit, and shall conform to UL 360.

2.2 CONDUIT SUPPORTS

- A. Supports for individual conduits shall be galvanized malleable iron one-hole type with conduit back spacer, unless specified otherwise on the Drawings.
- B. Supports for multiple conduits shall be hot-dip galvanized, inside or stainless steel, outside; Unistrut or Superstrut channels, or equal, as called for on the Drawings. All associated hardware shall be hot-dip galvanized or stainless steel to match the strut.
- C. All channels, strut, threaded rods, nuts and clamps in corrosive areas shall be of epoxy resin reinforced fiberglass material. Provide Robroy, Superstrut, or equal.

2.3 FITTINGS

- A. Fittings for use with rigid steel shall be hot dipped galvanized steel or galvanized cast ferrous metal; access fittings shall have gasketed cast covers and be Crouse-Hinds Condulets, Appleton Unilets, or equal. Provide threaded-type couplings and connectors.
- B. Fittings for flexible conduit shall be Appleton Type ST, O-Z Gedney Series 4Q, or equal.
- C. Union couplings for conduits shall be the Erickson type and shall be Appleton Type EC. O-Z Gedney 3-piece Series 4, or equal. Threadless couplings shall not be used.
- D. Bushings:
 - 1. Bushings shall be the Insulated type.
 - 2. Bushings for rigid steel shall be hot dip galvanized insulated grounding type, O-Z Gedney Type HBLG, Appleton Type GIB, or equal.
- E. Conduit seals, when required, shall have zinc electroplate and shall be Crouse-Hinds Type EYS or EZS; Appleton Type EYS, ESU, or EY series; or equal. Sealing compounds shall be provided by the same manufacturer as the seals and approved for use with the seals provided.
 - 1. After all cables have been installed, the seals shall be packed per manufacturer's instructions.
 - 2. After the system has been satisfactorily tested, the Engineer shall be notified a minimum of 24 hours prior to pouring the seals to allow for inspection.
 - 3. Poured seals shall be painted red after inspection and approval by the Engineer.
- F. Fittings in corrosive areas shall be:
 - 1. PVC coated rigid galvanized steel, minimum coating 40 mils. thick, compatible with the conduit supplied, or
 - 2. Schedule 40 PVC, if called for on the Drawings or approved by the Engineer.
 - 3. Conduit seals shall be provided in conduits entering the electrical room from the chemical rooms. Seals shall be packed with duct seal after cables have been tested and accepted for use.

2.4 WIREWAYS AND AUXILIARY GUTTERS

- A. General. Wireways shall consist of a prefabricated channel-shaped trough with hinged or removable covers, associated fittings, and supports. Straight sections shall not be longer than 5 feet. Cross-sectional dimensions shall be per the NEC. Fittings shall consist of elbows, tees, crosses, and closing plates as required.
- B. Interior Locations: All components shall be constructed from sheet steel not less than 16 gauge and coated with a corrosion-resistant gray paint. Covers shall be held closed with screws.
- C. Exterior Locations: Wireway and associated fittings shall meet NEMA 3R/12 classifications, with gasketed closing end plates and gasketed hinged covers.
- D. Corrosive Locations: In corrosive locations provide enclosure type boxes for use as wireways. Enclosures and associated fittings shall meet NEMA 4X classifications and shall be manufactured from reinforced injection molded fiberglass or formed and welded stainless steel, and shall have gasketed closing plates and hinged and gasketed covers with spring loaded latches.

2.5 CONDUIT SEALANTS

- A. Moisture Barrier Types: Sealant shall be a non-toxic, non-shrink, non-hardening, putty type hand applied material providing an effective barrier under submerged conditions.
- B. Fire Retardant Types: Fire stop material shall be a reusable, non-toxic, asbestos-free, expanding, putty type material with a 3-hour rating in accordance with UL 1479. Provide products indicated by the manufacturer to be suitable for the type and size of penetration.
- C. Chemical Vapor Types: Sealant shall be a non-toxic, non-shrink, non-hardening, putty type hand applied material providing an effective barrier resistant to chemical vapors it may be exposed to.

PART 3 - EXECUTION

3.1 CONDUIT, RACEWAY AND FITTING INSTALLATION

- A. From pull point to pull point, the sum of the angles of all of the bends and offsets shall not exceed 270 degrees.
- B. For power, control and signal circuits, provide conduit per the Drawings.
- C. At all boxes and equipment, provide insulated type metallic grounding bushings for metallic conduits. Bond together all conduits to provide continuity of the equipment grounding system. Size bonding conductor per the NEC.
- D. Provide flexible conduit in lengths of not more than 18 inches at connections to motors, valves and any equipment subject to vibration or relative movement.
- E. Conduit Supports: Properly support all conduits as required by the NEC. Run all conduits exposed except where the Drawings Indicate that they are to be embedded in the floor slab, walls, or ceiling, or to be installed underground.
 - 1. Exposed Conduits: Support exposed conduits within one foot of any outlet and at intervals not exceeding NEC requirements or 10 feet maximum; wherever possible, group conduits together and support on common supports. Support exposed conduits fastened to the surface of the concrete structure by one-hole clamps, or with channels. Use conduit spacers with one-hole clamps. Coordinate conduit locations with piping, equipment, fixtures, and with structural and architectural

elements. Conduits attached to walls or columns shall be as unobtrusive as possible and shall avoid windows. Run all exposed conduits parallel to building lines.

2. Group together exposed conduits in horizontal runs located away from walls and support on trapeze hangers, unless noted otherwise on the drawings. Arrange such conduits uniformly and neatly. Trapeze hangers shall consist of channels of adequate size, suspended by means of rods or other suitable means from the ceiling or from pipe hangers. Install such runs so as not to interfere with the operation of valves or any other equipment. Treat cut surfaces or damaged ends with corrosion-resistant coatings such as "Devcon Z", prepared by Subox Coatings; "Galvanox Type I", prepared by Pedley-Knowles; or equal. Application shall follow manufacturer's recommendation.
- F. Spare Raceways: After completing a conduit run between handholes, or pullboxes, prove the integrity of the conduit run. Use an air compressor to blow in a pull-line, then use the pull-line to pull a mandrel through the entire conduit run. Install a new 3/16-inch nylon, 800 pound test pull-line which has tape measure marking every foot to indicate length. Pull-line shall be labeled with the conduit number at each end. Plug the ends of the conduit, with conduit cap plugs. Taping the conduit ends is not acceptable.
 - G. All penetrations through walls into or out of corrosive locations, as defined in Section 160100, GENERAL ELECTRICAL REQUIREMENTS, shall be made gas tight. In concrete walls, pour concrete after the conduit is in place, if possible. If not, core drill concrete or CMU walls, Install conduit and caulk around it with non-shrink grout. Install conduit seal in each conduit near the penetration, or as shown on the drawings.
 - H. All conduit penetrations through interior walls and floors shall be sealed with fire retardant type conduit sealant, unless a corrosive location. See 2.5 C. above.
 - I. Conduit Identification: In each handhole, pullbox, cabinet, motor control center or other equipment enclosure, identify each conduit: using a conduit number system acceptable to the Engineer, by means of a stamped stainless steel tag affixed with stainless steel wire; where affixing a tag is not feasible, identify conduits by stenciling. Stencil all exposed conduits for identification at least once in each room.
 - J. Conduit Seals:
 1. Moisture Seals: Provide in accordance with NEC requirements and in all underground conduits entering vaults.

3.2 WIREWAY INSTALLATION

- A. Straight sections and fittings shall be solidly bolted together to be mechanically rigid and electrically continuous. Dead ends shall be closed. Unused conduit openings shall be plugged.
- B. Wireways shall be supported every five feet.
- C. Wireways and auxiliary gutters shall not contain wiring or control devices and shall not extend over 80 feet in length.

****END OF SECTION****

CONDUIT	MINIMUM CONDUIT SIZE (INCHES)	FROM	TO OR VIA	CONDUCTORS QTY-AWG	WIRE TYPE	VOLTAGE AC UNLESS NOTED OTHERWISE	PH.	GROUND (EGC) QTY- AWG	COMMENTS	DRAWING NUMBER
CP-001	2-1/2	MPWMD SANTA MARGARITA PUMP SITE BUILDING MCC	CHEM BUILDING MAIN CIRCUIT BREAKER	3-#4/0	XHHW-2	480	3	1-#3	MAIN POWER	E-3
CP-002	2-1/2	MPWMD SANTA MARGARITA PUMP SITE BUILDING MCC	INISDE CHEM BUILDING	-	-	-	-	-	SPARE - STUB UP 6" FROM FLOOR PULL STRING & CAP	E-3
CP-003	2-1/2	CHEM BUILDING MAIN CIRCUIT BREAKER	TRANSFER SWITCH	3-#4/0	XHHW-2	480	3	1-#3	MAIN POWER	E-3
CP-004	2-1/2	TRANSFER SWITCH	MCC	3-#4/0	XHHW-2	480	3	1-#3	MAIN POWER	E-3
CP-005	3/4	TRANSFER SWITCH	DP-1	2#12	XHHW-2	120	1	1-#12	SPACE HEATER	E-3
CJ-900A	1-1/2	CONTROL PANEL	PULLBOX PB-J900	3-#18 TSP 2-#18 TSP 4-#18 TSP 2-#18 TSP 4-#18 TSP 1-#18 TSP	BELDEN #1032A	24VDC	-	-	FDQIT-900 PIT-913A, PIT-913B FDQIT-915, FCV-916 PIT-923A, PIT-923B FDQIT-925, FCV-926 LT-1020	E-4
CJ-900B	1-1/2	CONTROL PANEL	PULLBOX PB-J900	-	-	-	-	-	SPARE, PULL STRING & CAP	E-4
CJ-900C	1-1/2	CONTROL PANEL	PULLBOX PB-J900	2-#16 PR 2-#16 PR 2-#16 PR	BELDEN #9487	24VDC	-	-	LSH1000, LSL-1000 LC-916 TO FCV-916 SOLENOIDS LC-926 TO FCV-926 SOLENOIDS	E-4
CJ-905	1	PULLBOX PB-J900	FDQIT-900	3-#18 TSP	BELDEN #1032A	24VDC	-	-	FLOW, TOTALIZER & DIRECTION	E-4

CONDUIT	MINIMUM CONDUIT SIZE (INCHES)	FROM	TO OR VIA	CONDUCTORS QTY-AWG	WIRE TYPE	VOLTAGE AC UNLESS NOTED OTHERWISE	PH.	GROUND (EGC) QTY- AWG	COMMENTS	DRAWING NUMBER
CJ-906	1	PULLBOX PB-J900	FDQIT-900 VAULT	-	-	-	-	-	SPARE - STUB OUT PULL STRING & CAP	E-4
CJ-913	1	PULLBOX PB-J900	PT-913A PT-913B	2-#18 TSP	BELDEN #1032A	24VDC	-	-	LOCATED IN OBRIEN BOX	E-4
CJ-915	1	PULLBOX PB-J900	FCV-916FDQIT-915	1-#18 TSP 3-#18 TSP	BELDEN #1032A	24VDC	-	-	VALVE POSITIONFLOW, TOTALIZER & DIRECTION	E-4
CJ-916	1	PULLBOX PB-J900	FCV-916 SV916A & B	2-#16 PR	BELDEN #9487	24VDC	-	1-#16	SV-916 A & B CONTROL	E-4
CJ-923	1	PULLBOX PB-J900	PIT-923A PIT-923B	2-#18 TSP	BELDEN #1032A	24VDC	-	-	LOCATED IN OBRIEN BOX	E-4
CJ-925	1	PULLBOX PB-J900	FCV-926 FDQIT-925	1-#18 TSP 3-#18 TSP	BELDEN #1032A	24VDC	-	-	VALVE POSITION FLOW, TOTALIZER & DIRECTION	E-4
CJ-926	1	PULLBOX PB-J900	FCV-926 SV926A & B	2-#16 PR	BELDEN #9487	24VDC	-	1-#16	SV-926A & B CONTROL	E-4
CP-900A	1	DP-1	PULLBOX PB-P900	2-#12 2-#12 2-#10	XHHW-2	120	1	1-#12 1-#12 1-#10	O-BRIEN ENCLOSURES POWER PARKING LIGHT S. GATE OPERATOR	E-4
CP-900B	1	DP-1	PULLBOX PB-P900	2-#12 2-#12	XHHW-2	120	1	1-#12 1-#12	PT-913A/913B O'BRIEN ENCL. PT-923A/923B O'BRIAN ENCL.	E-4
CP-900C	1	IP-1	PULLBOX PB-P900	2-#14 2-#14 2-#14	XHHW-2	120	1	1-#14 1-#14 1-#14	FDQIT-915 POWER FDQIT-925 POWER FDQIT-900 POWER	E-4
CP-900D	1	MCC	PULLBOX PB-P900	-	-	-	-	-	SPARE	E-4

CONDUIT	MINIMUM CONDUIT SIZE (INCHES)	FROM	TO OR VIA	CONDUCTORS QTY-AWG	WIRE TYPE	VOLTAGE AC UNLESS NOTED OTHERWISE	PH.	GROUND (EGC) QTY- AWG	COMMENTS	DRAWING NUMBER
CP-905	1	PULLBOX PB-P900	FDQIT-900	2-#14	XHHW-2	120	1	1-#14	POWER	E-4
CP-913	1	PULLBOX PB-P900	PT-913A/913B O'BRIEN ENCL.	2-#12	XHHW-2	120	1	1-#12		E-4
CP-915	1	PULLBOX PB-P900	FDQIT-915	2-#14	XHHW-2	120	1	1-#14	POWER	E-4
CP-923	1	PULLBOX PB-P900	PT-923A/923B O'BRIAN ENCL.	2-#12	XHHW-2	120	1	1-#12	-	E-4
CP-925	1	PULLBOX PB-P900	FDQIT-925	2-#14	XHHW-2	120	1	1-#14	POWER	E-4
CP-S. GATE	1	PULLBOX PB-P900	SOUTH GATE OPERATOR	2-#10	XHHW-2	120	1	1-#10	POWER	E-4
CJ-1000	1-1/2	AIT-1000/150 (CONTROL PANEL) VIA PULLBOX PB-J900	AE-1000	VENDOR CABLE	-	-	-	-	SUMP CONDUCTIVITY	E-5
CJ-1000A	1	PULLBOX PB-J900	LSH-1000 LSL-1000	1-#16 PR 1-#16 PR	BELDEN #9487	24VDC	-	-	SUMP LEVEL CONTROLS	E-5
CJ-1020	1	PULLBOX PB-J900	LT-1020	1-#18 TSP	BELDEN #1032A	24VDC	-	-	PIT LEVEL	E-5
CP-1000AB	1	MCC VIA PULLBOX PB-P900	P-1000A& B SUMP PUMPS JB	4-#12	XHHW-2	120	1	1#12	POWER	E-5
CP-1200	1	MCC	AC-1200 AIR COMPRESSOR VIA PULLBOX	3-#10	XHHW-2	480	3	1-#10	POWER	E-5

CONDUIT	MINIMUM CONDUIT SIZE (INCHES)	FROM	TO OR VIA	CONDUCTORS QTY-AWG	WIRE TYPE	VOLTAGE AC UNLESS NOTED OTHERWISE	PH.	GROUND (EGC) QTY- AWG	COMMENTS	DRAWING NUMBER
CP-1201	1	CONTROL PANEL	SV-1201 (COMPRESSOR)	2-#14	XHHW-2	120	1	1-#14		E-5
CP-902	1	CONTROL PANEL	PULLBOX PB-P900	2-#14	XHHW-2	120	1	1-#14 1-#14	PRV-955 CONTROLS	E-5
CP-955	1	PULLBOX PB-P900	PRV-955	2-#14	XHHW-2	120	1	1-#14	SOLENOID VALVE CONTROL	E-5
CP-IRR	1	DP-1	SEE PLAN	-	-	-	-	-	STUB CONDUIT UP OUTSIDE OF CONCRETE SIDEWALK. PULL STRING, CAP AND TAG (IRRIGATION)	E-5
CP-N. GATE	1	DP-1	NORTH GATE	2-#10	XHHW-2	120	1	1-#10	POWER	E-5
CP-PARK	1	LC-1 VIA PULLBOX PB- P900	PARKING LIGHT	2-#12	XHHW-2	120	1	1-#12	CONTROL	E-5
CJ-100	3/4	LSH-100LSHH-100	LCP-100	2-#14 2-#14	XHHW-2	120	-	-	STORAGE TANK FILL STATION CONTROLS	E-6
CJ-1050	3/4	CONTROL PANEL	ZS-1050A THRU I	2#14	XHHW-2	24VDC	-	-	DOOR INTRUDER SWITCHES WIRED IN SERIES	E-6
CJ-110 NOTE 1	1-1/2	CONTROL PANEL	FS-200 LSH-200 LCP-216 LCP-220 LSH-150 JB FS-100 LCP-100	4-#14 2-#14 16-#14 16-#14 2-#14 4-#14 6-#14	XHHW-2	24VDC	-	1-#14 1-#14	TOP SAFETY SHWR ALARM PWR/CNTRLs DAY TANK LEVEL ALARM CHEM PUMP CONTROLS CHEM PUMP CONTROLS SUMP ALARM BOT SAFETY SHWR ALARM PWR/CNTRLs FILL STATION CONTROLS	E-6
CJ-111	1	CONTROL PANEL	HYPOCHLORITE ROOM	-	-	-	-	-	SPARE - STUB OUT 12" FROM WALL, PULL STRING & CAP	E-6

CONDUIT	MINIMUM CONDUIT SIZE (INCHES)	FROM	TO OR VIA	CONDUCTORS QTY-AWG	WIRE TYPE	VOLTAGE AC UNLESS NOTED OTHERWISE	PH.	GROUND (EGC) QTY- AWG	COMMENTS	DRAWING NUMBER
CJ-115 NOTE 1	1-1/2	CONTROL PANEL	LT-200 LCP-216 LCP-220 LT-101 LCP-100	1-#18 TSP 4-#18 TSP 4-#18 TSP 1-#18 TSP 1-#18 TSP	BELDEN #1032A	24VDC	-		DAY TANK LEVEL CHEM PUMP FLOW COMMAND CHEM PUMP FLOW COMMAND STORAGE TANK LEVEL STORAGE TANK LEVEL TO FILL STATION	E-6
CJ-150	1-1/2	AIT-1000/150 (CONTROL PANEL)	AE-150 JB	VENDOR CABLE	-	-	-	-	AIT LOCATED IN CONTROL PANEL SUMP CONDUCTIVITY	E-6
CJ-217	3/4	LCP-216	PSL-217A PSL-217B	2-#14 2-#14	XHHW-2	24VDC	-	-	CHEM PUMP DISCH. PRESS. ALARM	E-6
CJ-221	3/4	LCP-220	PSL-221A PSL-221B	2-#14 2-#14	XHHW-2	24VDC	-	-	CHEM PUMP DISCH. PRESS. ALARM	E-6
CJ-300	3/4	LSH-300 LSHH-300	LCP-300	2-#14 2-#14	XHHW-2	120	-	-	STORAGE TANK FILL STATION CONTROLS	E-6
CJ-310 NOTE 1	1-1/2	CONTROL PANEL	FS-400 LSH-400 LCP-416 LCP-420 LSH-350 JB FS-300 LCP-300	4-#14 2-#14 16-#14 16-#14 2-#14 4-#14 6-#14	XHHW-2	24VDC	-	1-#14 1-#14	TOP SAFETY SHWR ALARM PWR/CNTRLS DAY TANK LEVEL ALARM CHEM PUMP CONTROLS CHEM PUMP CONTROLS SUMP ALARM BOT SAFETY SHWR ALARM PWR/CNTRLS FILL STATION CONTROLS	E-6
CJ-311	1	CONTROL PANEL	ZOP ROOM	-	-	-	-	-	SPARE - STUB OUT 12" FROM WALL,PULL STRING & CAP	E-6
CJ-315 NOTE 1	1-1/2	CONTROL PANEL	LT-400 LCP-416 LCP-420 LT-301 LCP-300	1-#18 TSP 4-#18 TSP 4-#18 TSP 1-#18 TSP 1-#18 TSP	BELDEN #1032A	24VDC	-	-	DAY TANK LEVEL CHEM PUMP FLOW COMMAND CHEM PUMP FLOW COMMAND STORAGE TANK LEVEL STORAGE TANK LEVEL TO FILL STATION	E-6

CONDUIT	MINIMUM CONDUIT SIZE (INCHES)	FROM	TO OR VIA	CONDUCTORS QTY-AWG	WIRE TYPE	VOLTAGE AC UNLESS NOTED OTHERWISE	PH.	GROUND (EGC) QTY- AWG	COMMENTS	DRAWING NUMBER
CJ-350	1-1/2	AIT-350/650 (CONTROL PANEL)	AE-350 JB	VENDOR CABLE	-	-	-	-	AIT LOCATED IN CONTROL PANEL SUMP CONDUCTIVITY	E-6
CJ-417	3/4	LCP-416	PSL-417A PSL-417B	2-#14 2-#14	XHHW-2	24VDC	-	-	CHEM PUMP DISCH. PRESS. ALARM	E-6
CJ-421	3/4	LCP-420	PSL-421A PSL-421B	2-#14 2-#14	XHHW-2	24VDC	-	-	CHEM PUMP DISCH. PRESS. ALARM	E-6
CJ-516/517	1	CONTROL PANEL	AIT-516 AIT-517	1-#18 TSP 1-#18 TSP	BELDEN #1032A	24VDC	-	-	-	E-6
CJ-518/522	1	CONTROL PANEL	STORAGE ROOM	-	-	-	-	-	FUTURE ANALYZER STUB OUT, PULL STRING AND CAP	E-6
CJ-526/527	1	CONTROL PANEL	AIT-526 AIT-527	1-#18 TSP 1-#18 TSP	BELDEN #1032A	24VDC	-	-	-	E-6
CJ-610	1-1/2	CONTROL PANEL	FUTURE CHEMICAL ROOM	-	-	-	-	-	STUB CONDUIT 12" FROM WALL, PULL STRING AND CAP	E-6
CJ-611	1	CONTROL PANEL	FUTURE CHEMICAL ROOM	-	-	-	-	-	SPARE STUB CONDUIT 12" FROM WALL, PULL STRING AND CAP	E-6
CJ-615	1-1/2	CONTROL PANEL	FUTURE CHEMICAL ROOM	-	-	-	-	-	STUB CONDUIT 12" FROM WALL, PULL STRING AND CAP	E-6
CJ-650	1-1/2	AIT-350/650 (CONTROL PANEL)	FUTURE CHEMICAL ROOM	-	-	-	-	-	STUB CONDUIT 12" FROM WALL, PULL STRING AND CAP	E-6
CJ-FS1010	3/4	CONTROL PANEL	FS-1010	4#14	XHHW-2	24VDC	-	1-#14	SAFETY SHOWER POWER & ALARM	E-6

CONDUIT	MINIMUM CONDUIT SIZE (INCHES)	FROM	TO OR VIA	CONDUCTORS QTY-AWG	WIRE TYPE	VOLTAGE AC UNLESS NOTED OTHERWISE	PH.	GROUND (EGC) QTY- AWG	COMMENTS	DRAWING NUMBER
CJ-FS600	3/4	CONTROL PANEL	FS-600 FS-700	4#14 4#14	XHHW-2	24VDC	-	1-#14	FUTURE CHEMICAL ROOM TOP SAFETY SHWR ALARM PWR/CNTRLS BOT SAFETY SHWR ALARM PWR/CNTRLS	E-6
CP-006	1	IP-1	PLC CONTROL PANEL	2-#12 2-#12	XHHW-2	120	1	1-#12 1-#12	CONTROL POWER RELAY POWER	E-6
CP-100	3/4	DP-1 IP-1	LCP-100 LT-101 LT-200	2-#12 2-#14 2-#14	XHHW-2	120	1	1-#12 1-#14 1-#14	POWER	E-6
CP-101	3/4	MCC	HYPOCHLORITE ROOM	-	-	-	-	-	SPARE - STUB OUT 12" FROM WALL, PULL STRING & CAP	E-6
CP-110A/B	3/4	MCC	PMP-110A PMP-110B	3-#12 3-#12	XHHW-2	480	3	1-#12 1-#12	POWER	E-6
CP-150	3/4	MCC	PMP-150 LSL-150 JB	2-#12 2-#14	XHHW-2	120	1	1-#12	SUMP PUMP POWER LSL CONTROL	E-6
CP-216/220	3/4	DP-1	LCP-216 LCP-220	2-#12 2-#12	XHHW-2	120	1	1-#12 1-#12	CHEM METERING SKIDS	E-6
CP-300	3/4	DP-1 IP-1	LCP-300 LT-301 LT-400	2-#12 2-#14 2-#14	XHHW-2	120	1	1-#12 1-#14 1-#14	POWER	E-6
CP-301	3/4	MCC	ZOP ROOM	-	-	-	-	-	SPARE - STUB OUT PULL STRING & CAP	E-6
CP-310A/B	3/4	MCC	PMP-310A PMP-310B	3-#12 3-#12	XHHW-2	480	3	1-#12 1-#12	POWER	E-6
CP-350	3/4	MCC	PMP-350 LSL-350 JB	2-#12 2-#14	XHHW-2	120	1	1-#12	SUMP PUMP POWER LSL CONTROL	E-6

CONDUIT	MINIMUM CONDUIT SIZE (INCHES)	FROM	TO OR VIA	CONDUCTORS QTY-AWG	WIRE TYPE	VOLTAGE AC UNLESS NOTED OTHERWISE	PH.	GROUND (EGC) QTY- AWG	COMMENTS	DRAWING NUMBER
CP-416/420	3/4	DP-1	LCP-416 LCP-420	2-#12 2-#12	XHHW-2	120	1	1-#12 1-#12	CHEM METERING SKIDS	E-6
CP-516/517	1	CONTROL PANEL	AIT-516AIT-517	2-#14 2-#14	XHHW-2	120	1	1-#14 1-#14	POWER	E-6
CP-518/522	1	IP-1	STORAGE ROOM	-	-	-	-	-	FUTURE ANALYZER STUB OUT, PULL STRING AND CAP	E-6
CP-526/527	1	CONTROL PANEL	AIT-526 AIT-527	2-#14 2-#14	XHHW-2	120	1	1-#14 1-#14	POWER	E-6
CP-600	3/4	DP-1 IP-1	FUTURE CHEMICAL ROOM	-	-	-	-	-	STUB CONDUIT 12" FROM WALL, PULL STRING AND CAP	E-6
CP-601	3/4	MCC	FUTURE CHEMICAL ROOM	-	-	-	-	-	SPARE -STUB CONDUIT 12" FROM WALL, PULL STRING AND CAP	E-6
CP-610A/B	3/4	MCC	FUTURE CHEMICAL ROOM	-	-	-	-	-	STUB CONDUIT 12" FROM WALL, PULL STRING AND CAP	E-6
CP-650	1	MCC	FUTURE CHEMICAL ROOM	-	-	-	-	-	STUB CONDUIT 12" FROM WALL, PULL STRING AND CAP	E-6
CP-716/720	3/4	DP-1	FUTURE CHEMICAL ROOM	-	-	-	-	-	STUB CONDUIT 12" FROM WALL, PULL STRING AND CAP	E-6
CP-EH1	1	MCC	EH-1	3-#10	XHHW-2	480	3	1-#10	HEATER POWER	E-6
CP-EH2	1	MCC	EH-2	3-#10	XHHW-2	480	3	1-#10	HEATER POWER	E-6

CONDUIT	MINIMUM CONDUIT SIZE (INCHES)	FROM	TO OR VIA	CONDUCTORS QTY-AWG	WIRE TYPE	VOLTAGE AC UNLESS NOTED OTHERWISE	PH.	GROUND (EGC) QTY- AWG	COMMENTS	DRAWING NUMBER
CP-EH3	1	MCC	EH-2	3-#10	XHHW-2	480	3	1-#10	HEATER POWER	E-6
CJ-ANT	2"	CONTROL PANEL	ANTENNA (ROOF)	RADIO CABLE	-	-	-	-	RADIO	E-7
CJ-PCCELL	1/2"	PC (PHOTOCONTROLLER)	PHOTOCELL	4-#18	XHHW-2	24VAC	-	-	LOCATED ON ROOF	E-7
CP-EF1A	1	MCC	EF-1 DISC	3-#12	XHHW-2	480	3	1-#12	FAN POWER	E-7
CP-EF1B	1	EF-1 DISC	EF-1	3-#12	XHHW-2	480	3	1-#12	FAN POWER	E-7
CP-EF2A	1	MCC	EF-2 DISC	3-#12	XHHW-2	480	3	1-#12	FAN POWER	E-7
CP-EF2B	1	EF-2 DISC	EF-2	3-#12	XHHW-2	480	3	1-#12	FAN POWER	E-7
CP-EF3A	1	MCC	EF-1 DISC	3-#12	XHHW-2	480	3	1-#12	FAN POWER	E-7
CP-EF3B	1	EF-3 DISC	EF-3	3-#12	XHHW-2	480	3	1-#12	FAN POWER	E-7
CP-HPA	1	DP-1	HP-1 DISC	2-#10	XHHW-2	208	1	1-#12	HVAC HEAT PUMP	E-7
CP-HPB	1	HP-1 DISC	HP-1	2-#10	XHHW-2	208	1	1-#12	HVAC HEAT PUMP	E-7

SECTION 161200 LOW VOLTAGE WIRE AND CABLE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Provisions: Applicable provisions of Section 160100 become a part of this section as if repeated herein.
- B. Related Work Described Elsewhere: All 170000 Sections.

1.2 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM):
 - 1. B3-74 Specification for Soft or Annealed Copper Wire
 - 2. B8-77 Specification for Concentric Lay Stranded Copper Conductors, Hard, Medium-Hard, or Soft
 - 3. B173-71 Specification for Rope Lay Stranded Copper Conductors Having Concentric Stranded Members
- B. Insulated Cable Engineers Association (ICEA):
 - 1. S-66-524 Cross-Linked Thermosetting Polyethylene Insulated Wire and Cable
- C. International Electrical Testing Association (NETA);
 - 1. NETA Acceptance Testing Specifications
- D. Underwriters Laboratories (UL) Standards:
 - 1. 44 Rubber Insulated Wire and Cable
 - 2. 62 Flexible Cords and Fixture Wire
 - 3. 83 Thermoplastic-Insulated Wires and Cables
 - 4. 510 Insulating Tape
 - 5. 719 Non-Metallic Sheath Cable
 - 6. 1063 Stranded Conductors for Machine Tool Wire

1.3 SUBMITTALS

- A. Submit material or equipment data in accordance with Section 013300 and Section 160100 of these Specifications.

1.4 LOCATIONS

- A. Refer to Section 160100, GENERAL ELECTRICAL REQUIREMENTS, for definitions of types of locations.

PART 2 - PRODUCTS

2.1 CONDUCTORS

- A. General: All conductors shall be copper [unless specifically shown otherwise on the Drawings or in the circuit schedule]. Wire or cable not specifically shown on the Drawings or specified, but required, shall be of the type and size required for the

application and in conformance with the applicable code. All insulated conductors shall be identified with printing colored to contrast with the insulation color.

B. Power and Control Conductors, 600 Volts and below:

1. Stranded copper wire shall be 600 volt Type XHHW-2, Class B stranding, sizes #14 AWG and larger.

2.2 SPLICES AND TERMINATIONS OF CONDUCTORS

A. Splices:

1. Wire and Cable Splicing Materials and Applications:

- a. All Equipment: Crimp type connectors shall be insulated type, suitable for the size and material of the wires and the number of wires to be spliced and for use with either solid or stranded conductors. They shall be UL listed.
- b. Division 16 Equipment and Power Conductors: Bolted pressure connectors shall be suitable for the size and material of the conductors to be spliced. They shall be UL listed and of the split bolt or bolted split sleeve type in which the bolt or set screw does not bear directly on the conductor.
- c. Provide Terminal Cabinets (J-boxes) as shown on the Drawings. Termination system shall include Insulated, crimp-type connectors. Coordinate the lug and boards for correct fit. All terminations shall include marker sleeves.

B. Terminations:

1. Low Voltage Terminations:

- a. Crimp type terminals shall be UL listed, self-insulating sleeve type, with ring or rectangular type tongue, suitable for the size and material of the wire to be terminated, and for use with either solid or stranded conductors.
- b. Terminal lugs shall be UL listed and of the split bolt or bolted split sleeve type in which the bolt or set screw does not bear directly on the conductor. Tongues shall have NEMA standard drilling.
- c. Crimp with manufacturer recommended ratchet-type tool with calibrated dyes. Hand crimping tools are not acceptable.

C. Tape used for splices and terminations shall be compatible with the insulation and jacket of the cable and shall be of plastic material. Tape shall conform with UL 510.

D. Wire markers shall be heat shrink type (Raychem, T&B, or approved substitute. Wire numbers shall be permanently imprinted on the markers.

PART 3 - EXECUTION

3.1 CONDUCTOR INSTALLATION

A. Provide the following types and sizes of conductors for the uses Indicated for 600 volts or less:

1. Stranded Copper. Size #14 AWG and Larger, Individual Conductors or multi-conductor: As shown on the Drawings for the control of motors or other equipment.
2. Stranded Copper. Sizes #12 AWG and Larger: As shown on the drawings for motors and other power circuits.

- B. Color Coding: Provide color coding for all circuit conductors. Insulation color shall be white for neutrals and green for grounding conductors. An isolated ground conductor shall be identified with an orange tracer in the green body. Ungrounded conductor colors shall be as follows:

1. 120/208 Volt, 3 Phase: Red, black and blue.
2. 277/480 Volt, 3 Phase: Yellow, brown and orange.
3. 120/240 Volt, 1 Phase: Red and Black.

Color coding shall be in the conductor insulation for all conductors #10 AWG and smaller; for larger conductors, color shall be either in the insulation or in colored plastic tape applied at every location where the conductor is readily accessible (e.g., enclosures, pullboxes, and junction boxes).

- C. Exercise care in pulling wires and cables into conduit or wireways so as to avoid kinking, putting undue stress on the cables or otherwise abrading them. No grease will be permitted in pulling cables. Only UL listed pulling compound will be permitted. The raceway construction shall be complete and protected from the weather before cable is pulled into it. Swab and mandrel conduits before installing cables and exercise care in pulling, to avoid damage to conductors.
- D. Cable bending radius shall be per applicable code. Install feeder cables in one continuous length.
- E. Provide an equipment grounding conductor, whether or not it is shown on the Drawings, in any flexible conduit or any raceway in which all or any portion of a run consists of non-metallic duct or conduit. For flexible conduit, an external bonding jumper is an acceptable alternative.
- F. In panels, bundle incoming wire and cables, No.6 AWG and smaller, lace at intervals not greater than 6 inches, neatly spread into trees and connect to their respective terminals. Allow sufficient slack in cables for alterations in terminal connections. Perform lacing with plastic cable ties. Where plastic panel wiring duct is provided for cable runs, lacing is not necessary when the cable is properly installed in the duct.
- G. For cables crossing hinges, utilize extra flexible stranded wire, make up into groups not exceeding 12, and arrange so that they will be protected from chafing and excess flexing when the hinged member is moved. Cover cables crossing the hinge with plastic spiral sleeves.

3.2 CONDUCTOR SPLICES AND TERMINATIONS

- A. Splices: install all conductors without splices unless necessary for installation, as determined by the Engineer. Splices, when permitted, and terminations shall be in accordance with the splice or termination kit manufacturer's instructions. Splice or terminate wire and cable as follows:
- B. Terminations:
1. Terminate stranded #14 wire using crimp type terminals where not terminated in a box lug type terminal. Terminals must be coordinated with type of terminal board where provided.

3.3 CONDUCTOR IDENTIFICATION

- A. Except for interior lighting and receptacle circuits, identify each wire or cable at each termination and in each pullbox, junction box, handhole, and manhole using numbered and lettered wire markers. All electrically common conductors shall have the same number. Each electrically different conductor shall be uniquely numbered. Identify panelboard circuits using the panelboard identification and circuit number. Identify motor control circuits using the equipment identification number assigned to the control unit by the motor control center manufacturer and the motor control unit terminal number. Identify other circuits as shown in the circuit schedule or as favorably reviewed by the Engineer.
- B. Conductors between terminals of different numbers shall have both terminal numbers shown at each conductor end. The terminal number closest to the end of the wire shall be the same as the terminal number.

3.4 FIELD TESTS

- A. Insulation Resistance Tests: For all circuits 150 volts to ground or more and for all motor circuits over 1/2 horsepower, test cables per NETA. The insulation resistance shall be 20 megohms or more. Any cable with insulation resistance less than 20 megohms shall be replaced. Submit results for review. See also Section 160100, 3.07 FIELD TESTS.
- B. Phase Rotation: The phase rotation of all circuits shall be clockwise in sequence. The Contractor shall verify that each three-phase service, feeder and branch circuits meet this requirement. A record shall be kept at each circuit tested and, on completion, given to the Engineer for review.

**** END OF SECTION ****

SECTION 161240 SIGNAL CABLE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Provisions: Applicable provisions of Section 160100 become a part of this section as if repeated herein.
- B. Related Work Described Elsewhere:
- C. Instrumentation and Controls, General Requirements: Section 170100.

1.2 REFERENCES

- A. Provisions: Applicable provisions of Section 160100 become a part of this section as if repeated herein.
- B. American Society for Testing and Materials (ASTM):
 - 1. B8 Concentric Lay Stranded Copper Conductors, Hard, Medium-Hard, or Soft, Specification for
- C. Institute of Electrical and Electronic Engineers (IEEE):
 - 1. 383 Shielded Instrumentation Cable, Specifications for
- D. Insulated Cable Engineers Association (ICEA):
 - 1. S-73-532 Standard for Control, Thermocouple, Extension And Instrumentation Cable
- E. Underwriters Laboratories Incorporated (UL):
 - 1. 13 Power Limited Circuit Cable Class 2, Specifications for (Bulletin)
 - 2. 83 Thermoplastic Insulated Wires and Cables

1.3 SUBMITTAL

Submit material or equipment data in accordance with the Product Information category of the General Conditions and the submittal requirements of Section 013300 and 160100.

PART 2 - PRODUCTS

2.1 INSTRUMENTATION PAIRS (IP)

- A. Cable shall conform to ICEA S-73-532 and shall be type TC cable suitable for direct burial. Each IP shall consist of two #16 AWG, 19X29 stranding tinned copper conductors with PVC / Nylon insulation unless noted otherwise on drawings. Conductors shall be non-twisted. Each pair shall have a .048 inch nominal PVC outer jacket. Cable shall be rated at 90°C and for operation of 600 volts, as noted on the Drawings.

Provide Belden #9487 or approved substitute.
- B. Cable shall conform to ICEA S-73-532 and shall be type TC cable suitable for direct burial. Each IP shall consist of two #14 AWG, 42X30 stranding tinned copper conductors with PVC / Nylon insulation unless noted otherwise on drawings. Conductors shall be non-twisted. Each pair shall have a .048 inch nominal PVC outer

jacket. Cable shall be rated at 90°C and for operation of 600 volts, as noted on the Drawings.

Provide Belden #9488 or approved substitute.

2.2 TWISTED SHIELDED PAIRS (TSP)

Cable shall conform to IEEE 383, UL 13, and UL 83 and shall be type PLTC cable suitable for direct burial. Each TSP shall consist of two #18 AWG, 7 strand copper conductors per ASTM B8 with 15 mils PVC insulation unless noted otherwise on drawings. Conductors shall be twisted with 2 inch or shorter lay, with 100% foil shielding and tinned copper drain wires. Each pair shall have a 35 mil thick outer jacket. Cable shall be rated at 90°C and for operation of 300 volts, as noted on the Drawings.

Provide Belden #1032A or approved substitute.

2.3 MULTIPLE (Twisted) SHIELDED PAIR (MSP) CABLES

Each MSP cable shall conform to IEEE 383, UL 13, and UL 83 and shall consist of the number of pairs shown on the Drawings, of #20 AWG, 7 strand copper conductors per ASTM B8. Conductors shall have 15 mil PVC insulation and shall be twisted in 2 inch or shorter lay. Each pair shall have a 100% foil shield and a tinned copper drain wire. The MSP cable itself shall have, in addition, an overall foil shield, tinned copper drain wire, and an outer PVC jacket. Thickness of the jacket shall be 50 mils for 8 or fewer pairs, 60 mils for 10 to 16 pairs, and 70 mils for 18 or more pairs. Provide Belden, Alpha, Dekoron, or equal.

2.4 SPECIAL CABLES

- A. Specialty vendor supplied cables shall be provided as shown on the Drawings.
- B. Special cables shall be supplied by the manufacturer of the equipment or instrument it is to be used with. No deviations are allowed.

PART 3 - EXECUTION

3.1 CABLE INSTALLATION

- A. Signal cable shall be installed by personnel who have had a minimum of 3 years experience in terminating and splicing twisted shielded conductors and co-axial cables.
- B. Adequate care shall be exercised by the installers to prevent cable damage or sheath distortion. Bending radius shall not be less than 10 times the cable O.D.
 - 1. Bending radius for specialty cables shall be per manufacturer requirements and recommendations.
- C. Cables shall be continuous from initiation to termination without splices except where specifically indicated.
- D. Cable shielding shall be grounded at one end only of the cable. Bonding shall be to a single ground point only. Bonding from cable to cable in multiple run installations shall not be permitted.
- E. Heat shrinkable sleeving shall be installed on all cables to insulate shielding at the ungrounded cable terminations.
- F. Where installed in control panels or boxes containing power circuits, cables shall be routed a minimum of 2 inches distant. Color coding shall be strictly observed throughout the installation.

- G. Manufacturer's cable pulling tension shall not be exceeded.

3.2 CONDUCTOR SPLICES AND TERMINATIONS

- A. Splices: Install all conductors without splices unless necessary for installation, as approved by the Engineer. Splices, when permitted, and terminations shall be in accordance with the splice or termination kit manufacturer's instructions. Splice cables as follows:

1. Watertight Splices: Splices in concrete pullboxes, for any type of cable or wire, shall be watertight. Make splices in low voltage cables using epoxy resin splicing kits rated for application up to 600 volts.
2. Terminal Cabinets: When splices are permitted by the Engineer, a terminal cabinet shall be installed. Terminal system shall include insulated, crimp-type connectors and barrier-type terminal boards. Coordinate the lug and boards for correct fit. All terminations shall include marker sleeves.

Shields shall be handled as a separate conductor. Use manufacturer's compression sleeve and insulated pigtail. Keep pigtail as short as possible. Terminate pigtail with marker sleeve and tug.

3. No splicing is acceptable for coaxial cables.

- B. Terminations:

1. Crimp-type terminals shall be UL listed, self-insulating, sleeve type with ring or rectangular tongue, suitable for size and material of the wire to be terminated and for use with either stranded or solid wire. Spade type lugs are acceptable with telephone (TC) cable systems only.
2. Crimp with manufacturer's recommended ratchet-type tool with calibrated dyes. Hand crimping tools are not acceptable.
3. Coaxial cable and connectors shall be terminated in accordance with the manufacturer's instructions. Use manufacturer's recommended solder. The Contractor shall prevent misapplication of solder and termination.

3.3 CONDUCTOR IDENTIFICATION

- A. Identify each wire or cable at each termination, in each pullbox, and in each handhole using numbered and lettered wire markers. All electrically common conductors shall have the same number. Each electrically different conductor shall be uniquely numbered. Identify panelboard circuits using the panelboard identification and circuit number. Identify motor control circuits using the equipment identification number assigned to the control unit by the motor control center manufacturer and the motor control unit terminal number. Identify other circuits as shown in the circuit schedule or as favorably reviewed by the Engineer. Conductor numbering shall be coordinated with the Interconnection Diagrams specified in Section 170100.
- B. Conductors between terminals of different numbers shall have both terminal numbers shown at each conductor end. The terminal number closest to the end of the wire shall be the same as the terminal number.

3.4 FIELD TESTS

- A. Insulation Resistance Tests: Perform insulation resistance tests on all circuits. Make these tests before any equipment has been connected. Test the insulation with a 500 Vdc insulation resistance tester with a scale reading 100 megohms. The insulation

resistance shall be 20 megohms or more. Any Cables with insulations resistance less than 20 megohms shall be replaced. Submit results for review.

**** END OF SECTION ****

SECTION 161300 BOXES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Provisions: Applicable provisions of Section 16010, GENERAL ELECTRICAL REQUIREMENTS, become part of this section as if repeated herein.
- B. Work Included:
 - 1. Installation of all necessary outlet boxes for wiring devices, lighting fixtures, and signal equipment as noted on the Drawings.
 - 2. Installation of junction boxes as required for the consolidation of conduit runs.
 - 3. Installation of pull boxes as necessary to aid in pulling in conductor.

1.2 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM) Publication:
 - 1. A123 Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products Federal Specifications (FS):
 - 2. W C 586 Conduit Outlet Boxes, Bodies, and Entrance Caps, Electrical, Cast Metal
 - 3. W J 800 Junction Box, Extension, Junction Box Cover, Junction Box (Steel, Cadmium or Zinc Coated)
- B. Underwriters Laboratories, Inc. (UL) Publications:
 - 1. Electrical Cabinets and Boxes
 - 2. 514A Metallic Outlet Boxes 11
 - 3. 514C Standard for Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
 - 4. Conduit, Tubing, and Cable Fittings

1.3 SUBMITTALS

- A. Submit material data for all fittings in accordance with the submittal requirements of Section 160100 and 013000.

1.4 LOCATIONS

- A. Refer to Section 160100, GENERAL ELECTRICAL REQUIREMENTS, for definitions of types of locations.

PART 2 - PRODUCTS

2.1 OUTLET, JUNCTION AND PULL BOXES

- A. Sheet Metal Boxes: Sheet metal boxes shall conform to UL 50, with a hot-dipped galvanized finish conforming to ASTM A123. Outlet boxes and switch boxes shall be designed for mounting flush wiring devices. Boxes and box extension rings shall be provided with knockouts. Boxes shall be formed in one piece from carbon-steel sheets. Outlet boxes shall not be less than 4 inches square and 1 1/2 inches deep. Ceiling boxes shall withstand a vertical force of 200 pounds for 5 minutes. Wall boxes shall withstand a vertical downward force of 50 pounds for 5 minutes. Gangable and

through-wall types are not acceptable. Boxes shall conform to FS W J 800D and UL 514.

1. **Cast Metal Boxes:** Box bodies and cover shall be cast or malleable iron with a minimum wall thickness of 1/8 inch at every point, and not less than 1/4 inch at tapped holes for rigid conduit. Bosses are not acceptable. Mounting lugs shall be provided at the back or bottom corners of the body. Covers shall be secured to the box body with No. 6 or larger brass or bronze flathead screws. Boxes shall be provided with neoprene cover gaskets. Where only cast aluminum is available for certain types of fixture boxes, an epoxy finish shall be provided. Outlet boxes shall be of the FS types. Boxes shall conform to FS W C 586C and UL 514.
 2. **Non-metallic Boxes:** Non-metallic boxes shall be hot-compressed fiberglass, one-piece, molded with reinforcing of polyester material, with minimum wall thickness of 1/8 inch.
 3. **Pull Boxes and Junction Boxes:** Except where NEMA 4X fiberglass boxes are called for, all boxes shall be fabricated from carbon steel per UL 50. Boxes shall be welded construction with all seams or joints closed and reinforced. Boxes shall be galvanized after construction. Boxes intended for outdoor use shall be cast metal with threaded hubs and neoprene gasketed covers or shall be of the fiberglass reinforced polyester type of 1/8 inch minimum thickness. Cover retention shall be by corrosion resistant stainless steel screws.
- B. All boxes for wiring operating at 601 volts or higher shall be constructed without hinges and shall be padlockable.
- C. All boxes and cabinets shall be securely fastened to building structural members so as to prevent movement in any direction. Boxes shall not be supported by lighting fixtures, suspended ceiling support wires or freely hanging rods.
1. Covers of boxes and cabinets mounted in horizontal plane (top or bottom) shall either weigh not more than 40 pounds or shall require not more than 40 pounds of force to open or close.
 2. Covers of boxes and cabinets mounted in vertical plane (front, back, sides) shall either weigh not more than 60 pounds or shall require not more than 60 pounds of force to open or close. All covers over 30 pounds shall be furnished with angle support at bottom to carry weight of cover for assembly.
 3. Covers of boxes and cabinets weighing more than 30 pounds shall be provided with lifting handles or some means of grasping other than edges.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. **Outlet Boxes:**
1. Provide fixture outlets with proper fixture connectors.
 2. Box mounting height shall be dictated by the wiring device enclosed.
 3. Blanking covers shall be installed on all unused openings.
 4. Sheet metal boxes shall be used in dry non-corrosive locations where the conduit system is routed concealed in the walls and ceilings.

5. Cast metal or molded non-metallic surface mounted boxes shall be used in exterior and/or in all wet locations.
6. Bonding jumpers shall be used around all concentric or eccentric knockouts.
7. Boxes shall be securely mounted to the building structure independent of conduits entering or exiting the boxes.

B. Junction Boxes and Pull Boxes:

1. Boxes shall be installed where required and where indicated on the Drawings.
2. Boxes shall be readily accessible.
3. Boxes shall not be installed in finished areas.
4. Pull boxes shall be provided at least every 150 feet on long straight conduit runs. Spacing shall be reduced by 50 feet for each 90 degree bend. See Section 161100 for maximum bends in conduit systems.
5. Box dimensions shall be in accordance with size and quantity of conductors and conduits entering and leaving box per NEC Article 370 requirements.
6. All boxes, both new and existing, for medium voltage systems shall be permanently marked "High Voltage" on all surfaces with red letters which are at least four inches high.

****END OF SECTION****

SECTION 161400 ELECTRICAL WIRING DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Provisions: Applicable provisions of Section 160100, GENERAL ELECTRICAL REQUIREMENTS, become part of this section as if repeated herein.
 - 1. Related Work: Section 161300 – Boxes
- B. Work Included: This Section includes wiring devices generally consisting of switches and receptacles as indicated on the drawings and as specified herein.

1.2 REFERENCE STANDARDS

- A. FS W-C-596 - Electrical Power Connector, Plug, Receptacle, and Cable Outlet.
- B. FS W-S-896 - Switch, Toggle.
- C. NEMA WD 1 - General-Purpose Wiring Devices.
- D. NEMA WD 5 - Specific-Purpose Wiring Devices.

1.3 SUBMITTALS

- A. Submit material data for all devices to be furnished in accordance with the submittal requirements of Section 013300 and Section 160100.

1.4 LOCATIONS

- A. Refer to Section 160100, GENERAL ELECTRICAL REQUIREMENTS, for definitions of types of locations.

PART 2 - PRODUCTS

2.1 WALL SWITCHES

- A. Wall switches for lighting circuits AC general use snap switch with toggle handle, rated 20 amperes and 120-277 volts AC. Handle: plastic and colored to match existing in area.

2.2 RECEPTACLES AND PLUGS

- A. General use duplex receptacles shall be NEMA type 5-15R, grounding type, 15 amp, 120 volt rating. Where a single duplex receptacle is wired to a dedicated 20 ampere, 120 volt circuit, provide NEMA type 5-20R grounding type 20 ampere receptacles. Color to match others in area.
- B. Chemical pump receptacles shall be corrosion resistant and have "In-Use" weatherproof covers.

2.3 WALL PLATES

- A. Provide wall plates for wiring devices, with ganging and cutouts as indicated on the drawings, with metal screws for securing plates to devices. Screw heads colored to match finish of plate.
- B. Cover-plates shall be of plastic, non-combustible, mar-proof thermosetting material, minimum 0.100" are required for flush mounted devices. Color of plates shall be to match others in area or beige if no other plates are in the area.

- C. Device plates for surface mounted type FS or FD boxes are to be type FSK galvanized steel covers.
- D. Device plates shall be corrosion resistant plastic with stainless steel screws for corrosive areas.
- E. Provide telecommunications outlet faceplates.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine areas and conditions under which wiring devices are to be installed and notify District in writing of conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install light switches and receptacles at standard elevations unless indicated otherwise on the drawings.
- B. Install products in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation," and in accordance with recognized industry practices.
- C. Before installing receptacles and switches, clean electrical boxes of dirt and debris.
- D. Do not use terminals on wiring devices (hot or neutral) for feed-through connections, looped or otherwise. Make circuit connections via wire connectors and pigtails.
- E. Install gasket plates for devices or system components having light emitting features, such as switches with pilot lights. Where installed on rough textured surfaces, seal plates with black self-adhesive poly-foam.
- F. Ground receptacles with an insulated green ground wire from device ground screw to a bolted outlet box connection. Route a continuous green equipment grounding conductor with branch circuit conductors serving isolated ground receptacles. Terminate the equipment ground on the ground bus in panelboards.
- G. Wrap two layers of electrical tape around the terminals of all switches and receptacles after completion of wiring connections.
- H. Install devices and wall plates flush and level.
- I. Install receptacles vertically with ground slot down or where indicated on the drawings, horizontally with ground slot to the left.
- J. Provide separate circuit for utility outlets.

3.3 TESTING

- A. Provide operational testing for all devices. Test receptacles with Hubbell 5200, Woodhead 1750, or equal, for correct polarity, proper ground connection, and wiring faults. Record all results and submit to the Engineer.

****END OF SECTION****

SECTION 161800 PROTECTIVE DEVICES AND SWITCHES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Provisions: Applicable provisions of Section 160100 become a part of this section as if repeated herein.
- B. Work Included: Provide all necessary labor, tools and material to install circuit protective devices as shown on the Drawings and as described in these Specifications.

1.2 REFERENCE STANDARDS

- A. American National Standards Institute (ANSI) Publication:
 - 1. Z55.1 Gray Finishes for Industrial Apparatus and Equipment
- B. National Electrical Manufacturers Association (NEMA) Publications:
 - 1. ICS 3 Industrial Systems
 - 2. ICS 6 Enclosures for Industrial Controls and Systems
 - 3. 250 Type 1 Enclosures for Electrical Equipment (1,000 Volts Maximum)
- C. Federal Specifications (FS):
 - 1. W C 375 Circuit Breakers, Molded Case, Branch Circuit and Series Service, Series Trip
 - 2. W F 1726 Class H Cartridge Fuses
- D. Underwriters Laboratories (UL) Standards:
 - 1. 50 Electrical Cabinets and Boxes
 - 2. 198C Fuses, High-Interrupting-Capacity-Current Limiting Types
 - 3. 489 Molded Case Circuit Breakers and Enclosures
- E. National Fire Protection Association (NFPA) Publication:
 - 1. 70 National Electric Code

1.3 SUBMITTALS

- A. Submit material or equipment data in accordance with the Product Review category of the General Conditions and the submittal requirements of Section 013300 and Section 160100.

1.4 LOCATIONS

- A. Refer to Section 160100, GENERAL ELECTRICAL REQUIREMENTS, for definitions of types of locations.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

- A. Fusible switches shall be heavy duty safety switches with the voltage ratings, current ratings, and number of poles as indicated by the Drawings. The switches shall be horsepower rated. Auxiliary contacts shall be provided as indicated on the Drawings.

Stationary contacts shall be equipped with arc chutes. Fuse clips shall accept only Class J current limiting cartridge fuses. Where indicated on the Drawings, units shall have service entrance labels and shall be equipped with an insulated neutral lug. Switches shall be Square D, Type HU; or equal.

- B. Enclosures shall be as follows:
 - 1. Dry Locations: NEMA Type 1.
 - 2. Corrosive Locations: NEMA Type 4X.
 - 3. Wet locations: NEMA Type 4.
- C. Nameplates: Provide an engraved plastic nameplate for each disconnect switch identifying the equipment it protects.

2.2 FUSES

- A. General: Provide one complete set of fuses of each ampere rating shown on the Drawings plus one spare set for each size shown.
- B. Fuse Type: Units shall be Class J current limiting, 700 volt, in the ampere ratings shown. Plug fuses are unacceptable. Barrels shall be non-hygroscopic with brass knurled ferrules.
- C. Fuses shall conform to FS W F 1726 and UL 198B, and shall carry labels showing UL class, interrupting rating, time delay characteristics, and voltage rating.

2.3 ENCLOSED CIRCUIT BREAKERS

- A. Units shall be electronic trip, LSIG molded case circuit breakers in surface mounted non-ventilated enclosures conforming to the appropriate articles of NEMA 250, as follows:
 - 1. Indoor, Dry, Clean Locations: NEMA Type 1.
 - 2. Outdoor, Unprotected Locations: NEMA Type 3R/12.
 - 3. Wet Locations: NEMA Type 4.
 - 4. Corrosive Locations: NEMA Type 4X.
- B. Each unit shall have an external operating handle with a cover interlocking mechanism which will prevent opening of the enclosure when the operating handle is in the "ON" position. The handle shall be capable of being padlocked in either the "ON" or the "OFF" position. A breaker "tripped" position shall be clearly indicated between the "ON" and the "OFF" position.
- C. Where indicated on the Drawings, enclosed breakers used as service entrance equipment shall be so labeled for such service and shall contain an insulated neutral lug. The complete unit shall conform to UL 489.
- D. The circuit breakers shall be of the voltage, number of poles, frame size and ampere rating shown on the Drawings. Units shall be manually operated, trip-free, electronic trip, molded case, front mounted circuit breakers.
- E. Frame sizes larger than 100 amperes shall have adjustable electronic trip elements. Minimum interrupting rating shall not be less than 30,000 amps asymmetrical and the breaker shall conform to FS W C 375. Multiple breakers shall have a common trip single operating handle with three positions of indication. Circuit breaker shall be calibrated at 40°C (104°F).

- F. Each breaker shall be completely enclosed in a molded case with the calibrated sensing element factory sealed to prevent tampering.

2.4 DISCONNECT SWITCHES

- A. Disconnect switches shall be heavy duty safety switches with the voltage ratings, current ratings, and number of poles as indicated by the Drawings. The switches shall be 600 volt type and horsepower rated. Auxiliary contacts shall be provided as indicated on the Drawings.
- B. Switches shall be Square D Type HU, as shown on the Drawings or approved substitute.
- C. Enclosures shall be as follows:
 - 1. Dry Locations: NEMA Type 1.
 - 2. Corrosive Locations: NEMA Type 4X.
 - 3. Wet Locations: NEMA Type 3R or 4X.
- D. Nameplates: Provide an engraved plastic nameplate for each disconnect switch identifying the motorized equipment it controls.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units plumb within 1/8 inch of vertical, and in accordance with manufacturer's instructions. Make sure that fuse ratings and breaker trip settings are as shown on the Drawings.
- B. Mounting Heights
 - 1. Fusible switches and enclosed circuit breakers shall be centered 5' 0" above the floor.

3.2 FIELD TESTS

- A. Insulation Resistance Tests: Perform insulation resistance tests on circuits to be energized with a line-to-neutral voltage of 120 volts or more. Make these tests after all equipment has been connected, except that equipment which may be damaged by the test voltage shall not be connected. Test the insulation with a 500 Vdc insulation resistance tester with a scale reading 100 megohms. The insulation resistance shall be 20 megohms or more. Submit results for review.
- B. Continuity Tests: Perform circuit continuity tests from a low powered dc test source to operate a buzzer or bell. Tests shall be made prior to energizing the protected circuit.
- C. Operating Tests: Demonstrate that the protected circuit can be manually controlled by the installed equipment.

****END OF SECTION****

SECTION 163050 ELECTRICAL SYSTEM STUDIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Short-circuit fault analysis study.
 - 2. Protective device coordination study.
 - 3. Arc-flash hazard study.

1.2 REFERENCES

- A. Section 160100 General Electrical Requirements.
- B. Institute of Electrical and Electronics Engineers (IEEE):
 - 1. 1584 - IEEE Guide for Performing Arc Flash Hazard Calculations, latest edition.
- C. California Electric Code (CEC), latest edition accepted by the Authority Having Jurisdiction
- D. National Fire Protection Association (NFPA).
 - 1. National Electrical Code (NEC) (NFPA-70, latest edition accepted by the Authority Having Jurisdiction
 - 2. Electrical Safety In The Workplace (NFPA-70E), latest edition
 - a. All arc flash personal protective equipment requirements shall be complied with.

1.3 DEFINITIONS

- A. As specified in Section 160100 General Electrical Requirements.

1.4 SYSTEM DESCRIPTION

- A. General study requirements:
 - 1. Scope:
 - a. The short-circuit fault analysis, protective device coordination, and arc- flash hazard studies shall include all new and existing equipment in the power distribution system including, but not limited to:
 - i. Service equipment.
 - ii. Switchboards.
 - iii. Generators.
 - iv. Transformers:
 - a) Including all dry-type transformers.
 - v. Motor control centers.
 - vi. Freestanding variable frequency drives and starters.
 - vii. Disconnect switches.
 - viii. Motors.

- ix. Panelboards:
 - a) Including all 240- and 208-volt systems.
- x. Vendor control panels.
- b. Study scenarios:
 - i. The studies shall include all possible electrical system configurations, for example:
 - a) Operation on normal (utility) source.
 - b) Operation on generator source.
- 2. Obtain, for all equipment, the required data for preparation of the study including, but not limited to:
 - a. Transformer kilovolt-ampere (kVA) and impedances.
 - b. Generator impedances.
 - c. Generator decrement curves.
 - d. Bus withstand ratings.
 - e. Cable and bus data.
 - f. Protective device taps, time dials, instantaneous pickups, and time-delay settings.
- 3. Obtain the Electric Utility information on the minimum and maximum available fault current, minimum and maximum utility impedances, X/R ratios, and model information up to the point of connection:
 - a. Utility tolerances and voltage variations.
- 4. The individual performing the studies shall visit the site and collect all necessary field data in order to perform and complete comprehensive electrical system studies.
- 5. Obtain equipment layouts and configurations from the manufacturer's final submittal requirements and project layout drawings as required.
- 6. Bus and conductor data:
 - a. Use impedances of the actual installed or specified conductors, unless otherwise indicated.
 - b. Use cable and bus impedances calculated at 25 degrees Celsius, unless otherwise indicated.
 - c. Use 600-volt cable reactance based on typical dimensions of actual installed or specified conductors, unless otherwise indicated.
 - d. Use bus withstand values for all equipment having buses.
- 7. Motors:
 - a. Each motor, 25 HP and larger, shall be individually modeled:
 - i. Grouping of motors under 25 HP for fault contribution current is acceptable.
 - b. Motors with variable frequency drives (VFD's) may be assumed to have no contribution to fault current but shall be shown on the one lines.

- i. Motors having VFD's with bypasses shall be modeled as having full contributions to the fault currents.
 - 8. Use the equipment, bus, and device designations (Tag Numbers) as indicated on the Drawings for all studies, or provide a cross reference table on each drawing showing study results.
- B. Short-circuit fault analysis study additional requirements:
 - 1. The short-circuit fault analysis shall be performed and submitted in 2 phases:
 - a. Initial short-circuit fault analysis:
 - i. Based on the Contract Documents and Electric Utility information.
 - ii. The initial short-circuit fault analysis study shall indicate the estimated available short-circuit current at the line side terminals of each piece of equipment covered by the scope of the study.
 - iii. Provide a list of assumptions used in the initial study.
 - b. Final short-circuit fault analysis:
 - i. The final short-circuit fault analysis shall modify the initial analysis as follows:
 - a) Utilize the actual equipment provided on the project.
 - b) Utilize conductor lengths based on installation.
 - c. If all actual equipment and installed cable data is available only the final draft of the short-circuit fault analysis is required.
 - i. Provide a list of all assumptions used in the study.
 - 2. Calculate 3-phase bolted fault, line-to-line fault, line-to-ground fault, double line-to-ground fault, short-circuit 1/2 cycle momentary symmetrical and asymmetrical RMS, 1-1/2 to 4 cycle interrupting symmetrical RMS, and 30-cycle steady-state short-circuit current values at each piece of equipment in the distribution system.
 - 3. Evaluate bus bracing, short-circuit ratings, fuse interrupting capacities and circuit-breaker-adjusted interrupting capacities against the fault currents, and calculate X/R values:
 - a. Identify and document all devices and equipment as either inadequate or acceptable.
 - 4. Calculate line-to-ground and double line-to-ground momentary short-circuit values at all buses having ground-fault devices.
 - 5. Provide calculation methods, assumptions, one-line diagrams, and source impedance data, including utility X/R ratios, typical values, recommendations, and areas of concern.
- C. Protective device coordination study additional requirements:
 - 1. Furnish protective device settings for all functions indicated on the Drawings including, but not limited to:
 - a. Current.
 - b. Voltage:

- i. Provide settings for all voltage relays based upon actual utility and generator tolerances and specifications.
 - c. Frequency:
 - i. Provide settings for all frequency relays based upon actual utility and generator tolerances and specifications.
 - d. Negative sequence.
 - e. Machine protection functions:
 - i. Provide settings for all motor and generator protective relays based on the manufacturer's recommended protection requirements.
 - a) The settings for all VFD motor protection settings shall be included in the above settings.
2. Provide log-log form time-current curves (TCCs) graphically indicating the coordination proposed for the system:
- a. Include with each TCC a complete title and one-line diagram with legend identifying the specific portion of the system covered by the particular TCC:
 - i. Typical TCCs for identical portions of the system, such as motor circuits, are acceptable, as listed below and as allowed by the Engineer.
 - a) Typical TCCs for motors of the same HP, in the same service with identical starting equipment are acceptable.
 - b. Include a detailed description of each protective device identifying its type, function, manufacturer, model number and time-current characteristics:
 - i. These details can be included on the TCC.
 - ii. These details shall also be provided in an Excel spreadsheet format.
 - c. Include a detailed description of each protective device tap, time dial, pickup, instantaneous, and time delay settings:
 - i. These details can be included on the TCC.
 - ii. These details shall also be provided in an Excel spreadsheet format.
3. TCCs shall include all equipment in the power distribution system where required to demonstrate coordination. Include utility relay and fuse characteristics, medium-voltage equipment protective relay and fuse characteristics, low-voltage equipment circuit breaker trip device characteristics, transformer characteristics, motor and generator characteristics, and characteristics of other system load protective devices:
- a. Include all devices down to the largest branch circuit and largest feeder circuit breaker or motor circuit protector in each motor control center or VFD, main breaker in branch panelboards, and fused disconnect switches.
 - b. Provide ground fault TCCs with all adjustable settings for ground fault protective devices.

- c. Include manufacturing tolerances and damage bands in plotted fuse and circuit breaker characteristics.
 - d. On the TCCs, show transformer full load currents, transformer magnetizing inrush, ANSI transformer withstand parameters, and transformer damage curves.
 - e. Cable damage curves.
 - f. Terminate device characteristic curves at a point reflecting the maximum symmetrical or asymmetrical fault current to which the device is exposed based on the short-circuit fault analysis study.
4. Site generation: When site generation (including cogeneration, standby, and emergency generators) is part of the electrical system, include phase and ground coordination of the generator protective devices:
 - a. Show the generator decrement curve and damage curve along with the operating characteristic of the protective devices.
 5. Suggest modifications or additions to equipment rating or settings in a tabulated Excel spreadsheet form.
- D. Arc-flash hazard study additional requirements:
1. Include the calculated arc-flash boundary and incident energy (calories/square centimeter) at each piece of equipment in the distribution system:
 - a. Perform study with 15 percent arcing fault variation as defined by IEEE 1584.
 - b. Perform arc-flash calculations at minimum and maximum utility **[and generator]** fault contributions.
 - c. Perform arc-flash calculations for both the line side and load side of the switchgear, switchboard, motor control center, VFD and panelboard main breakers.
 - d. Perform arc-flash calculations for all short-circuit scenarios with all motors on for 3 to 5 cycles and with all motors off.
 - e. Protective device clearing time shall be limited to 2 seconds, maximum.
 2. Provide executive summary of the study results:
 - a. Provide summary based upon worst case results.
 3. Provide a detailed written discussion and explanation of the tabulated outputs:
 - a. Include all scenarios.
 4. Provide alternative device settings to allow the DISTRICT to select the desired functionality of the system:
 - a. Minimize the arc-flash energy by selective trip and time settings for equipment maintenance purposes.
 - b. Identify the arc-flash energy based upon the criteria of maintaining coordination and selectivity of the protective devices.
- E. Electrical system study meetings:

1. The individual conducting the short-circuit fault analysis, protective device coordination, and the arc-flash hazard studies shall meet with the DISTRICT and Engineer 3 times.
 2. The purpose of the 3 meetings is as follows:
 - a. Initial meeting:
 - i. Meet with the DISTRICT and Engineer to discuss the scope of the studies.
 - ii. Discuss the DISTRICT's operational requirements for both normal operation and maintenance.
 - b. Preliminary results meeting:
 - i. This meeting will be held after the studies have been completed, reviewed, and accepted by the Engineer.
 - ii. The purpose of this meeting is to inform the DISTRICT of the results of the study and impacts on normal operation and maintenance including:
 - a) Protective device coordination problems and recommended solutions.
 - b) Explanation of the arc-flash hazard study results and its potential impact on operations.
 - c) Recommendations for reduction of arc-flash category levels including reduction of protective device settings or changes in operational practices.
 - c. Final meeting:
 - i. Discuss changes to the studies based on the previous meeting.
 - ii. Discuss with the DISTRICT how changes to the electrical system may change the arc-flash hazard category.
 - iii. Deliver the final electrical system studies report.
 3. The meetings will be at the DISTRICT's facility:
 - a. Provide a minimum of 3-weeks' notice to the DISTRICT and Engineer in advance of the projected meeting date.
 - b. Submit a draft of the meeting agenda when each meeting is requested.
 4. Meeting materials:
 - a. Prepare and provide the following materials:
 - i. Meeting agenda. Include, at a minimum, the scope of the meeting, estimated time length for the meeting, and meeting goals.
 - ii. 3 copies of the project one-line diagrams for the initial meeting.
 - iii. 3 copies of the submitted studies.
- F. By virtue of the fact that this is a professional study, the DISTRICT reserves the right to modify the requirements of the study to comply with its operational requirements. The protective device coordination study and the arc-flash hazard study shall be modified based on the results of the meetings with the DISTRICT.

1.5 SUBMITTALS

- A. Furnish submittals as specified in Sections 160100 AND 013300.
- B. Initial studies and reports:
 - 1. Include the following in the initial short-circuit current report:
 - a. List of all devices included in the studies.
 - b. A description of all operating scenarios.
 - c. Form and format of arc-flash labels.
- C. Final studies and reports:
 - 1. Format and quantity:
 - a. Provide 6 bound copies of all final reports.
 - b. Provide 3 complete sets of electronic files on flash drives, CD or DVD media, including the electrical system model(s), configuration files, custom libraries, and any other files used to perform the studies and produce the reports. Also provide an electronic version of the bound reports in PDF format.
 - 2. Include the sections below in the final report:
 - a. Copies of correspondence and data obtained from the electric utility company.
 - b. Letter certifying the inspection and verification of existing equipment.
 - c. One-line diagrams:
 - i. The following information shall be included at a minimum:
 - a) Motor horsepower.
 - b) Transformer data:
 - ◆ kVA.
 - ◆ Configuration.
 - c) Cable data:
 - ◆ Insulation.
 - ◆ Size.
 - ◆ Length.
 - ii. One-line diagrams shall be fully legible at 11-inch by 17-inch size.
 - d. Include in the short-circuit fault analysis study:
 - i. Descriptions, purpose, basis, assumptions, recommendations, and scope of the study.
 - ii. Normal system connections and those that result in maximum fault conditions.
 - iii. Tabulation of circuit breaker, fuse, and other protective device ratings compared to maximum calculated short-circuit duties.
 - iv. Fault current calculations for the cases run including a definition of terms and guide for interpretation of computer software printouts.

- e. Protective device coordination study shall include:
 - i. Descriptions, purpose, basis, assumptions, recommendations, and scope of the study.
 - ii. List all requirements used in the selection and setting criteria for any protective devices.
 - iii. Manufacturer's time-current curves for circuit breakers, fuses, motor circuit protectors, and other protective devices for all new equipment.
 - iv. TCCs graphically indicating the coordination proposed for the system on log-log graphs.
 - v. Tabulation of relay, fuse, circuit breaker, and other protective devices in graphical form with a one-line diagram to display area coordination.
 - vi. Where coordination could not be achieved, an explanation shall be included in the report to support the statement along with recommendations to improve coordination. Recommended equipment modifications or settings shall be in a tabulated form.
- f. Include in the arc-flash hazard study:
 - i. Descriptions, purpose, basis, assumptions, recommendations, and scope of the study.
 - ii. Normal system connections and those that result in maximum arc-flash conditions.
 - iii. Arc-flash raw data, calculations, and assumptions.
 - iv. Arc-flash label data:
 - a) Identifying the content of each label.
 - b) Identifying the location of each label.
- D. Certification:
 - 1. Submit written certification, sealed and signed by the professional engineer conducting the study, equipment supplier, and electrical subcontractor stating that the data used in the study is correct.
- E. Submit the credentials of the individual(s) performing the study and the individual in responsible charge of the study.
- F. The Engineer will review all studies and reports. After review, the Engineer will make recommendations and/or require changes to be made to the short-circuit fault analysis, protective device coordination, or arc-flash hazard studies. These changes shall be provided as part of the scope of work.
- G. Submit course outline for DISTRICT's training.

1.6 QUALITY ASSURANCE

- A. As specified in Section 160100.
- B. Qualifications of the entity responsible for electrical system studies:
 - 1. The studies shall be performed, stamped, and signed by a professional electrical engineer registered in the state of California.

- a. Provide a resume for review and approval.
 - b. DISTRICT approval is required for a change in the approved professional electrical engineer performing the studies.
- 2. A minimum of 5 years of experience in power system analysis is required for the individual in responsible charge of the studies.
 - a. Provide a resume for review and approval.
- 3. The short-circuit fault analysis, protective device coordination, and arc-flash hazard studies shall be performed with the aid of a DISTRICT approved digital computer program:
 - a. Point-to-point calculations are not acceptable.

1.7 SEQUENCING

- A. Submittal and approval of personnel performing the study.
- B. Site visit to gather data on the existing facility systems for all studies.
- C. Submit the initial short-circuit fault analysis study before submittal of any electrical equipment.
- D. Initial electrical system study meeting.
- E. Submit the preliminary short-circuit fault analysis, protective device coordination, and arc-flash hazard studies.
- F. Second electrical system study meeting for preliminary results.
- G. Final arc-flash meeting and final short-circuit fault analysis, protective device coordination, and arc-flash hazard studies.
- H. Label equipment with approved arc-flash labels.
- I. DISTRICT's training.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Electrical system study software:
 - 1. Operation Technology, Inc., ETAP.
 - 2. SKM System Analysis, Inc., Power*Tools
 - 3. EasyPower, LLC, EasyPower Suites

2.2 COMPONENTS

- A. Arc-flash hazard labels:
 - 1. Dimensions:
 - a. Minimum 5 inches by 3.5 inches.
 - 2. Materials:
 - a. Polyester with polyvinyl polymer over-laminate.
 - b. Self-adhesive.
 - c. Resistant to:

- i. UV.
 - ii. Chemicals and common cleaning solvents.
 - iii. Scuffing.
 - iv. Wide temperature changes.
- 3. Contents:
 - a. Short-circuit bus identification.
 - b. Calculated incident energy (calories/square centimeter) range:
 - i. Based on worst-case study results.
 - c. Personnel protective equipment level number consistent with the DISTRICT's Electrical Safety Program.
 - d. Arc-flash protection boundary.
 - e. Shock hazard boundary:
 - i. The CONTRACTOR may provide separate labels for indication of the shock hazard boundary.
 - f. Description of the combined level of personnel protective equipment.
- 4. Color scheme:
 - a. For locations above 40 calories/square centimeter:
 - i. White label with red "DANGER" strip across the top.
 - ii. Black lettering.
 - b. For locations below 40 calories/square centimeter:
 - i. White label with orange "WARNING" strip across the top.
 - ii. Black lettering.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. As specified in Section 160100.
- B. After review and acceptance of the arc-flash hazard study by the Engineer, install all arc-flash hazard labels:
 - 1. Install labels at all locations required by NFPA, ANSI, or IEEE standards.
 - 2. At a minimum, install labels in the following locations:
 - a. The front of each main or incoming service compartment.
 - b. The front of each low-voltage switchgear section.
 - c. The front of each medium-voltage circuit breaker door.
 - d. The front of each accessible auxiliary or conductor compartment.
 - e. Each accessible rear or side vertical section.
 - f. Each motor control center vertical section.
 - g. Each panelboard covered by the study.

- h. Each control panel, individual starter or VFD, or other equipment covered by the scope of the study.
- 3. Install preliminary labels showing preliminary results of the studies prior to VFD energization, if required to maintain schedule.
 - a. Preliminary labels shall be replaced with permanent labels as soon as possible, but no later than three weeks after the VFD's have been energized.
- C. After review and acceptance of the arc-flash hazard study and protective device coordination study by the Engineer, adjust protective device settings per final study prior to equipment energization.
 - 1. Devices that require power for configuration may be set during energization, but before any subfed loads are energized.
 - 2. Ensure that settings for upstream equipment are set prior to energizing downstream devices.

3.2 COMMISSIONING

- A. As specified in Section 160100.

3.3 FIELD QUALITY CONTROL

- A. As specified in Section 160100.
- B. The individual performing the arc-flash hazard study shall direct the installation of the arc-flash hazard labels:
 - 1. Remove and replace any improperly applied labels.
 - 2. Repair the equipment finish damaged by removal of any label.
 - 3. Install labels level or plumb across the entire dimension of the label.

* END OF SECTION *

SECTION 164000 MOTOR CONTROL CENTERS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This specification covers requirements for furnishing and installing a factory built, prototype tested, field tested, complete and operable Motor Control Center (MCC).
- B. Work Included: Provide all necessary labor, tools and material to install the MCC as shown on the Drawings and as described in these Specifications.
- C. Provisions: Applicable provisions of Section 160100 become a part of this section as if repeated herein.

1.2 REFERENCES

- A. Applicable provisions of Section 160100 become a part of this section as if repeated herein.
- B. National Electrical Manufacturers Association (NEMA) Publications:
 - 1. ICS-18-2001 Motor Control Centers
 - 2. ST 20-1992 Dry Type Transformers for General Applications
 - 3. NEMA PB 1-2000 Panelboards
- C. Underwriters Laboratories (UL) Standards:
 - 1. 845 Motor Control Centers
 - 2. 67 Panelboards
 - 3. 489 Molded Case Circuit Breakers and Enclosures
 - 4. 1561 Dry-Type General Purpose and Power Transformers
- D. National Fire Protection Association (NFPA) Publication:
 - 1. 70 National Electric Code

1.3 TESTING

- A. The intent of this specification is to provide equipment of proven reliability and compatibility. Each installed motor starter shall be individually tested to ensure that the starter has been properly installed and connected and that it operates as required and specified.

1.4 SUBMITTALS

- A. Submit MCC data in accordance with the submittal requirements of Section 013300 and Section 160100.
- B. MCC submittal shall be complete with the following as a minimum:
 - 1. MCC product information.
 - 2. MCC one line
 - 3. MCC elevations with section layouts and center of gravity shown
 - 4. MCC plans

5. Specifications
6. Nameplates
7. Complete control drawings per contract documents
8. Anchor bolt locations and seismic restraint details

PART 2 - PRODUCTS

2.1 MOTOR CONTROL CENTER CONSTRUCTION

- A. The MCC is a free standing, totally metal enclosed NEMA 1 MCC, U.L. listed and shall consist of one or more enclosed vertical sections joined together to form a rigid, free standing assembly.
- B. Enclosure
 1. Enclosures shall be as follows:
 2. Dry Locations: NEMA Type 1, gasketed.
- C. Service
 1. Motor Control Centers shall be suitable for operation for 480 volt, 3 phase, 3 wire, 60 hertz service. Control Centers shall have a minimum short circuit fault rating as shown on Drawings.
- D. Vertical Sections
 1. Vertical sections shall support the horizontal and vertical combination starter units, panelboards, circuit breaker units or other equipment, covers and doors, and shall be designed to allow for easy rearrangement of units by the purchaser. Vertical sections shall have structural supporting members formed of a minimum of 13 gauge hot-rolled steel. All finished surfaces shall be blemish-free. Where needed, reinforcement structural parts shall be of 10-gauge steel to provide a strong, rigid assembly. Each section shall be standard height and shall have 7-gauge steel minimum, 3-inch high removable lifting angle and two 1-1/2 inch high base channels. The lifting angle shall be provided on the top of each shipping split and shall extend the entire width of the shipping split. Lifting angles shall be designed to support the entire weight of MCC section. Base channels shall be provided with holes to permit bolting the Motor Control Centers to the floor. The entire assembly shall be constructed and packaged to withstand all stresses induced in transit and during installation.
 2. Motor Control Centers shall be designed so that matching vertical sections of the same current rating and manufacture can be added later at either end of the line-up without use of transition sections and without difficulty or undue expense. Removable end closing plates shall be provided to close off openings on the ends of Motor Control Center line-up. A removable top plate shall be provided on each vertical section and vertical sections shall be designed to accommodate plug-on units in front-of-board construction. Vertical housing plug-on units shall be 20 inches wide and shall be 20 inches deep. Wider sections will be permitted only for bolted connection type units not fitting the 20-inch sections. Unit mounting area shall be divided into 1/2 space factor divisions, each approximately 6 inches. NEMA size 1 and 2 combination starter units shall use only 1 space factor, or 12 inches, of unit mounting space. Vertical sections shall allow for 7 space factors of unit mounting

space. Removable blank plates shall cover all unused unit mounting spaces. Blank plates shall be flanged on all four sides and shall be mounted with captive screws.

3. Vertical sections shall be provided with both horizontal and vertical wireways. Sufficient clearances shall be provided in the horizontal wireway so that no restriction is encountered in running wires from the vertical to horizontal wireway. Wireways shall be in accordance with the wireway sections contained in this document.
4. Thermostatically controlled space heaters shall be provided to prevent condensation inside the sections. One 120VAC circuit shall feed all the space heaters from the distribution panel inside the MCC as shown on the Drawings. All space heater wiring shall be installed by the MCC manufacturer.

E. Horizontal Wireways

1. Horizontal wireways shall be provided in the top and bottom of each vertical section and shall be arranged to provide full length continuity throughout the entire assembly. The top horizontal wireway shall have a cross sectional wireway area of not less than 20 square inches with openings between sections of not less than 11-1/2 square inches. The bottom horizontal wireway shall extend through the length and depth of the vertical sections and shall also be provided with openings of not less than 11-1/2 square inches to allow for full length continuity throughout the entire assembly. The bottom horizontal wireway height shall be not less than 9-1/4 inches. Covers for all wireways shall be equipped with captive type screws to prevent loss of hardware during installation. All wireways shall be isolated from the bus bars.

F. Vertical Wireways

1. A vertical wire trough shall be located on the right hand side of each vertical section and shall extend from the top horizontal wireway to the bottom of the available unit mounting space. Each vertical wire trough shall have a cross sectional area of not less than 19 square inches and shall be isolated from the bus bars to guard against accidental contact. A separately hinged door having captive type screws shall cover the vertical wire trough to provide easy access to control wiring without disturbing control units.
2. Reusable wire ties shall be furnished in each vertical wire trough for the purpose of grouping and securely holding wires in place for a neat and orderly installation.

G. Bus Bars

1. A continuous main three conductor horizontal bus shall be provided over the full length of the control center. Minimum ampere rating per the Drawings. A horizontal ground bus, 300 Ampere minimum, shall be supplied over the full length of the motor control center. When necessary, the bus shall be split to allow for ease in moving and handling. Splice bars will be supplied to join the bus whenever a split has been made. All splice connections shall be made with at least two bolts and shall employ the use of Belleville washers in the connection. Horizontal bus bars shall be mounted edgewise and supported by insulated bus supports.
2. For distribution of power from the main horizontal bus to each unit compartment, a three-phase bus shall be provided. The vertical bus shall be firmly bolted to the horizontal bus for permanent contact.
3. The main horizontal buses shall be made of copper.
4. Bus supports shall be formed of high strength glass reinforced alkyd material. Bus supports shall have generous surface clearances in the vertical plane to shed dust

and maintain dielectric integrity. Bus supports and insulators shall be red to indicate proximity of energized bus parts.

5. The main horizontal bus rating shall be a minimum of 600 amperes continuous or as noted on the Drawings. Vertical bus rating shall be a minimum of 300 amperes for adequate current carrying capacity or as noted on drawings. Continuous current ratings shall be in accordance with temperature specifications set forth by U.L. ANSI and NEMA Standards.
6. A copper ground lug shall be provided in each incoming line vertical section capable of accepting #8 to 250 MCM cable. A horizontal and vertical copper ground bus shall be provided in each section of the motor control center. Horizontal ground bus shall run continuously throughout the control center except where splits are necessary for ease of shipment and handling in which case splice bars shall be provided. Horizontal ground bus shall be located at the bottom of the Motor Control Center. Vertical ground bus shall run parallel to the power distribution bus in each vertical section. Design shall be such that for any plug-on unit the ground bus stab shall make contact with ground bus before the power bus contact is made. All buss splices shall be accessible from the front for maintenance purposes.

H. Bus Barriers

1. Insulated horizontal and vertical bus barriers shall be furnished to reduce the hazard of accidental contact with the bus. Barriers shall have a red color to indicate proximity of energized buses. Vertical bus barriers shall have interlocking front and back pieces to give added protection on all side and shall segregate the phases to reduce the possibility of accidental "flash over". Small, separate openings in the vertical bus barriers shall permit unit plug-on contacts to pass through and engage the vertical bus bars. Bottom bus covers shall be provided below the vertical bus to protect the ends of the bus from accidental contact with fish tapes or other items entering from the bottom of the enclosure. Unused plug-on openings in the bus shall have plastic snap-in closing plates for added safety.

I. Main Incoming Compartment

1. Main lugs shall be provided in the MCC as shown on the Drawings for one 2 AWG - 300 kcmil conductors per phase. Main lug compartment shall be located to facilitate the termination of incoming feeder cables as shown on the Drawings.

J. Units

1. Combination starter units shall consist of full voltage magnetic starters, adjustable magnetic-trip circuit breakers (MCP's), and auxiliary control devices, as required and/or shown on the one-line and elementary diagrams. All auxiliary equipment, except that which is specified for mounting on the door, shall be mounted within the compartment. All units shall be provided with unit doors, unit support pans, unit saddles and unit disconnect operators as outlined in this specification. Each unit compartment shall be enclosed and isolated from adjacent units, buses and wire ways except for openings for conductor entrance into units. Units shall be designed and constructed so that any fault will be localized within the compartment. All units shall be UL listed for a minimum of 42,000 amperes RMS symmetrical fault withstand ability.
 - a. Combination starter for single phase and two-phase motor loads may be compact type starters and requirements for full size starters and components in these specifications do not apply.

2. Each combination starter shall have the pushbuttons, switches, pilot lights and miscellaneous control/indicating devices as indicated on the Drawings. Devices shall be door mounted, unless indicated otherwise on the Drawings, and shall be oil tight.
 - a. Pushbuttons, switches, pilot lights shall be 30mm
 - b. Pilot lights shall be push-to-test, LED.
 3. Plug-on combination starter units of the same NEMA size and branch feeder units of the same trip size shall be readily interchangeable with each other. It shall be possible to withdraw each plug-on unit to a de-energized position with the unit still being supported by the structure. It shall be possible to lock the unit in the position with one padlock.
 4. Full voltage non-reversing combination starter units shall have the following minimum space factor requirements, shall be provided with plug-on connections and shall be provided with ample space for customer wiring room:
 5. Circuit Breaker Space Factor
 - a. Size 1 1
 - b. Size 2 1
 - c. Size 3 1-1/2
 - d. Size 4 2
 - e. Size 5 4
- K. Unit Plug-On
1. For convenient unit connection to bus bars, unit plug-on contacts shall be provided on the following units:
 2. For circuit breaker type units: full voltage starters, Size 4 and smaller; branch circuit units, 225 ampere and smaller.
 3. The plug-on connection for each phase shall be of a high quality two point connection and shall be designed to tighten around the vertical bus bar during a heavy current surge. For trouble free connections, the plug-on fingers shall be coated with a compound to assure a low resistance connection. Contact fingers shall be of a floating and self-aligning design to allow solid seating onto the vertical bus bars.
 4. Units Doors
 5. Each unit shall have a door securely mounted with rugged concealed-type hinges which allow the door to swing open a minimum of 112 degrees for ease of unit maintenance and withdrawal. Doors shall be fastened to the structure so that they remain in place when a unit is withdrawn and may be closed to cover the unit space when the unit has been temporarily removed. Doors shall be held closed with captive type screws which engage self-aligning cage nuts. These screws shall provide at least two threads of engagement to hold doors closed under fault conditions. Each unit door shall be interlocked with it's disconnect mechanism to prevent the door from opening when the unit is energized. A defeater mechanism shall be provided for defeating this interlock by authorized personnel. Removable door panels held with captive type screws shall be provided in starter unit doors for mounting push buttons, selector switches or pilot lights. Blank door panels capable of accepting future pilot devices shall be furnished when pilot devices are not

originally specified for starter units. Each starter unit door shall house an external low-profile overload reset button for resetting the overload relay in the event of tripping.

L. Unit Support Pan

1. Each plug-on unit shall be supported and guided by a tilt and lift-out removable pan, so that the unit rearrangement can be easily accomplished. For easy unit installation and rearrangement, transfer of this unit support pan from one location to another shall be accomplished with ease after the control unit and door have been removed.

M. Unit Saddles

1. Each plug-on unit shall have a saddle of 14 gauge hot rolled steel designed and constructed to physically isolate the unit from the bus compartment and adjacent units. Saddles shall be equipped with captive, self-aligning mounting screws which shall hold the unit securely in place during shipment. Flanged edges shall be provided on each saddle to facilitate unit removal.

N. Disconnect Operators

1. An external operator handle shall be supplied for each switch or breaker. This mechanism shall be engaged with the switch or breaker at all times regardless of unit door position to prevent false circuit indication. The operator handle shall be color coded to display red in the ON position and black in the OFF position. The operator handle shall have a conventional up-down motion and shall be designed so that the down position will indicate the unit is OFF. For added safety it shall be possible to lock this handle in the OFF position with up to three padlocks. The operator handle shall be interlocked, with the unit door to prevent switching the unit to ON while the unit door is open. A defeater mechanism shall be provided for the purpose of defeating this interlock by a deliberate act of an electrician should he desire to observe the .0operation of the operator handle assembly or the unit components. In the tripped position, the external mechanism will assume a neutral or horizontal position with at least 40 degrees of movement from the "ON" position.

O. Magnetic Starters

1. Type S magnetic starters shall be furnished in all combination starter units.
 - a. Starter Sizes 1 through 5 shall employ the use of a bell-crank lever design to transform vertical action of the armature into horizontal action of contact carrier and thus minimize contact bounce and produce extra long contact life.
 - b. Self-powered, selectable Class 10, 20, 30 three phase electronic overload relays shall be provided in each starter unit. Overloads shall be locally resettable and have phase loss, ground fault, current imbalance, jam, over/under voltage, over/under power, voltage, current, power, energy, ethernet capability, dry contact for motor failure plc input and operator station on unit cubicle.
 - c. Magnetic motor starters shall per NEMA ICS 2-321.2 combination circuit-breaker type for full voltage across-the-line starting or reduced voltage starting as noted. Starters shall be equipped with three thermal overload devices, one in each ungrounded leg. Starters shall be suitable for operation on a 480-volt, 3-phase, 3-wire system, unless otherwise indicated, and equipped with 250 VA control transformers. Coil voltage shall be 120 volts. Motor starter contacts shall be NEMA rated (no I.E.C. ratings) with a maximum contact temperature rise of 50 degrees centigrade measured on the contact body.

P. Circuit Breakers

1. Molded case circuit breakers shall be furnished in all starter and branch feeder units using circuit breakers as a disconnect means or as noted on drawings. All circuit breakers will have a push-to-trip test feature for testing and exercising the circuit breaker trip mechanism.

Q. Lighting Transformers

1. Transformers shall be provided and installed in the MCC as shown on the drawings. Transformers shall be ventilated dry-type with 115°C rise. Transformers shall have energy efficiencies that meet or exceed the latest requirements of the California Code of Regulations Title 20 and Title 24, NEMA TP-1 and other applicable local codes. Transformers shall be Energy Star labeled. Transformers shall be protected on line and load sides as required by the NEC.

R. Lighting/Distribution Panels

1. Panels shall be provided and installed in the MCC with the number of circuits and ratings as shown on the drawings.
2. Circuit breakers shall be full panel size breakers; half size breakers are not acceptable.
3. Breakers shall be fully rated for the short circuit capability of the panel.
4. Spare breakers shall be provided as shown on the drawings.

S. Identification

1. A control center identification nameplate with factory identification numbers and characteristics shall be fastened on the vertical wire trough door of every section. Each control center unit shall have its own identification nameplate fastened to the unit saddle. These nameplates shall have suitable references to factory records for efficient communication with supplier. Each control center unit shall also have an engraved phenolic nameplate fastened to the outside of the unit door for ease in identification and for making changes when regrouping units.

T. Wiring

1. The control center wiring shall be NEMA Class 1, Type B. As defined by NEMA Standard ISC-2-322, Class 1 control centers shall include no interconnections between control units. Type B wiring shall include terminal blocks mounted in the units. Terminal blocks shall be conventional track mounted solderless box lug type.
2. Any power wiring interconnecting between power components shall be factory installed and terminated, except wiring crossing shipping splits shall be labeled on both ends, lugs installed, terminated on one end, and coiled in the section for re-connection in field.

U. Finish

1. All metal structural and unit parts shall be completely painted using an electro-deposition process so that interior and exterior surfaces as well as bolted joints have a complete finish coat on and between them. The basic process shall consist of using an iron phosphate pretreatment or equivalent for improvement of paint adhesion. The paint process shall consist of cleaning, rinsing, phosphating, painting, a bake cure, and cool down. Paint shall be manufacturer's standard grey suitable for an outdoor environment.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install the motor control center level and plumb, and secure to a housekeeping concrete pad in conformance with UBC seismic mounting requirements. Doors shall swing freely and close tightly.
- B. Carefully repair any damage to the structure, components or finish to the satisfaction of the Engineer. Clean all nameplates.
- C. Exercise care at all times after installation of motor control center to keep foreign matter, dust, dirt, debris, and moisture out of the control center.
- D. Conduits entering in or terminating on the motor control center shall have insulated grounding bushings wire-bonded to the ground bus system.
- E. Lace incoming and outgoing power conductors to resist short circuit forces. Follow manufacturer's instructions.
- F. Install all labels and nameplates required by these specifications including the Arc Flash Warning labels.

3.2 FIELD TEST

- A. Test the motor control center per NETA requirements.
- B. Motor control center main bus shall be meggered immediately prior to energization to confirm bus is free of grounds and shorts.
 - 1. Megger voltage shall be per NETA requirements.
 - 2. Disconnect switches shall be opened to prevent damage to starter components.
 - 3. Contractor shall confirm no components connected to the buses will be damaged by the megger test voltage.

**** END OF SECTION ****

SECTION 164500 ELECTRICAL GROUNDING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This specification covers requirements for furnishing all labor, material, equipment, tools and services necessary for the installation, connection and testing of all grounding as specified herein and as shown on the Drawings.
- B. Provisions: Applicable provisions of Section 160100, GENERAL ELECTRICAL REQUIREMENTS, become a part of this section as if repeated herein.
- C. Reference Standards
 - 1. American Society for Testing and Materials (ASTM) Publication:
 - a. B228 Copper Clad Steel Conductors Specification
 - 2. National Fire Protection Association (NFPA):
 - a. 70 National Electric Code (NEC)
 - 3. International Electrical Testing Association (NETA) Publication:
 - a. ATS Acceptance Testing Specifications for Electrical Equipment for Power Systems

1.2 SUBMITTALS

- A. Submit material or equipment data in accordance with Section 013300, Section 170100 and Section 160100 of these Specifications.

PART 2 - PRODUCTS

2.1 GENERAL

- A. The grounding systems shall consist of the grounding conductors, ground bus, ground fittings and clamps, ground rods, and bonding conductors to provide a complete ground system as shown on the Drawings and required by the NEC.

2.2 SYSTEM COMPONENTS

- A. Ground Conductors: Ground conductors shall be soft drawn copper, insulated when run inside raceways, or shown on the Drawings and bare for enclosure grounding. Sizes over No.6 AWG shall be stranded.
- B. Coat all ground connections except the exothermic welds with electrical joint compound, non-petroleum type, UL listed for copper and aluminum applications.
- C. Ground Connections: Lugs for attachment of cables to steel enclosures shall be of the binding post type with a 3/8 x 31/32" stud, unless shown otherwise on the Drawings.

PART 3 - EXECUTION

3.1 INSTALLATIONS

- A. Ground all equipment for which a ground connection is required per NEC whether or not the ground connection is specifically shown on the Drawings.

- B. Ground separately derived electrical system neutrals to the metallic water piping and structural steel, in addition to the system driven ground, per NEC requirements.
- C. Provide a ground wire in every conduit as shown on the Drawings.

3.2 TESTING

- A. Conduct ground resistance tests using a ground megohm-meter with a scale reading of 25 ohms maximum.
- B. Test methods shall conform to NETA Standard ATS using the three electrode method. Conduct tests only after a period of not less than 48 hours of dry weather.
- C. Furnish to the Engineer with an unofficial copy of test data on the day of testing and a signed test report within 30 days with recorded data of the Main Switchboard or Service Main Panel, Transfer Switch(es), standby generator and MCC ground system and connections.
- D. Ground resistance shall be 5 ohms or less at each of the connection points tested above.

**** END OF SECTION ****

SECTION 165000 LIGHTING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This specification covers requirements for furnishing a lighting system complete, including fixtures, lamps, standards, bases, hangers, reflectors, glassware, lenses, auxiliary equipment, ballasts, sockets, controllers, and photoelectric cells as specified herein and shown on the Drawings.

1.2 REFERENCES

- A. Applicable provisions of Section 160100 become a part of this section as if repeated herein.
- B. Federal Regulations
 - 1. Title 21 Performance Standards for Light Emitting Products CFR 1040
- C. Underwriters Laboratories (UL) Standards
 - 1. 1598 - Luminaires.
 - 2. 8750 - Light Emitting Diode (LED) Equipment For Use In Lighting Products.
- D. Illuminating Engineering Society of North America (IESNA):
 - 1. LM-79 - IES Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products.
 - 2. LM-80 - IES Approved Method: Measuring Lumen Maintenance of LED Light Sources.
 - 3. TM-21 - Projecting Long Term Lumen Maintenance of LED Light Sources.
- E. Institute of Electrical and Electronics Engineers (IEEE):
 - 1. for Surge Voltages in Low-Voltage AC Power Circuits.
- F. National Electrical Manufacturers Association (NEMA):
 - 1. 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts.

1.3 SUBMITTALS

- A. Submit material or equipment data in accordance with the submittal requirements of Section 013300 and 160100.
- B. LED Luminaires:
 - 1. Catalog literature for each luminaire specified, cross-referenced to the luminaire type on the Luminaire Schedule in the Drawings.
 - 2. Provide for each luminaire type:
 - 3. Materials.
 - 4. Type of diffuser.
 - 5. Hardware.
 - 6. Gasketing.

7. Reflector.
8. Chassis.
9. Finish and color.
10. Driver type and protection.
- C. LED luminaire:
 1. Initial lumen output at 40 degrees Celsius ambient.
 2. Correlated color temperature.
 3. Lumen maintenance factors.
 4. Lumen ambient temperature multipliers.
 5. Drive current.
 6. Efficacy.
 7. Picture of luminaire.
 8. Dimensioned drawings:
 9. Effective projected area rating for pole mounted luminaires.
 10. Weight.
 11. Photometric data:
 12. Coefficient of utilization tables based on the IES zonal cavity system by an approved testing laboratory.
 13. Luminaire dirt depreciation factor.
 14. Candlepower distribution curves.
 15. Average luminaire brightness.
 16. Lumen output charts.
- D. Furnish support method for interior luminaires weighing more than 30 pounds and all wall-mounted luminaires:
 1. Support methods shall be based on seismic UBC requirements at the project site.
- E. Luminaire substitutions:
 1. Provide complete literature for each luminaire substitution:
 2. Submittals for substituted luminaires shall be sufficient for competent comparison of the proposed luminaire to the originally specified luminaire:
 - a. Photometric data:
 - b. IES file in standard IES format.
 - c. Coefficient of utilization tables based on the IES zonal cavity system by an approved testing laboratory.
 - d. Candlepower distribution curves.
 - e. Average luminaire brightness.
 - f. Lumen output charts.

- g. Power requirements in watts and volt-amperes.
- 3. Calculations:
 - a. Provide software generated calculations showing illuminance levels in footcandles and power usage in watts per square foot for each of the areas in which substitutions are proposed:
 - i. Use surface reflectance values and luminaire light loss factors approved by the Engineer to perform all calculations.
 - b. Specification sheets:
 - i. If lacking sufficient detail to indicate compliance with contract documents, standard specification sheets will not be accepted. This includes, but is not limited to, luminaire type designation, manufacturer's complete catalog number, voltage, LED type, CCT, CRI, specific driver information, system efficacy, L70 life rating, and any modifications necessary to meet the requirements of the contract documents.
 - c. Substitutions for specified luminaires will be evaluated upon quality of construction, light distribution, energy use, appearance, and maintenance.
 - d. Substitutions shall comply with all applicable building and energy codes.
- F. Driver: Provide for each driver type:
 - 1. Catalog number.
 - 2. Type of driver.
 - 3. Output wattage.
 - 4. Input voltage.
 - 5. Operating voltage range.
 - 6. Maximum input power.
 - 7. Efficiency.
 - 8. Operating line current.
 - 9. Power factor.
 - 10. Operating temperature range.
 - 11. Current output range in ambient temperatures of 30 to 55 degrees Celsius.
 - 12. Surge suppression data.
- G. Photocell:
 - 1. Provide for each photocell type:
 - 2. Switching capacity.
 - 3. Life expectancy when used on LED sources.
 - 4. The means of adjusting the lighting pickup level.
 - 5. Enclosure type.
 - 6. Mounting method.
- H. Record documents:

1. Update the Luminaire Schedule in the Drawings to reflect the acceptable substitutions, after the substitution has been reviewed and accepted by the Engineer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Luminaires:

1. The following or approved substitute:
 - a. As noted on the Drawings.
2. Individual LEDs connected such that a catastrophic loss or the failure of 1 LED will not result in the loss of the entire luminaire.
3. Minimum ambient temperature range of 0 degrees Celsius to 40 degrees Celsius.
4. Minimum rated life:
 - a. 70,000 hours when operated at 25 degrees Celsius.
5. Minimum efficacy of 100 lumens/watt.
6. Minimum Color Rendering Index of 80.
7. Tested according to IESNA LM-79 and LM-80.
8. Lumen maintenance projection in accordance with IESNA TM-21.
9. RoHS compliant.
10. Integral driver.
11. Suitable for dry, damp, or wet locations as indicated on the Drawings or on the Luminaire Schedule.
12. UL listed for the area of use.
13. Designed as a complete LED assembly. Retrofit LED lamps in luminaires not designed specifically for LED light sources shall not be used.
14. Exterior/outdoor or corrosive area luminaires:
15. hardware and hinged doors or lens retainer.

B. Drivers:

1. Standard driver for the luminaires specified above.

C. Lighting Controllers:

1. The following or approved substitute:
 - a. As noted on the Drawings.
2. Controller shall be cable of controlling 8 lighting zones through mechanically latching relays.
 - a. Each relay shall be capable of being controlled from the controller clock, outside switched inputs, occupancy sensors, photocell, or other devices.
 - b. Control of relays shall be capable of being controlled in groups from the same control input.
 - c. LED for indication of relay status.

- d. Controller clock shall have 7-day programming, astronomical programming and automatic daylight savings.
- D. Photo-electric cells:
 - 1. The following or approved substitute:
 - a. As noted on the Drawings.
- E. Substitutions:
 - 1. The lighting design and luminaire selection has been based upon the photometric data of the identified luminaire. It is the Contractor's responsibility to ensure and prove to the Engineer at time of submittal the substitutions meet the quality and photometric requirements of the original design.
 - 2. The lighting controller has been selected to provide the required number of controlled circuits, control functions and code requirements. It is the Contractor's responsibility to ensure and prove to the Engineer at time of submittal the substitutions meet the quality and requirements of the original design.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install luminaires per the manufacturer's guidelines.
- B. Support luminaires from structural concrete ceiling/roof planks.
 - 1. Comply with structural specification requirements for penetrating and supporting from concrete ceiling/roof planks.
- C. Install luminaires plumb and square with building and wall intersections:
- D. Install luminaires in rooms after equipment has been installed, so as to ensure no conflict with equipment, piping, or ductwork.
- E. In all cases, coordinate luminaire locations with work of other trades to prevent obstruction of light from the fixtures:
 - 1. Locate bottom of luminaire approximately at the bottom of ductwork, unless otherwise specified or indicated on the Drawings.
- F. Support luminaires weighing more than 25 pounds independently of the outlet box and the conduit.
- G. Provide ceiling or pendent mounted luminaires with a safety chain connecting the lens, driver, and other components to the building structure.
- H. COMMISSIONING
 - 1. ADJUSTING
 - a. Aim and verify all exterior and outdoor luminaires alignment, during dark evening hours, as directed by Owner or the Engineer.
- I. CLEANING
 - 1. Clean all lenses, diffusers, and reflectors.
 - 2. Refinish all luminaires' trim, poles, and support brackets, where finish has been damaged.

3. Clean all LED luminaires (new and old), used during construction for construction lighting, before substantial completion.

3.2 INSPECTION

- A. A night walk through shall be performed by the District to review the adequacy of the lighting for the station. Contractor shall reposition fixtures to correct any deficiencies found.

**** END OF SECTION ****

SECTION 170100 INSTRUMENTATION AND CONTROLS GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 SCOPE

- A. Work Included:
 - 1. Provide all tools, equipment, materials, and supplies and be responsible for all labor required to complete the installation, startup and operational testing of a complete and operable Instrumentation and Control (I&C) System as indicated on the Drawings and as specified herein.
 - 2. Provide all the necessary equipment components and interconnections along with the services of manufacturers' engineering representatives necessary to ensure that the District receives a completely integrated and operational I&C system as herein specified.
 - 3. Provide all terminations for wiring at field mounted instruments, equipment enclosures, alarm and status contacts.
 - 4. Provide all Instrumentation and Control wire required for a fully functioning Instrumentation and Controls System as shown on the Drawings except for wire specifically specified in Division 16. See Section 160100, Paragraph 1.1.
 - 5. See Section 160100 for the facilities to be included in the contract.
- B. Work Specified in Other Divisions:
 - 1. Process piping, installation of inline instrumentation, and other mechanical work and equipment as specified in Divisions 11, 12, 13, 14, or 15.
 - 2. Instruments and controls which are not directly used for process control, i.e., those provided as part of a package system, such as the generator diesel tank, etc. as specified in Divisions 11, 12, 13, 14, 15, or 16.
 - 3. Division 16 work, including all instrumentation and controls conduit, and only that wire specified in Division 16. Refer to Division 16 Specifications for specific requirements for wire, conduit, grounding, and other electrical equipment.

1.2 REFERENCE STANDARDS

- A. Instrumentation Society of America (ISA) Publications:
 - 1. S5.4 Instrument Loop Diagrams
 - 2. S20 Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves

1.3 SYSTEM RESPONSIBILITY

- A. General
 - 1. The I&C equipment as specified in this Division shall be considered an integrated system. Entire system installation including calibration, verification, startup, operation testing, and training shall be performed by qualified personnel, possessing all the necessary equipment, and who have had experience performing similar installations. Instrumentation and control systems drawings are diagrammatic only; it is the responsibility of the Contractor to obtain technical

data, determine performance requirements, develop instrumentation detail installation designs, and coordinate the selection of specified equipment with Contractor supplied equipment to meet the design conditions stated.

B. Compatibility

1. The Contractor shall be responsible to see that all components of the instrumentation system, including equipment specified under other Divisions, are completely compatible and function properly as a system. Provide such additional equipment, accessories, etc., as are necessary to meet these objectives at no cost to the District.

C. Coordination

1. For control components, devices, and systems shown on the Instrumentation Drawings, the Contractor shall:
 - a. Verify the correctness of installation of all instruments.
 - b. Verify that the proper type, size, and number of control wires with their conduits are provided.
 - c. Verify that proper electric power circuits provided for all components and systems.
 - d. Supervise final electric signal connections to all process instrumentation and control equipment.
 - e. Contractor shall tag and record all cables at the control cabinet end.
 - f. Adjust, startup, and test all process instrumentation and control equipment.
 - g. Provide specified documentation and training

1.4 QUALITY ASSURANCE

- A. Standard of Quality: The Contractor shall provide equipment of the types and sizes specified which has been demonstrated to operate successfully. Provide equipment which is new and of recent proven design.

1.5 DRAWINGS

- A. Drawings: The Instrumentation Drawings are diagrammatic; exact locations of instrumentation products shall be determined in the field with the District. Except where special details are used to illustrate the method of installation of a particular piece or type of equipment or material, the requirements or descriptions in this Specification shall take precedence in the event of conflict.
 1. Locations of equipment, inserts, anchors, instruments, panels, junction boxes, pull boxes, manholes, conduits, stub-ups, fittings, power and convenience outlets, and ground wells are approximate unless dimensioned; verify locations with the District prior to installation. Field verify scaled dimensions on Drawings.
 2. Review the Drawings and Specification Divisions of other trades and perform the instrumentation work that will be required for the installations.
 3. Should there be a need to deviate from the Instrumentation Drawings and Specifications, submit written details and reasons for all changes to the District for favorable review and written approval, prior to any changes being implemented.

4. Resolution of varying interpretations of the Contract Documents shall conform to the General Specifications.
5. In addition, the Process and Instrumentation Diagrams show schematically the operating logic (concept) of the I&C system. The Contractor shall be responsible for implementing the I&C scheme indicated by the Drawings and specified by these specifications.

1.6 SUBMITTALS

- A. Submit manuals, shop drawings and cutsheets for each instrument for approval in accordance with the Sections 013300, 160100 and this specification.
- B. Interconnection Diagrams: Prior to installation of wire, submit point-to-point type interconnection diagrams for each instrument. Include electric panel and circuit numbers for all sources of 120 Vac power. Show wiring interconnections between telemetry cabinet, instrument, motor control center, motor combination starter, valve actuator, and other field-mounted device or junction box. Include junction box terminal numbers and wire/cable numbers.
 1. Show conduit pullboxes with appropriate tag names and/or numbers.
- C. Reports: Submit test reports as required by paragraphs 3.8, 3.9, and 3.10 below to the District for approval within 30 calendar days of completion of testing.
- D. As-Built Drawings: Submit "As-Built" process and instrumentation diagrams for all work included in Division 17. Submit complete schematics and wiring diagrams or drawings to include all installed field and panel conduit routing, mounting details, interconnection diagrams with cable, wire, and termination numbers. Interconnection diagrams shall be coordinated with the conductor identification requirements in Sections 161200, LOW VOLTAGE WIRE AND CABLE, and 161240, SIGNAL CABLE. Provide copies of all CAD produced drawings on magnetic media in AutoCAD DWG format.

Furnish 3 copies of Operation and Maintenance Manuals, including Instruction Manuals and Part Lists, for all equipment provided under Division 17.

1. The following information, as applicable, for each instrument, equipment, subsystem and/or control loop shall be included:
2. Equipment/instrument number and name.
3. Specifications sufficiently detailed for reordering exact duplicates of the original items.
4. Installation instructions, procedures, sequences, tolerances, and precautions.
5. Operational procedures.
6. Shutdown procedures.
7. Maintenance, calibration, and repair instructions.
8. Parts list and spare parts recommendations.
9. Calibration curves, rating tables, and any other data showing the relationship of the variable inputs and the calibrated output of all measuring devices and controlled equipment.
10. Manufacturer's name, local representative's address and telephone number.

11. Bind information in standard three ring binders, in a logical sequence, with indexed tabs between each type of instrument or equipment.

1.7 Instrument Index

- A. The index of instruments in the Appendix lists all pertinent information about instruments identified for the contract. The index is a listing of devices but shall not be construed as a Bill of Materials or as a complete listing. For example, equipment procured as a packaged unit or assembled in the field to perform a standardized function (such as water seals) may contain instruments, which are not listed. Upon request, a copy of the Spreadsheet can be provided.

PART 2 - PRODUCTS

2.1 MATERIALS AND STANDARD SPECIFICATIONS

- A. Provide instruments, equipment and materials suitable for service conditions and meeting standard specifications such as ANSI, ASTM, ISA, and SAMA. The intent of this Specification is to secure instruments and equipment of a uniform quality and manufacture throughout the plant. All instruments in the plant of the same type shall be made by the same manufacturer.

2.2 NAMEPLATES

- A. For each piece of equipment, provide a manufacturer's nameplate showing his name, location, the pertinent ratings and the model designation.
 1. Identify each piece of equipment and related controls with a rigid laminated engraved phenolic nameplate. Engrave nameplates with the inscriptions indicated on the Drawings and, if not so indicated, with the equipment name. Securely fasten nameplates in place using two stainless steel screws or, where favorably reviewed by the District, with epoxy cement. Where no inscription is indicated on the Drawings, furnish nameplates with an appropriate inscription furnished by the District upon prior request by the Contractor.
 2. Each control device, including pushbuttons, control switches, and indicating lights, shall have an integral legend plate or nameplate indicating the device function. These shall be inscribed as indicated on the Drawings or as favorably reviewed by the District.
 3. Provide CAUTION or SAFETY nameplates to alert operators of special conditions that may result in faulty equipment operations or potential unsafe situations, such as automatic starting of equipment or foreign voltages present.
 4. Devices containing batteries that must be replaced periodically must be clearly identified. Nameplates are not required if the device senses and displays a low battery warning.

2.3 NAME TAGS

- A. All instrumentation and equipment items or systems shall be identified by nametags. Field equipment shall be tagged with the assigned instrumentation tag number listed in the Instrument Index.
- B. Nametags shall be stainless steel with engraved or stamped black characters of 3/16 inch minimum height. Tags shall be attached to equipment with a tag holder and stainless steel band with a worm screw clamping device. Use 20 gauge stainless steel wire where banding is impractical. For field panels or large equipment cases

use stainless steel screws; however, such permanent attachment shall not be on an ordinarily replaceable part.

2.4 EQUIPMENT OPERATING CONDITIONS

All equipment shall be rated for normal operating performance with varying operating conditions over the following minimum ranges:

- A. Electrical Power
 - 1. 120 volts ac $\pm 10\%$, 60 Hz, unregulated, except where specifically stated otherwise on the Drawings or in the Specifications, or when two-wire, loop-powered devices are specified.
- B. Field Instruments
 - 1. Outdoor Areas:
 - 2. Ambient Temperature: $+32^{\circ}\text{F}$ to $+100^{\circ}\text{F}$
 - 3. Ambient Relative Humidity: 5% to 100%
 - 4. Weather: Rain
- C. Indoor Unheated Areas
 - 1. Ambient Temperature: $+32^{\circ}\text{F}$ to $+100^{\circ}\text{F}$
 - 2. Ambient Relative Humidity: 5% to 95%, non-condensing
- D. Indoor Environmentally Controlled Areas
 - 1. Ambient Temperature: $+60^{\circ}\text{F}$ to $+95^{\circ}\text{F}$
 - 2. Ambient Relative Humidity: 10% to 90%, non-condensing

2.5 EQUIPMENT LOCATIONS

- A. Provide equipment and materials suitable for the types of locations in which they are located as defined under Division 16.
- B. All equipment specified for field mounting shall be weatherproof and splash proof as a minimum.
- C. If electrical or electronic components are contained within the equipment, they shall be housed in NEMA 4 cases, NEMA 4X in corrosive locations, and NEMA 7 in hazardous locations unless noted otherwise.

2.6 SIGNAL TRANSMISSION

- A. Discrete: All alarm and status signals shall be 24 VDC unless specified otherwise on the Instrument Index or on the Drawings.

2.7 FASTENERS

- A. Fasteners for securing equipment to walls, floors and the like shall be either hot-dip galvanized after fabrication or stainless steel.
- B. Provide stainless steel fasteners in corrosive or outdoor locations.
- C. When fastening to walls, floors, and the like, provide capsule anchors, not expansion shields. Size capsule anchors to meet load requirements. Minimum size capsule anchor bolt is 3/8 inch.

PART 3 - EXECUTION

3.1 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Box, crate, or otherwise enclose and protect instruments and equipment during shipment, handling, and storage. Keep all equipment dry and covered from exposure to weather, moisture, corrosive liquids and gases or any element, which could degrade the equipment.
 - 1. Protect painted surfaces against impact, abrasion, discoloration, and other damage.
- B. Notify the District in writing in the event that any equipment or material is damaged. Obtain prior favorable review by the District before making repairs to damaged products.

3.2 INSPECTION

- A. In execution of the work defined in Section 170100, the Contractor shall be responsible for the following services:
 - 1. Inspection of each instrument and piece of equipment for damage, defects, completeness, and correct operation before start-up.
 - 2. Inspection of previously installed related work and verification that it is ready for installation of instruments and equipment.

3.3 MOUNTINGS

- A. Mount and install equipment as indicated. Mount field instruments on pipe mounts or other similar means in accordance with suppliers' recommendation. Where mounted in control panels, mount according to requirements of that section.
- B. Equipment specified for field mounting shall be suitable for direct pipe mounting or surface mounting and non-inline indicators and equipment with calibration adjustments or requiring periodic inspection shall be mounted not lower than 3 feet nor higher than 5 feet above grade, and the like. Instruments designated to be installed below hatches shall have covers and calibration equipment accessible from the hatch.
- C. Manufacturers of all process instrument panels and instruments shall certify that their equipment, when installed and anchored, will safely transfer seismic forces through the equipment to the anchorage without failure of equipment or components.
- D. All devices shall be accessible to operators for servicing, operating, reading, etc. The Contractor shall provide platforms or remote meters and/or control switches to assure devices are accessible for operation.

3.4 FIELD WIRING

- A. Ring out signal wiring prior to termination. Verify wire number and terminations are satisfactory per Section 161200 or 161240. The wire numbers shall be designated on the Drawing "As-Built".

3.5 ELECTROMAGNETIC INTERFERENCE (EMI)

- A. Construction shall proceed in a manner which minimizes the introduction of noise into the I&C System.
- B. Cross signal wires and wires carrying ac power or control signals at right angles.

- C. Separate signal wires from wires carrying ac power or switched AC/DC control signals within control panels and terminal cabinets, as much as possible. Provide the following minimum separations within such equipment unless indicated otherwise on the Drawings:

<u>Power Wiring Capacity</u>	<u>Separation (inches)</u>
120 volts ac or 10 amps	12
240 volts ac or 50 amps	18
480 volts ac or 200 amps	24

3.6 GROUNDING

- A. Proper grounding of equipment and systems in this Division is critical, especially where the PLC and associated networks and peripherals are involved. The Drawings and Division 16, Section 164500 specify safety grounding for all equipment in this Division.
- B. Ground all signal shields, signal grounds, and power supplies at an isolated, ground single bus within each rack or enclosure. The far ends of these signal cables must be disconnected (floated) from any ground to prevent ground loops.

3.7 PREPARATION

- A. Ensure that installation areas are clean, and that concrete or masonry operations are completed prior to installing instruments and equipment. Maintain the areas in a broom-clean condition during installation operations.
- B. Panels shall be protected during construction to prevent damage to front panel devices and prevent dust accumulation in the intervals. Other protective measures (lamp, strip heaters, etc.) shall be included as weather conditions dictate.

3.8 INSTRUMENT CALIBRATION

- A. Provide the services of instrumentation technicians, tools, and equipment to field calibrate each instrument to its specified accuracy in accordance with the manufacturer's specifications and instructions for calibration.
- B. Each instrument shall be calibrated at 0%, 25%, 50%, 75% and 100% of span using test instruments to simulate inputs and read outputs that are rated to an accuracy of at least 5 times greater than the specified accuracy of the instrument being calibrated, unless waived in writing by the District.
- C. Submit a written report to the District for approval on each instrument certifying that it has been calibrated to its published specified accuracy. This report shall include a listing of the published specified accuracy, permissible tolerance at each point of calibration, calibration reading as finally adjusted within tolerances, defects noted, correction action required, and correction made. This report shall list instrument readings in actual engineering units such as Gallons per Minute, Feet, psi, etc., rather than 0 to 100%.

3.9 SYSTEM VERIFICATION

- A. Provide the services of field experienced instrumentation technicians/electricians to verify that each instrument is operational and performing its intended function within system tolerance.
- B. Verification will include, but may not be limited to:

- C. Verify that each instrument is operational and performing its intended function within manufacturer's tolerance. Simulate inputs at 0%, 25%, 50%, 75%, and 100% of span or with on-off inputs, as applicable.
 - 1. Cause malfunctions to sound alarms or switch to standby to check system operation.
 - 2. Check all systems thoroughly for correct operation.
 - 3. Correction of all defects and malfunctions disclosed by tests. Use new parts and materials as required and approved and retest.
 - 4. Submit a report to the District for approval certifying completion of verification of each instrument system.
 - a. Report shall contain all instrument test sheets.

3.10 FINAL OPERATIONAL TESTING AND ACCEPTANCE

- A. Provide the services of field experienced instrumentation technicians/electricians to assist District's personnel during startup of the plant process. The purpose of this assistance is to support in making final adjustments of settings on the instrument systems prior to performing the demonstration and final operational testing.
- B. The intent of this test is to demonstrate and certify the operational interrelationship of the instrumentation systems. This testing shall include, but not be limited to, taking process variables to their limits (simulated or process) to verify all alarms, failure interlocks, and operational interlocks.
- C. If defects or malfunctions occur, immediately correct defects and malfunctions with approved methods and materials and repeat the testing.
 - 1. Upon completion of final operational testing, submit the test results and a certified report to the District for approval indicating that all required system tests have been completed satisfactorily and the systems meet all the functional requirements of their applicable specifications.
 - 2. Each test shall be witnessed, documented, and signed off upon completion by the District. Notify the District in writing a minimum of 48 hours prior to the proposed date for commencing the test.

**** END OF SECTION ***

Equipment Identification	Number	Equipment Suffix	Service	Furnished by	Equip. Type M=Mech, E=Elec, V= Valve, I= Instrument	Equipment Description or Manufacturer / Model Number	P&ID Diagram	Spec. Section	Voltage	Range	Initial Setpoint	PLC I/O Type AI - Analog Input AO- Analog Output DI-Discrete Input DO-Discrete Output	Comments
FDQIT	900		MARINA METER	CONTRACTOR	I	TIGERMAG EP MODEL 656	I-2	151600 173100	120VAC/ 24VDC			AI, DI	TRANSMITTER
FDQIT	915		16" HEADER	CONTRACTOR	I	TIGERMAG EP MODEL 656	I-2	151600 173100	120VAC/ 24VDC			AI, DI	TRANSMITTER
FDQIT	925		16" HEADER	CONTRACTOR	I	TIGERMAG EP MODEL 656	I-2	151600 173100	120VAC/ 24VDC			AI, DI	TRANSMITTER
FE	900		MARINA METER, 24"	CONTRACTOR	M	TIGERMAG EP MODEL 656	I-2	173100					FLOW TUBE WITH GROUND RINGS
FE	915		16" HEADER	CONTRACTOR	M	TIGERMAG EP MODEL 656	I-2	173100					FLOW TUBE WITH GROUND RINGS
FE	925		20" HEADER	CONTRACTOR	M	TIGERMAG EP MODEL 656	I-2	173100					FLOW TUBE WITH GROUND RINGS
FQI	950		WASTE TO PIT	CONTRACTOR	M		I-2						TURBINE FLOW METER NO ELCTRICAL OUTPUT
HS	955		HOA OPERATES PRV-955	NIC; BY OTHERS	I	-	I-2		24VDC			DI	BY CONTROL PANEL MANUFACTURER
LCP	916		16" HEADE	CONTRACTOR	I	CLA-VALVE CONTROLLER	I-2	152180	24VDC			AI, DI	INSTALL IN CONTROL PANEL
LCP	926		16" HEADE	CONTRACTOR	I	CLA-VALVE CONTROLLER	I-2	152180	24VDC			AI, DI	INSTALL IN CONTROL PANEL

Equipment Identification	Number	Equipment Suffix	Service	Furnished by	Equip. Type M=Mech, E=Elec, V= Valve, I= Instrument	Equipment Description or Manufacturer / Model Number	P&ID Diagram	Spec. Section	Voltage	Range	Initial Setpoint	PLC I/O Type AI - Analog Input AO- Analog Output DI-Discrete Input DO-Discrete Output	Comments
PI	912		16" HEADER	CONTRACTOR	I	ASHCROFT	I-2	175100					
PI	922		20" HEADER	CONTRACTOR	I	ASHCROFT	I-2	175100					
PT	913	A	16" HEADER	CONTRACTOR	I	ROSEMOUNT 3051TG3A2B21AB4M5	I-2	175100	24VDC	0-200 psi		AI	SUPPLY WITH O'BRIEN BOX WITH HEAT TRACE; COMMON WITH PT-913B
PT	913	B	16" HEADER	CONTRACTOR	I	ROSEMOUNT 3051TG3A2B21AB4M5	I-2	175100	24VDC	0-200 psi		AI	SUPPLY WITH O'BRIEN BOX WITH HEAT TRACE; COMMON WITH PT-913A
PT	923	A	20" HEADER	CONTRACTOR	I	ROSEMOUNT 3051TG3A2B21AB4M5	I-2	175100	24VDC	0-200 psi		AI	SUPPLY WITH O'BRIEN BOX WITH HEAT TRACE; COMMON WITH PT-923B
PT	923	B	20" HEADER	CONTRACTOR	I	ROSEMOUNT 3051TG3A2B21AB4M5	I-2	175100	24VDC	0-200 psi		AI	SUPPLY WITH O'BRIEN BOX WITH HEAT TRACE; COMMON WITH PT-923A
SV	916	A	16" HEADER	CONTRACTOR	V	CLA-VALVE SOLENOID	I-2	151600	24VDC				SUPPLIED WITH VALVE
SV	916	B	16" HEADER	CONTRACTOR	V	CLA-VALVE SOLENOID	I-2	151600	24VDC				SUPPLIED WITH VALVE
SV	926	A	20" HEADER	CONTRACTOR	V	CLA-VALVE SOLENOID	I-2	151600	24VDC				SUPPLIED WITH VALVE
SV	926	B	20" HEADER	CONTRACTOR	V	CLA-VALVE SOLENOID	I-2	151600	24VDC				SUPPLIED WITH VALVE

Equipment Identification	Number	Equipment Suffix	Service	Furnished by	Equip. Type M=Mech, E=Elec, V= Valve, I= Instrument	Equipment Description or Manufacturer / Model Number	P&ID Diagram	Spec. Section	Voltage	Range	Initial Setpoint	PLC I/O Type AI - Analog Input AO- Analog Output DI-Discrete Input DO-Discrete Output	Comments
SV	955		PRV-955 SOLENOID	CONTRACTOR	V	ASCO TYPE	I-2		120VAC			DO	SUPPLIED WITH VALVE
ZI	1050	A	DOOR LIMIT SWITCH	CONTRACTOR	I	HONEYWELL-ADMECO #968XTP	I-2	175900	24VDC			DI	
ZI	1050	B	DOOR LIMIT SWITCH	CONTRACTOR	I	HONEYWELL-ADMECO #968XTP	I-2	175900	24VDC			DI	
ZI	1051	C	DOOR LIMIT SWITCH	CONTRACTOR	I	HONEYWELL-ADMECO #968XTP	I-2	175900	24VDC			DI	
ZI	1051	D	DOOR LIMIT SWITCH	CONTRACTOR	I	HONEYWELL-ADMECO #968XTP	I-2	175900	24VDC			DI	
ZI	1051	E	DOOR LIMIT SWITCH	CONTRACTOR	I	HONEYWELL-ADMECO #968XTP	I-2	175900	24VDC			DI	
ZI	1051	F	DOOR LIMIT SWITCH	CONTRACTOR	I	HONEYWELL-ADMECO #968XTP	I-2	175900	24VDC			DI	
ZI	1051	G	DOOR LIMIT SWITCH	CONTRACTOR	I	HONEYWELL-ADMECO #968XTP	I-2	175900	24VDC			DI	
ZI	1051	H	DOOR LIMIT SWITCH	CONTRACTOR	I	HONEYWELL-ADMECO #968XTP	I-2	175900	24VDC			DI	
ZI	1051	I	DOOR LIMIT SWITCH	CONTRACTOR	I	HONEYWELL-ADMECO #968XTP	I-2	175900	24VDC			DI	

Equipment Identification	Number	Equipment Suffix	Service	Furnished by	Equip. Type M=Mech, E=Elec, V= Valve, I= Instrument	Equipment Description or Manufacturer / Model Number	P&ID Diagram	Spec. Section	Voltage	Range	Initial Setpoint	PLC I/O Type AI - Analog Input AO- Analog Output DI-Discrete Input DO-Discrete Output	Comments
AE	1000		OUTSIDE /CHEM ROOM SUMP	CONTRACTOR	I	YOKOGAWA CONDUCTIVITY PROBE ISC40FD-V-01/FA/PH5	I-3	172150	mV				PURCHASE EXTENSION JUNCTION BOX & CABLE WITH PROBE
AIT	1000 / 150		SUMP CONDUCTIVITY	CONTRACTOR	I	YOKOGAWA FLXA402	I-3, I-4	172150	120VAC			AI	COMMON CONDUCTIVITY ANALYZER FOR 2 SUMPS; INSTALLED IN CONTROL PANEL
FS	1010		TRUCK LOADING SAFETY SHOWER	CONTRACTOR	I	FLUID COMPONENTS INTERNATIONAL, / FLT93B-AX00	I-3		24VDC			DI	"X" - INSERTION U-LENGTH TO BE DETERMINED BY CONTRACTOR
HS	1000	A	HOA OPERATES PMP-1000A	NIC; BY OTHERS	E	-	I-3		24VDC			DI	BY CONTROL PANEL MANUFACTURER
HS	1200		ON/OFF SELECTOR SWITCH	NIC; BY OTHERS	I		I-3					DI	BY CONTROL PANEL MANUFACTURER
LSH	1000		SUMP LEVEL SWITCH	CONTRACTOR	I	OMEGA LV-80	I-3	174200	24VDC			DI	
LSL	1000		SUMP LEVEL SWITCH	CONTRACTOR	I	OMEGA LV-80	I-3	174200	24VDC			DI	
LT	1020		PIT WATER LEVEL	CONTRACTOR	I	DRUCK	I-3	174200	24VDC	0-12' H2O		AI	OFCI
SV	1201		TRUCK AIR SOLENOID	CONTRACTOR	V	ASCO	I-3		120VAC			DO	
AE	150		NAOCL CHEM ROOM SUMP	CONTRACTOR	I	YOKOGAWA CONDUCTIVITY PROBE ISC40FD-V-01-NFL/PH5	I-4	172150	mV				PURCHASE EXTENSION JUNCTION BOX & CABLE WITH PROBE

Equipment Identification	Number	Equipment Suffix	Service	Furnished by	Equip. Type M=Mech, E=Elec, V= Valve, I= Instrument	Equipment Description or Manufacturer / Model Number	P&ID Diagram	Spec. Section	Voltage	Range	Initial Setpoint	PLC I/O Type AI - Analog Input AO- Analog Output DI-Discrete Input DO-Discrete Output	Comments
FS	100		NAOCL BULK TANK SAFETY SHOWER	CONTRACTOR	I	FLUID COMPONENTS INTERNATIONAL, / FLT93B-AX00	I-4		24VDC			DI	"X" - INSERTION U-LENGTH TO BE DETERMINED BY CONTRACTOR
HS	100		LCP-100 ACKNOWLEDGE / RESET SELECTOR	CONTRACTOR	I	ALLEN BRADLEY 800H SERIES	I-4	172100	120VAC				
HS	110	A	HOA OPERATES PMP-110A	NIC; BY OTHERS	I	-	I-4		24VDC			DI	BY CONTROL PANEL MANUFACTURER
HS	110	B	HOA OPERATES PMP-110B	NIC; BY OTHERS	I	-	I-4		24VDC			DI	BY CONTROL PANEL MANUFACTURER
HS	150	A	PMP-150 START-STOP PUSHBUTTON	NIC; BY OTHERS	I		I-4		24VDC				BY CONTROL PANEL MANUFACTURER
HS	1000	B	HOA OPERATES PMP-1000B	NIC; BY OTHERS	E	-	I-4		24VDC			DI	BY CONTROL PANEL MANUFACTURER
LI	100		NAOCL BULK LEVEL INDICATOR	CONTRACTOR	I	GEMS SURESITE	I-4	174200		0-12'			
LI	101		NAOCL2 BULK LEVEL INDICATOR	CONTRACTOR	I	RED LION PAX	I-4	172100	24VDC	0-100%		AO	IN LCP-100
LSH	100		NAOCL BULK TANKLEVEL SWITCH	CONTRACTOR	I	GEMS 84320-P	I-4	174200	24VDC		11'-0"	DI	ORDER WITH LI100
LSH	100		INDICATING LIGHT	CONTRACTOR	I	ALLEN BRADLEY 800H SERIES	I-4	172100	24VDC				IN LCP-100

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LSH	150		SUMP LEVEL SWITCH	CONTRACTOR	I	OMEGA LV-80	I-4	174200	24VDC			DI	
LSHH	100		NAOCL BULK TANK LEVEL SWITCH	CONTRACTOR	I	GEMS 84320-P	I-4	174200	120VAC		12'-0"		ORDER WITH LI100
LSHH	100		INDICATING LIGHT	CONTRACTOR	I	ALLEN BRADLEY 800H SERIES	I-4	172100	24VDC				IN LCP-100
LSHH	100SL		STROBE LIGHT & HORN	CONTRACTOR	I	FEDERAL SIGNAL AV1-LED SERIES	I-4		120VAC				IN LCP-100
LSL	150		SUMP LEVEL SWITCH	CONTRACTOR	I	OMEGA LV-80	I-4	174200	24VDC			DI	
LT	101		NAOCL BULK TANK LEVEL	CONTRACTOR	I	ENDRESS + HAUSER – PROSONIC FMU40	I-4	174200	120VAC/ 24VDC	0-15'		AI	
PI	100		NAOCL CHEM ROOM FILL LINE	CONTRACTOR	I	ASHCROFT	I-4	175100					
FS	200		NAOCL DAY TANK SAFETY SHOWER	CONTRACTOR	I	FLUID COMPONENTS INTERNATIONAL, / FLT93B-AX00	I-5		24VDC			DI	"X" - INSERTION U-LENGTH TO BE DETERMINED BY CONTRACTOR
HS	216	A	HOA OPERATES PMP-216A	DISTRICT	I	PROMINENT	I-5		24VDC			DI	PART OF CHEM SKID PACKAGE; OFCI
HS	216	B	HOA OPERATES PMP-216B	DISTRICT	I	PROMINENT	I-5		24VDC			DI	PART OF CHEM SKID PACKAGE; OFCI

Equipment Identification	Number	Equipment Suffix	Service	Furnished by	Equip. Type M=Mech, E=Elec, V= Valve, I= Instrument	Equipment Description or Manufacturer / Model Number	P&ID Diagram	Spec. Section	Voltage	Range	Initial Setpoint	PLC I/O Type AI - Analog Input AO- Analog Output DI-Discrete Input DO-Discrete Output	Comments
HS	220	A	HOA OPERATES PMP-220A	DISTRICT	I	PROMINENT	I-5		24VDC			DI	PART OF CHEM SKID PACKAGE; OFCI
HS	220	B	HOA OPERATES PMP-220B	DISTRICT	I	PROMINENT	I-5		24VDC			DI	PART OF CHEM SKID PACKAGE; OFCI
LI	200		NAOCL DAY TANK LEVEL INDICATOR	CONTRACTOR	I	GEMS SURESITE	I-5	174200		0-6'			
LI	400		ZOP DAY TANK LEVEL INDICATOR	CONTRACTOR	I	GEMS SURESITE	I-5	174200		0-7'			
LIT	200		NAOCL DAY TANK LEVEL	CONTRACTOR	I	ENDRESS + HAUSER – PROSONIC FMU40	I-5	174200	120VAC/ 24VDC	0-6'		AI	
LSHH	200		NAOCL DAY TANK LEVEL SWITCH	CONTRACTOR	I	GEMS 84320-P	I-5	174200	24VDC		5'-6"	DI	ORDER WITH LI200
LSHH	400		ZOP DAY LEVEL SWITCH	CONTRACTOR	I	GEMS 84320-P	I-5	174200	24VDC		6'-6"	DI	ORDER WITH LI200
PI	216	A	NAOCL PMP-216A OUTLET PRESSURE	DISTRICT	I	PROMINENT	I-5			0-60 PSI			PART OF CHEM SKID PACKAGE; OFCI
PI	216	B	NAOCL PMP-216B OUTLET PRESSURE	DISTRICT	I	PROMINENT	I-5			0-60 PSI			PART OF CHEM SKID PACKAGE; OFCI
PI	218		NAOCL PMP-216A & B SKID OUTLET PRESSURE	DISTRICT	I	PROMINENT	I-5			0-160 PSI			PART OF CHEM SKID PACKAGE; OFCI

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PI	220	A	NAOCL PMP-220A OUTLET PRESSURE	DISTRICT	I	PROMINENT	I-5			0-160 PSI			PART OF CHEM SKID PACKAGE; OFCI
PI	220	B	NAOCL PMP-220B OUTLET PRESSURE	DISTRICT	I	PROMINENT	I-5			0-160 PSI			PART OF CHEM SKID PACKAGE; OFCI
PI	222		NAOCL PMP-220A & B SKID OUTLET PRESSURE	DISTRICT	I	PROMINENT	I-5						PART OF CHEM SKID PACKAGE; OFCI
PSL	217	A	NAOCL PMP-217A OUTLET PRESSURE SWITCH	DISTRICT	I	PROMINENT	I-5		24VDC		120 PSI	DI	PART OF CHEM SKID PACKAGE; OFCI
PSL	217	B	NAOCL PMP-217B OUTLET PRESSURE SWITCH	DISTRICT	I	PROMINENT	I-5		24VDC		120 PSI	DI	PART OF CHEM SKID PACKAGE; OFCI
PSL	221	A	NAOCL PMP-220A OUTLET PRESSURE SWITCH	DISTRICT	I	PROMINENT	I-5		24VDC		120 PSI	DI	PART OF CHEM SKID PACKAGE; OFCI
PSL	221	B	NAOCL PMP-220B OUTLET PRESSURE SWITCH	DISTRICT	I	PROMINENT	I-5		24VDC			DI	PART OF CHEM SKID PACKAGE; OFCI
AE	516		16" HEADER CHLORINE SENSOR	CONTRACTOR	I	DULCOMETER DAC SERIES / CLE SENSOR / DGMA201T010 HOUSING	I-6	172150	mV	0.1-10 PPM	2 PPM		PART OF PROMINENT FLUID CONTROLS CHLORINE RESIDUAL ANALYZER PACKEGE
AE	517		16" HEADER TURBIDITY SENSOR	CONTRACTOR	I	HACH / TU5300SC	I-6	172150	120VAC				TURBIDITY SENSOR COMES WITH ANALYZER
AE	518		16" HEADER FUTURE SENSOR	NIC	I		I-6						FUTURE; NIC

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AE	520		20" HEADER CHLORINE SENSOR	CONTRACTOR	I	DULCOMETER DAC SERIES / CLE SENSOR / DGMA201T010 HOUSING	I-6	172150	mV	0.1-10 PPM	2 PPM		PART OF PROMINENT FLUID CONTROLS CHLORINE RESIDUAL ANALYZER PACKEGE
AE	521		20" HEADER TURBIDITY SENSOR	CONTRACTOR	I	HACH / TU5300SC	I-6	172150	mV				TURBIDITY SENSOR COMES WITH ANALYZER
AE	522		20" HEADER FUTURE SENSOR	NIC	I		I-6						FUTURE; NIC
AIT	516		16" HEADER CHLORINE ANALYZER	CONTRACTOR	I	DULCOMETER DAC SERIES	I-6	172150	120VAC	0-10 PPM	2 PPM	AI	PART OF PROMINENT FLUID CONTROLS CHLORINE RESIDUAL ANALYZER PACKEGE
AIT	517		16" HEADER TURBIDITY ANALYZER	CONTRACTOR	I	HACH / TU5300SC	I-6	172150	120VAC	0-5 NTU	2 NTU	AO	WITH CONTROLLER
AIT	518		16" HEADER FUTURE ANALYZER	NIC	I		I-6						FUTURE; NIC
AIT	520		20" HEADER CHLORINE ANALYZER	CONTRACTOR	I	DULCOMETER DAC SERIES	I-6	172150	120VAC	0-10 PPM	2 PPM	AI	PART OF PROMINENT FLUID CONTROLS CHLORINE RESIDUAL ANALYZER PACKAGE
AIT	521		20" HEADER TURBIDITY ANALYZER	CONTRACTOR	I	HACH / TU5300SC	I-6	172150	120VAC	0-5 NTU	2 NTU	AI	WITH CONTROLLER
AIT	522		20" HEADER FUTURE ANALYZER	NIC	I		I-6					AI	FUTURE; NIC
AE	350		ZOP CHEM ROOM SUMP	CONTRACTOR	I	YOKOGAWA CONDUCTIVITY PROBE ISC40FD-V-01-NFL/PH5	I-7	172150	mV				PURCHASE EXTENSION JUNCTION BOX & CABLE WITH PROBE

Equipment Identification	Number	Equipment Suffix	Service	Furnished by	Equip. Type M=Mech, E=Elec, V= Valve, I= Instrument	Equipment Description or Manufacturer / Model Number	P&ID Diagram	Spec. Section	Voltage	Range	Initial Setpoint	PLC I/O Type AI - Analog Input AO- Analog Output DI-Discrete Input DO-Discrete Output	Comments
AIT	350 / 650		SUMP CONDUCTIVITY	CONTRACTOR	I	YOKOGAWA FLXA402	I-7, I-9	172150	120VAC			AI	COMMON CONDUCTIVITY ANALYZER FOR 2 SUMPS; INSTALL IN CONTROL PANEL
FS	300		ZOP BULK TANK SAFETY SHOWER	CONTRACTOR	I	FLUID COMPONENTS INTERNATIONAL, / FLT93B-AX00	I-7		24VDC			DI	"X" - INSERTION U-LENGTH TO BE DETERMINED BY CONTRACTOR
HS	300		LCP-300 ACKNOWLEDGE / RESET SELECTOR	CONTRACTOR	I	ALLEN BRADLEY 800H SERIES	I-7	172100	120VAC				IN LCP-300
HS	310	A	HOA OPERATES PMP-310A	NIC; BY OTHERS	I	-	I-7		24VDC			DI	BY CONTROL PANEL MANUFACTURER
HS	310	B	HOA OPERATES PMP-310B	NIC; BY OTHERS	I	-	I-7		24VDC			DI	BY CONTROL PANEL MANUFACTURER
HS	350	A	PMP-350 START-STOP PUSHBUTTON	NIC; BY OTHERS	I		I-7						BY CONTROL PANEL MANUFACTURER
LI	300		TNK-300 ZOP BULK LEVEL LEVEL INDICATOR	CONTRACTOR	I	GEMS SURESITE	I-7	174200		0-10'			
LI	301		ZOP BULK LEVEL INDICATOR	CONTRACTOR	I	RED LION PAX	I-7	172100	24VDC	0-100%		AI	IN LCP-300
LIT	301		ZOP BULK TANK LEVEL	CONTRACTOR	I	ENDRESS + HAUSER – PROSONIC FMU40	I-7	174200	120VAC/ 24VDC	0-10'		AI	
LSH	300		INDICATING LIGHT	CONTRACTOR	I	ALLEN BRADLEY 800H SERIES	I-7	172100	24VDC				IN LCP-300

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LSH	300		ZOP BULK LEVEL SWITCH	CONTRACTOR	I	GEMS 84320-P	I-7	174200	24VDC			DI	ORDER WITH LI300
LSH	350		SUMP LEVEL SWITCH	CONTRACTOR	I	OMEGA LV-80	I-7	174200	24VDC			DI	
LSHH	300		INDICATING LIGHT	CONTRACTOR	I	ALLEN BRADLEY 800H SERIES	I-7	172100	24VDC				IN LCP-300
LSHH	300		ZOP BULK LEVEL SWITCH	CONTRACTOR	I	GEMS 84320-P	I-7	174200	120 VAC				ORDER WITH LI300
LSHH	300SL		STROBE LIGHT & HORN	CONTRACTOR	I	FEDERAL SIGNAL AV1- LED SERIES	I-7		120VAC				IN LCP-300
LSL	350		SUMP LEVEL SWITCH	CONTRACTOR	I	OMEGA LV-80	I-7	174200	24VDC			DI	
PI	300		ZOP CHEM ROOM FILL LINE	CONTRACTOR	I	ASHCROFT	I-7	175100	24VDC	0-60 PSI			
FS	400		ZOP DAY TANK SAFETY SHOWER	CONTRACTOR	I	FLUID COMPONENTS INTERNATIONAL, / FLT93B-AX00	I-8		24VDC			DI	"X" - INSERTION U-LENGTH TO BE DETERMINED BY CONTRACTOR
HS	416	A	HOA OPERATES PMP-416A	CONTRACTOR	I	PROMINENT	I-8		24VDC			DI	PART OF CHEM SKID PACKAGE: OFCI
HS	416	B	HOA OPERATES PMP-416B	CONTRACTOR	I	PROMINENT	I-8		24VDC			DI	PART OF CHEM SKID PACKAGE: OFCI

Equipment Identification	Number	Equipment Suffix	Service	Furnished by	Equip. Type M=Mech, E=Elec, V= Valve, I= Instrument	Equipment Description or Manufacturer / Model Number	P&ID Diagram	Spec. Section	Voltage	Range	Initial Setpoint	PLC I/O Type AI - Analog Input AO- Analog Output DI-Discrete Input DO-Discrete Output	Comments
HS	420	A	HOA OPERATES PMP-420A	CONTRACTOR	I	PROMINENT	I-8		24VDC			DI	PART OF CHEM SKID PACKAGE: OFCI
HS	420	B	HOA OPERATES PMP-420B	CONTRACTOR	I	PROMINENT	I-8		24VDC			DI	PART OF CHEM SKID PACKAGE: OFCI
LIT	400		ZOP DAY TANK LEVEL	CONTRACTOR	I	ENDRESS + HAUSER – PROSONIC FMU40	I-8	174200	120VAC/ 24VDC	0-7'		AI	
PI	416	A	ZOP PMP-416A OUTLET PRESSURE	CONTRACTOR	I	PROMINENT	I-8			0-160 PSI			PART OF CHEM SKID PACKAGE: OFCI
PI	416	B	ZOP PMP-416B OUTLET PRESSURE	CONTRACTOR	I	PROMINENT	I-8			0-160 PSI			PART OF CHEM SKID PACKAGE: OFCI
PI	418		ZOP PMP-416A & B SKID OUTLET PRESSURE	CONTRACTOR	I	PROMINENT	I-8			0-160 PSI			PART OF CHEM SKID PACKAGE: OFCI
PI	420	A	ZOP PMP-420A OUTLET PRESSURE	CONTRACTOR	I	PROMINENT	I-8			0-160 PSI			PART OF CHEM SKID PACKAGE: OFCI
PI	420	B	ZOP PMP-420B OUTLET PRESSURE	CONTRACTOR	I	PROMINENT	I-8			0-160 PSI			PART OF CHEM SKID PACKAGE: OFCI
PI	422		ZOP PMP-420A & B SKID OUTLET PRESSURE	CONTRACTOR	I	PROMINENT	I-8			0-160 PSI			PART OF CHEM SKID PACKAGE: OFCI
PSL	417	A	ZOP PMP-417A OUTLET PRESSURE SWITCH	CONTRACTOR	I	PROMINENT	I-8		24VDC		120 PSI	DI	PART OF CHEM SKID PACKAGE: OFCI

Equipment Identification	Number	Equipment Suffix	Service	Furnished by	Equip. Type M=Mech, E=Elec, V= Valve, I= Instrument	Equipment Description or Manufacturer / Model Number	P&ID Diagram	Spec. Section	Voltage	Range	Initial Setpoint	PLC I/O Type AI - Analog Input AO- Analog Output DI-Discrete Input DO-Discrete Output	Comments
PSL	417	B	ZOP PMP-417B OUTLET PRESSURE SWITCH	CONTRACTOR	I	PROMINENT	I-8		24VDC		120 PSI	DI	PART OF CHEM SKID PACKAGE: OFCI
PSL	421	A	ZOP PMP-420A OUTLET PRESSURE SWITCH	CONTRACTOR	I	PROMINENT	I-8		24VDC		120 PSI	DI	PART OF CHEM SKID PACKAGE: OFCI
PSL	421	B	ZOP PMP-420B OUTLET PRESSURE SWITCH	CONTRACTOR	I	PROMINENT	I-8		24VDC		120 PSI	DI	PART OF CHEM SKID PACKAGE: OFCI
AE	650		FUTURE CHEM ROOM SUMP	NIC	I		I-9						FUTURE; NIC
FS	600		FUTURE BULK TANK SAFETY SHOWER	CONTRACTOR	I	FLUID COMPONENTS INTERNATIONAL, / FLT93B-AX00	I-9		24 VDC			DI	
HS	600		FUTURE LCP-600 NORMAL/TEST SELECTOR	NIC	I		I-9						FUTURE; NIC
HS	601		FUTURE LCP-600 SILENCE PUSHBUTTON	NIC	I		I-9						FUTURE; NIC
HS	610	A	FUTURE HOA OPERATES PMP-610A	NIC	I	-	I-9						FUTURE; NIC
HS	610	B	FUTURE HOA OPERATES PMP-610B	NIC	I	-	I-9						FUTURE; NIC
HS	650	A	FUTURE PMP-650 START- STOP PUSHBUTTON	NIC	I		I-9						FUTURE; NIC

Equipment Identification	Number	Equipment Suffix	Service	Furnished by	Equip. Type M=Mech, E=Elec, V= Valve, I= Instrument	Equipment Description or Manufacturer / Model Number	P&ID Diagram	Spec. Section	Voltage	Range	Initial Setpoint	PLC I/O Type AI - Analog Input AO- Analog Output DI-Discrete Input DO-Discrete Output	Comments
LI	600		FUTURE BULK LEVEL INDICATOR	NIC	I		I-9						FUTURE; NIC
LI	601		FUTURE BULK TANK LEVEL INDICATOR	NIC	I		I-9						FUTURE; NIC
LSH	600		FUTURE BULK LEVEL SWITCH	NIC	I		I-9						FUTURE; NIC
LSH	600		FUTURE LCP-600	NIC	I		I-9						FUTURE; NIC
LSH	650		FUTURE SUMP LEVEL SWITCH	NIC	I		I-9						FUTURE; NIC
LSHH	600		FUTURE BULK LEVEL SWITCH	NIC	I		I-9						FUTURE; NIC
LSHH	600		FUTURE LCP-600	NIC	I		I-9						FUTURE; NIC
LSL	650		FUTURE SUMP LEVEL SWITCH	NIC	I		I-9						FUTURE; NIC
LT	601		FUTURE BULK TANK LEVEL	NIC	I		I-9						FUTURE; NIC
PI	600		FUTURE CHEM ROOM FILL LINE	NIC	I		I-9						FUTURE; NIC

Equipment Identification	Number	Equipment Suffix	Service	Furnished by	Equip. Type M=Mech, E=Elec, V= Valve, I= Instrument	Equipment Description or Manufacturer / Model Number	P&ID Diagram	Spec. Section	Voltage	Range	Initial Setpoint	PLC I/O Type AI - Analog Input AO- Analog Output DI-Discrete Input DO-Discrete Output	Comments
FS	700		FUTURE DAY TANK SAFETY SHOWER	CONTRACTOR	I		I-10						FUTURE; NIC
HS	716	A	HOA OPERATES PMP-716A	NIC	I		I-10						FUTURE; NIC
HS	716	B	FUTURE HOA OPERATES PMP-716B	NIC	I		I-10						FUTURE; NIC
HS	720	A	FUTURE HOA OPERATES PMP-720A	NIC	I		I-10						FUTURE; NIC
HS	720	B	FUTURE HOA OPERATES PMP-720B	NIC	I		I-10						FUTURE; NIC
LI	700		FUTURE DAY TANK LEVEL INDICATOR	NIC	I		I-10						FUTURE; NIC
LIT	700		FUTURE DAY TANK LEVEL	NIC	I		I-10						FUTURE; NIC
LSHH	700		FUTURE DAY LEVEL SWITCH	NIC	I		I-10						FUTURE; NIC
PI	716	A	FUTURE PMP-716A OUTLET PRESSURE	NIC	I		I-10						FUTURE; NIC
PI	716	B	FUTURE PMP-716B OUTLET PRESSURE	NIC	I		I-10						FUTURE; NIC

Equipment Identification	Number	Equipment Suffix	Service	Furnished by	Equip. Type M=Mech, E=Elec, V= Valve, I= Instrument	Equipment Description or Manufacturer / Model Number	P&ID Diagram	Spec. Section	Voltage	Range	Initial Setpoint	PLC I/O Type AI - Analog Input AO- Analog Output DI-Discrete Input DO-Discrete Output	Comments
PI	718		FUTURE PMP-716A & B SKID OUTLET PRESSURE	NIC	I		I-10						FUTURE; NIC
PI	720	A	FUTURE PMP-720A OUTLET PRESSURE	NIC	I		I-10						FUTURE; NIC
PI	720	B	FUTURE PMP-720B OUTLET PRESSURE	NIC	I		I-10						FUTURE; NIC
PI	722		FUTURE PMP-720A & B SKID OUTLET PRESSURE	NIC	I		I-10						FUTURE; NIC
PSL	717	A	FUTURE PMP-717A OUTLET PRESSURE SWITCH	NIC	I		I-10						FUTURE; NIC
PSL	717	B	FUTURE PMP-717B OUTLET PRESSURE SWITCH	NIC	I		I-10						FUTURE; NIC
PSL	721	A	FUTURE PMP-720A OUTLET PRESSURE SWITCH	NIC	I		I-10						FUTURE; NIC
PSL	721	B	FUTURE PMP-720B OUTLET PRESSURE SWITCH	NIC	I		I-10						FUTURE; NIC

SECTION 172100 FILL STATION PANELS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work included: Furnish and install the fill station panels as shown on the drawings, and as specified herein.

1.2 QUALITY ASSURANCE

- A. All components shall be new and of the best quality, constructed of durable materials, and designed for long life in continuous service with a minimum of maintenance.
- B. All mechanisms shall be enclosed in such a manner that they shall be protected against damage from dust, moisture, or striking by external objects.
- C. Where shown in the Specifications or on the drawings, components shall comply with the referenced codes and standards.

1.3 SUBMITTALS

- A. Submit material data for all fill station panels in accordance with the submittal requirements of Section 160100 and 013000.
- B. Submit the following:
 - 1. Outline dimension drawings
 - 2. Assembly drawings
 - 3. Shop detail drawings
 - 4. Wiring diagrams
 - 5. Parts lists and costs
 - 6. Instruction manuals
 - 7. Test and verification reports

PART 2 - PRODUCTS

2.1 GENERAL

- A. Quality assurance:
 - 1. Unless otherwise approved by the District, all panels shall be constructed with external dimensions as shown on the Drawings. The panel construction and all interior wiring shall be in strict accordance with the National Electric Code (NEC), state and local codes, and in conformance with applicable specifications of NEMA, ANSI, UL, and ICECA.
 - 2. Front instrument arrangement shall be designed to allow easy identification of components. Each device or instrument shall have a nameplate with tag number and function.
 - 3. Arrangement and design shall be subject to the approval of the District.
 - 4. All panels shall be completely fabricated, instruments installed and wired at the factory.

B. Nameplates:

1. Machine engraved laminated white or colored plastic nameplates with black lettering shall be provided for front panel mounted equipment. Nameplate engraving shall be as shown on the Drawings. Nameplates shall be attached to the panel with a minimum of two self-tapping Type 316 stainless steel sheet metal screws or with epoxy to maintain NEMA rating, if applicable. The Contractor agrees that nameplate wording may be changed without additional cost or time if changes are identified in the review comments of the first or second submittal required under the Contract.
2. Machine-embossed, adhesive-backed nameplates shall identify tag number of instruments, terminal boards, relays, fused terminal points, and circuit breakers inside panels. Prior to mounting adhesive nameplate, the intended mounting surface shall be cleaned with lacquer thinner or alcohol. Panel-mounted devices shall have nameplates identifying tag number on the inside of the panel.

C. Control panel electrical:

1. Interior panel wiring:
 - a. Power and control wiring shall be single conductor stranded copper NFPA No. 70 Type MTW No. 14 AWG minimum.
 - b. Wiring shall be supported independently of terminations by lacing to panel support structure or by slotted flame-retardant plastic wiring channels. Wiring channels shall comply with UL 94, Type V-I. Wiring channel fill shall not exceed 40 percent of cross section area.
 - c. Wiring shall comply with the requirements of NEC as a minimum. Panel work shall contain no exposed connections, and adjustments to equipment shall be made without exposing these terminals. Power and control wiring operating above 80 VAC or dc shall be carried in covered channels separate from low voltage signal circuits.
 - d. Terminal blocks: Terminal blocks shall meet the following requirements:
 - i. Provide sufficient terminations to accommodate both present and future needs. Wire all spare or unused panel mounted elements to their panels' terminal blocks. Provide the greater of 10 percent of all connected terminals or four unused spare terminals.
 - ii. Each terminal strip shall have a unique identifying alphanumeric code at one end and a vinyl marking strip running the entire length of the terminal strip with a unique number for each terminal. Numbers shall be machine printed and 1/8 inch high. Terminal strip codes and terminal numbers shall comply with numbers listed on the wiring and interconnection diagrams.
 - iii. Size all terminal block components to allow insertion of all necessary wire sizes and types. Supply terminal blocks with marking system allowing the use of preprinted or field-marked tags. Provide listed terminal blocks manufactured by suppliers as shown on the Drawings or approved equal.
 - e. Field connections shall be to separate terminal blocks. Terminal blocks for field terminations shall be in a separate part of the panel close to where the field cables enter the panel.

- f. Circuits shall be fused as required. Fuses shall be 1/4 by 1-1/4 inch. Fuses for 120 VAC & 24 Vdc circuits shall be fast-acting glass tube type rated 1/8 or 1/10 amp for 4-20 and 10-50 mA loops and 3 amps for the power supply to individual instruments or as noted on drawings. Fuse holders shall be single circuit lever fusible terminal block as shown on drawings.
2. Power distribution within panels:
 - a. Panels shall have internal power distribution as required.
 - b. Circuit breakers and power distribution terminals and fuses shall be by Allen Bradley or approved substitute.
3. Signal wiring: Analog signal cables shall be separated from power and control within a panel and shall cross at right angles where necessary. Signal cable shall be No. 18 AWG, 7 x 28 stranded copper twisted shielded pair or triad with a 100 percent, aluminum-polyester shield, rated 60oC. For panels containing circuits less than 300 volts, signal cable shall be rated 300 V minimum and shall be Belden Type 8762 or 8772 or approved equal. For panels containing circuits of 300 to 600 volts, signal cable shall be rated at 600 V and shall be Belden No. 16 AWG Type 8760 or 8770 or approved equal.
4. Signal distribution within panels:
 - a. 4 to 20 mA signals shall be distributed within panels as required by the instruments.
 - b. Signals distributed outside panels shall be isolated 4 to 20 mA signals.
 - c. Instrument loop field wires shall terminate on panel terminal strips in the control panel. Instruments in the same loop shall be wired to panel terminal strips with spare terminal enough for one additional instrument. No looping from instrument to instrument.
 - d. In the event of a conflict between instrumentation manufacturer's cable specifications and this Specification, the instrumentation manufacturer's specifications shall take precedence.
5. Control Relays:
 - a. General purpose relays shall be enclosed octal plug in units. Relays shall be Potter-Blumfield, or approved equal, or as shown on the Drawings. Relay contacts for control circuits shall be rated not less than 7.5 amperes at 120 VAC and at 30 Vdc. Relays shall be UL listed.
 - b. Where shown, time delay functions shall be accomplished with time delay relays. Units shall be adjustable time delay relays with the number of contacts and contact arrangements as shown. A neon status indicating light shall be provided with each relay. Contacts shall be rated for 7.5 A at 120 VAC. Integral knob with calibrated scale shall be provided for adjustment of time delay. Initial setting shall be as shown with time delay range approximately three times the initial setting. Delay rangeability shall be at least 10:1. Timing relays shall be solid state pulse count type utilizing a high frequency resistance capacitance (RC) oscillator and integrated circuit counter for timing.
 - c. All relays shall have a screw terminal interface with the wiring. Terminals shall have a permanent, legible identification. Relays shall be mounted such that the

terminal identifications are clearly visible and the terminals are readily accessible.

6. 2-, 3-, and 4-position, 30mm selector switches:
 - a. Position switches shall be maintained contact type or as shown on the drawings, rated 10 A minimum at 120 VAC. Control knob shall be black, NEMA 4X, and shall show clearly the control switch position.
 - b. Selector switch shall be complete with legend plate, and with contact blocks as shown on the drawings.
 - c. Acceptable products: Allen Bradley Bulletin 800H, or approved substitute.
7. Push to Test 30mm Indicating Lights:
 - a. Indicating lights shall be NEMA 4X, sunlight resistant, 12-130V AC/DC LED, push-to-test pilot lights.
 - b. Color as shown on the Drawings.
 - c. Acceptable products: Allen Bradley Bulletin 800H, or approved substitute.
8. Level Indicating Display
 - a. Level indicating display shall be 5-digit, red LED, readable in sunlight, NEMA 4X, 120VAC power in.
 - b. Indicators shall be fully programmed to show tank level (0-100%) based on a 4-20mA signal from the PLC.
 - c. Acceptable products: Red Lion PAX Model

PART 3 - EXECUTION

3.1 ASSEMBLY

- A. The installation of switches and associated components shall conform to the approved submittal drawings and as specified.
- B. Equipment shall be installed in a neat and workmanlike manner, and firmly secured to the surface on which it is mounted.
- C. Control device identification:
 1. All control devices, including instrumentation shall be labeled on the rear of the control panel with their proper tag numbers as shown on the wiring drawings.
- D. Inspection and testing:
 1. Testing shall be coordinated per the requirements of Section 17110, Part 3.

3.2 INSTALLATION

- A. The fill station panels shall be set level and plumb, as shown on the Drawings.
- B. Any damage to the structure, components or finish shall be carefully repaired to the satisfaction of the Engineer.
- C. Conduit entries into the panel shall facilitate separation and routing of the different voltage levels within the panel.
 1. All conduit penetrations shall be weatherproof, using grounding Meyers hubs or equal.

- D. Installation, testing, calibration, validation, startup and instruction shall be in accordance with Section 170100.

**** END OF SECTION ****

SECTION 172150 PROCESS FLUID ANALYZERS

PART 1 - PART 1--GENERAL

1.1 DESCRIPTION

- A. This section specifies requirements for process fluid analyzer indicating transmitters.

1.2 REFERENCES

- A. References shall be as specified in Section 170100.

1.3 SUBMITTALS

Submittals shall be provided as specified in Sections 013300 and 170100, including:

A. SHOP DRAWINGS:

1. Marked product literature of all equipment and features to be provided.
2. Installation drawings for only the analyzers, sensors, and mounting accessories to be provided.
3. Electrical and signal connection drawings for only the analyzers and sensors to be provided.
4. List of miscellaneous items, cables, spare parts, replenishment parts, and chemicals that will be provided.
5. List of spare parts available.

1.4 ENVIRONMENTAL CONDITIONS

- A. Refer to Section 170100.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Process fluid analyzer manufacturers and model numbers shall be as shown on the Drawings. No substitutions.

2.2 GENERAL

- A. Process fluid analyzers shall comply with the following requirements:
1. Measured parameter output indicators shall be calibrated in process engineering units.
 2. Outputs shall be 4-20mA, 24VDC.

2.3 PRODUCT DATA

- A. The following data shall be provided in accordance with Section 013300:
1. Operating and maintenance information as specified in Section 170100, limited to standard installation and instruction manuals available for analyzers and sensors. Include final reviewed submittal and separate record of all final configuration, jumper, and switch settings for each analyzer.
 2. Test results as specified in Section 170100.
- B. Residual Chlorine Analyzer (AIT-516, AIT-520)

1. Analyzer shall have a range of 0-10 ppm of free chlorine and output a 4-20mA proportional signal.
 2. Analyzer shall use amperometric sensor technology and not require any reagents to detect the chlorine.
 - a. Sensor shall measure free chlorine. Range: 0.1-10ppm, Maximum pressure: 14.5 psi, Temperature range: 5° – 45° C
 - b. Analyzer and sensor housing shall be mounted to a backboard with all wiring to the analyzer and plumbing required for connection to the process system. Piping and wiring shall leave adequate room for conduit connections to the analyzer.
 3. Analyzer shall have an HMI screen for reviewing residual and process events and alarms.
 4. Input power voltage shall be 120VAC with terminals for user connection.
 5. Enclosure shall be NEMA 4X.
 6. Analyzer shall be Prominent Fluid Controls Chlorine Residual Analyzer DAC Series with CLE type sensor and sensor housing #DGMA201T010. No substitutes.
- C. Turbidity Analyzer (AIT-517, AIT-521)
1. Analyzer shall provide continuous, online monitoring of low range turbidity in water.
 2. The sensor shall utilize a laser-based 360° x 90° optical system that measures turbidity from multiple different angles.
 - a. Sensor shall measure turbidity. Range: 0 to 700 NTU, Maximum pressure: 87 psi, Temperature range: 0° – 40° C
 3. A controller shall be provided to interface directly with the analyzer and provide readouts, process controls and turbidity readouts.
 - a. The controller shall be equipped with two 4-20mA output scaled for the turbidity range of the sensor or as shown on the Drawings.
 - b. The controller shall have a menu-driven operation system.
 - c. The controller display shall be graphic dot matrix LCD with LED backlighting.
 - d. The controller shall be equipped with a real-time clock.
 - e. The controller shall be equipped with two security levels.
 - f. The controller shall be equipped with a data logger with RS-232 capability.
 - g. The controller is equipped with an SD card reader for data download and controller software upload.
 - h. Four electromechanical, UL rated, SPDT relays (Form C) are provided for user-configurable contacts rated 100 to 230 Vac, 5 Amp at 30 VDC resistive maximum.
 - i. The following can be programmed:
 - i. Alarm
 - ii. Warning
 - iii. Timer/scheduled cleaning
 - iv. Feeder control
 - v. Event control
 - j. One analog 0/4-20 mA output shall be provided with a maximum impedance of 500 ohms.
 4. Analyzer and controller input power shall be 120VAC with terminals for user connection.
 5. Analyzer and controller shall be mounted to a backboard with pre-wired wiring

between the analyzer and controller and analyzer plumbing required for connection to the process system. Piping and wiring shall leave adequate room for conduit connections to the controller.

- a. Backboard wiring shall be per NEC requirements.
 6. Analyzer/controller system shall be provided with:
 - a. EPA version
 - b. SC200 Controller
 - c. Flow Sensor
 - d. Automatic Cleaning Module
 - e. System Check
 - f. Bubble trap
 - g. Turbidimeter maintenance kit
 - h. Glass calibration/verification rod
 - i. StablCal® Sealed Vial Calibration Standards
 7. Analyzer/Controller shall be Hach Part # 8627000. No substitutes.
- D. Conductivity Analyzer (AIT- 1000/150, AIT- 350/650)
1. Analyzer shall have a range of 100 μ S/cm-2000 mS/cm and output two 4-20mA proportional signals, minimum.
 2. Analyzer shall capability for two inductive conductivity sensor inputs.
 3. Sensor shall measure conductivity. Range: 0-2000 mS/cm, Maximum pressure: 72 psi, Temperature range: -20° – 130° C
 - a. Sensors shall be pre-mounted on PVC extensions pipes with 6 feet of cable with protective hoses.
 - b. Provide extension cable and IP 65 junction box for termination of sensor cable and extension cable.
 4. Analyzer shall have four SPDT dry contacts with display indicators.
 - a. High/Low process alarms
 - b. Configurable delay time and hysteresis
 - c. Warning /failure annunciation
 5. Analyzer shall have an HMI screen for reviewing conductivity and process events and alarms.
 6. Input power shall be 120VAC with terminals for user connection.
 7. Enclosure shall be NEMA 4X.
 8. Analyzer and sensors shall be Yokogawa.
 - a. Analyzer Part # FLXA402-A-B-AJ-C5-C5-A4-WR-N-N/PM/SCT
 - b. Conductivity Probe Part # See Instrument List
 - c. No substitutes.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation requirements are specified in Section 170100. All instruments or components installed outdoors shall be provided with the manufacturer's recommended sunshade. Outdoor instruments installed under canopies may be installed with a sunshade provided the canopy provides adequate protection of the instrument.

3.2 TESTING

- A. Installation, testing, calibration, validation, startup and instruction shall be in accordance with Section 170100.

3.3 TRAINING

- A. Manufacturer's Service and Start-Up
 - 1. Contractor shall include the manufacturer's services to perform start-up on instrument to include basic operational training and certification of performance of the instrument.
 - a. Provide three training sessions, each with one hour per type of Analyzer.
 - b. Training shall include classroom and hands-on field training. An outline of the proposed training and copy of training handouts shall be submitted for approval.
 - c. Training shall be coordinated with the District 30 days prior to the training date.
 - 2. Contractor shall include a manufacturer's Service Agreement that covers all the manufacturer's recommended preventative maintenance, regularly scheduled calibration and any necessary repairs beginning from the time of equipment startup through to end user acceptance / plant turnover.
 - a. Optional Service Agreement to extend the above services for 12 months after user acceptance shall be provided.
 - 3. Items 1 and 2 are to be performed by manufacturer's factory-trained service personnel. Field service and factory repair by personnel not employed by the manufacturer is not allowed.
 - 4. Use of manufacturer's service parts is required. Third-party parts are not approved for use.

****END OF SECTION****

SECTION 173100 FLOW METER SPECIFICATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section describes the materials, installation and testing of meter assemblies. The CONTRACTOR shall install magnetic flow meters as shown on the contract drawings and as specified herein, complete with all necessary accessories for a complete and operable system including, but not limited to, magnetic flow sensors and flow transmitters. All equipment specified in this section shall be by one manufacturer. The CONTRACTOR shall be responsible for all the necessary meter transmitter conduits, wire and related appurtenances to provide a functioning water flow meter system.

1.2 REFERENCES

- A. Applicable provisions of Section 160100 and Section 170100 become a part of this section as if repeated herein.

1.3 SUBMITTALS

Submittals shall be provided as specified in Sections 013300 and 170100, including:

- A. SHOP DRAWINGS:
 - 1. Marked product literature of all equipment and features to be provided.
 - 2. Installation drawings of flow meters, transmitter and accessories to be provided.
 - 3. Electrical and signal connection drawings.
 - 4. List of miscellaneous items, cables, spare parts.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Contractor shall provide and install 3 each, Sparling Tigermag FM 656 magnetic flow meters, as shown on the Drawings. No substitutions will be allowed.

2.2 FABRICATION

- A. The magnetic flowmeter shall be microprocessor-based, and flanged. It shall indicate, totalize, and transmit flow in full pipes in both forward and reverse directions.
- B. The magnetic flowmeter shall utilize DC bipolar pulsed coil excitation, operating at frequencies up to 100 Hz and automatically re-zeroing after every cycle.
- C. The accuracy shall be at least 0.5% (>50% of span) of flow rate over a 33:1 turndown at all flow rates above 1 fps. Accuracy shall be verified by calibration in a flow laboratory traceable to the U.S. National Institute of Standards and Technology.

- D. The flow sensor liner shall be Polyurethane, suitable for Potable water service. The housing shall be steel.
- E. The integrally-mounted flow sensor and transmitter shall be FM approved for outdoor service, with NEMA 4X rating. The electronics shall be integrally mounted.
- F. The flowmeters shall include a Grounding Ring kit consisting of 2 grounding rings of 304 stainless steel.
- G. The flowmeter shall be suitable for operation at temperatures from -40°F to 266°F and at pressures from full vacuum to 150 psi.
- H. The flowmeter electrodes shall be 316 stainless steel and shall not require O-rings.
- I. The meter shall incorporate HI-Z circuitry. The preamplifier input impedance shall not be less than 1012 ohms. External ultrasonic electrode cleaners shall not be acceptable.
- J. Available outputs shall be
 - 1. Isolated analog 4-20 mAdc into 800 ohms (standard).
 - 2. Scaled pulse 24 Vdc with selectable 12.5/25/50/100 ms on time, max. freq. 60 Hz.
 - 3. 0-1000 Hz freq., for 0-100% flow rate. 15 Vdc.
 - 4. Two flow alarms.
 - 5. Fault, with open collector.
 - 6. RS232 communication.
 - 7. Flow direction with open collector.
 - 8. Positive Zero Return (PZR) for external relay contacts. Outputs 2 & 3 can be open collector if required. Flow meters shall have MODBUS TCP communications.
- K. Low flow cutoff shall be selectable from 0-9% of FS and there shall be two flow alarms settable from 0-99% of span.
- L. A 2-line, 16-character backlit alphanumeric display shall indicate user-defined flow units and total flow. All menu advice and commands shall be visible on this display. The display shall be modular and rotatable 360°, in 90° increments. Characters shall be at least 0.125" high for ease of readability.
- M. The flowmeter shall incorporate the MAG-COMMAND feature allowing menu selection and changes to be made from outside the housing via Hall-effect sensors. It shall not be necessary to remove covers, panels or fasteners to accomplish calibration or program changes.
- N. The diagnostic functions shall not require the technician to carry test equipment or open the housing. Current ramp, complete coil check and true front-end input simulator may be activated in MAG-COMMAND without opening the enclosure.

- O. The meter software shall incorporate a password feature preventing inadvertent program changes.
- P. The meter shall feature nonvolatile E2PROM memory and universal electronics module compatibility between all TigermagEP meters.
- Q. The flowmeter shall have a switching power supply having an operating range from 77 - 265 Vac 50/60 Hz (12-60 Vdc). Power consumption shall not exceed 20 Watts.
- R. All printed circuit boards shall be contained in a plug-in module and be interchangeable for any size without requiring test equipment.
- S. The flowmeter manufacturer shall have meters of the DC pulse type in similar flowing mediums for a minimum of five years.
- T. The flowmeter shall be warranted against defective workmanship or materials for a period of two years from date of shipment.
- U. Totalized flow and programmed configuration shall be maintained in memory for the meters lifetime.
- V. The flowmeter shall be MODEL 656 TigermagEP as manufactured by Sparling Instruments, Inc.
- W. Meter sizes shall be 16", 20", and 24" for the 3 meters.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Flow meter shall be installed per manufacturer's recommendations and installation requirements specified in Section 170100.
- B. Contractor shall coordinate installation of the flow meter and flow transmitter with the mechanical contractor.
 - 1. Flow transmitter wiring shall be installed after the flow tube has been set in place to avoid any damage.
- C. Flow transmitter display shall be oriented for easy viewing by operators.

3.2 TESTING

- A. Installation, testing, calibration, validation, startup and instruction shall be in accordance with Section 170100.

****END OF SECTION****

SECTION 174200 LEVEL TRANSMITTERS, SWITCHES AND GAUGES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work Included: Furnish and install level transmitters, level sight gauges and level switches, as shown on the Drawings and as specified herein.

1.2 REFERENCES

- A. Applicable provisions of Section 160100 and Section 170100 become a part of this section as if repeated herein.

1.3 SUBMITTALS

Submittals shall be provided as specified in Sections 013300 and 170100, including:

- A. SHOP DRAWINGS:
 - 1. Marked product literature of all equipment and features to be provided.
 - 2. Installation manuals and drawings of level transmitters, level sight gauges and level switches and accessories to be provided.
 - 3. Electrical and signal connection drawings.
 - 4. List of miscellaneous items, cables, spare parts.

PART 2 - PRODUCTS

2.1 PIT LEVEL TRANSMITTER – (Pressure Transducer)

- A. The transducer shall sense the liquid level or pressure variation and convert these variations into a linear analog 4-20 mA output.
- B. The liquid level or pressure shall be sensed by a pressure transducer certified by FM, UL, and CSA for installation in a non-hazardous area.
- C. When specified, the level transducer shall be the vented type. The vent tube shall be integral to the signal lead cable and constructed to protect the vent tube from crushing.
- D. Level ranges shall be factory set as shown on the Instrument List.
- E. Static Accuracy: ± 1.0 percent (includes the combined errors due to nonlinearity, hysteresis and non-repeatability on a Best Fit Straight Line basis at 25°C per ISA S51.1).
- F. The pressure sensing element shall incorporate a four active arm Wheatstone Bridge strain gage diffused directly into an elastomeric fluid-filled titanium isolation diaphragm.
- G. The sensing element shall exhibit no measurable hysteresis, withstand overpressures up to 200 percent of range pressure and have a life expectancy of 20 million cycles.
- H. The transducer shall be capable of operating from a DC supply, between 9 and 30 VDC, unregulated.
- I. The transducer shall have on-board signal conditioning and include over voltage and reverse polarity protection.
- J. Wetted materials shall be Titanium.
- K. Transducer diameter shall be 1-inch maximum.

- L. Transducer cable shall be factory-attached molded polyurethane jacketed water block cable with non-stretch stiffeners, cable shield wrap and vent tube for atmospheric reference with moisture barrier.
- M. Transducer shall have an anti-snag cone to prevent cable from "hanging-up" on foreign debris.
- N. Contractor shall specify required transducer cable length based on field take-offs.
- O. A desiccant or equivalent assembly shall be provided to prevent condensation from forming in the vent tubing. The desiccant shall be mounted in a junction box with terminals for the sensor cable. See the Drawings for details.
- P. Manufacturer and Product: The level monitoring systems shall be Druck.

2.2 TANK LEVEL TRANSMITTER

- A. Continuous non-contact 4-wire level measurement device with transmitter using ultrasonic echo sensing.
- B. Measuring Range: 5 M (16 Ft) Maximum
- C. Output: 4-20mA proportional to level
- D. Menu-guided plain text operation with 4-line VU331 local display
- E. Envelope curve display on VU331 local display
- F. Capable of operation remotely via HART communication
- G. Adjustable measuring range
- H. Integrated temperature sensor for automatic correction of sound time-of-flight
- I. Transducer material: PVDF (EPDM); Housing: Aluminum; Rated: IP66/68
- J. Transducer 2" Flange connection
- K. Power Supply: 4-wire – 90-253VAC
- L. Stainless steel tag with instrument tag number.
- M. Manufacturer and Product: Endress + Hauser – Prosonic FMU40.

2.3 TANK LEVEL GAUGES & SWITCHES

- A. Level gauges for chemical bulk and day tank solutions shall utilize a magnet-equipped float and external magnetic flags for level indication. All components shall be compatible with measured chemical.
- B. Operating pressure: 15 psig; Maximum pressure: 20 psig
- C. Gauge tank Connections: Top: Top of Tank- 150# FF Flange; Bottom: Side of Tank- 150# FF Flange
- D. Material: PVC
- E. Visual indication length: See Instrument List.
- F. Provide switch modules for the level gauges.
 - 1. Level switch shall be high temperature switch module, 316 stainless steel housing, SPDT contacts, 1/2" MNPT connection designed to strap onto and be activated by the magnetic level gauge float.

2. Stainless steel mounting clamp.
 3. LSHH and LSH switches provided for bulk tanks. LSHH switch provided for day tanks.
 4. Position switches at setpoints shown on the Instrument List.
- G. Manufacturer and Product: GEMS SureSite with High Temp Switch modules 84320-P

2.4 SUMP LEVEL SWITCHES

- A. Provide single station liquid level switches for the chemical room and truck loading sumps.
- B. Level switch shall be encapsulated switch module, all CPVC housing, SPST convertible NO or NC contact, 72" lead wires, 1/4" MNPT connection.
- C. Maximum temperature rating: 85°C; Maximum pressure: 15 psi
- D. Provide Schedule 40 PVC conduit extension with union from switch to top of sump for connection to junction box shown on the Drawings.
 1. Junction box shall be above 26" water containment level in chemical rooms.
- E. Manufacturer and Product: Omega LV-80 or approved substitute.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Inspect each level instrument for any damage and confirm specifications match with its intended use.
- B. Check-out each instrument to confirm it activates or works properly before installation.
- C. After inspection and checkout, install the level instruments in accordance with manufacturer's instructions and as shown on Drawings.
- D. Set operating and alarm levels as shown on the Drawings or Instrument List.

3.2 TESTING

- A. Installation, testing, calibration, validation, startup and instruction shall be in accordance with Section 170100.

**** END OF SECTION ****

SECTION 175100 PRESSURE SWITCHES, TRANSMITTERS AND PRESSURE GAUGES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Furnish and install pressure transmitters, switches and pressure gauges as shown on the drawings and specified herein.
- B. The manufacturer shall have been regularly engaged in design and manufacture of pressure transmitters, gauges and switches of comparable size, type and rating for at least three years.

1.2 REFERENCES

- A. Applicable provisions of Section 160100 and Section 170100 become a part of this section as if repeated herein.

1.3 SUBMITTALS

- A. Submit shop drawings in accordance with Section 170100, Article 1.6.

PART 2 - PRODUCTS

2.1 PRESSURE TRANSMITTERS – ELECTRONIC

- A. Electronic indicating type pressure transmitters shall convert a gauge or absolute pressure measurement to a 4-20 mA dc linear electrical output signal capable of transmission into at least a 600 ohm maximum load at 24 Vdc or less. Signal and power transmission shall be provided on a single pair of wires. Operating ambient temperature limits shall be at least 40° to +82°C.
- B. Range shall be as indicated in the Instrument List. Overrange protection shall be at least 1 1/2 times span without degradation of accuracy. Reference accuracy shall be $\pm 1/2$ percent or better.
- C. Construction: The transmitter enclosure shall be NEMA 4X rated except where explosion proof is required as noted on the Drawings. The process connection for clean liquid service shall be 1/4 inch NPT compatible with root valve specified in the piping material section. Enclosure and wetted surface material shall be corrosion resistant and suitable for the process fluid.
- D. Acceptable Manufacturers: Rosemount Model 3051T per the Instrument List

2.2 PRESSURE GAUGES

- A. Pressure gauge:
 - 1. ANSI B40.1 Grade A accuracy:
 - a. +1% of span in middle half of range.
 - b. 2% for rest of scale.
 - 2. Bronze bourdon tube.
 - 3. Stainless steel case with threaded ring.
 - 4. 1/4" NPT stem mount.
 - 5. 3-1/2" dial. Polycarbonate face.

6. See the Instrument list for tag numbers and pressure ranges.
- B. Manufacturers: Ashcroft or approved substitute.

2.3 PRESSURE SWITCHES

- A. General -
 1. Pressure switches shall be factory assembled and in accordance with the Instrument List for pressure ranges and set-points.
 2. Contacts: SPDT
 3. Diaphragm Material: Buna-N
 4. Pressure switches shall be NEMA 4X, SS with ½" NPT conduit connection
 5. Pressure switches shall be mounted on the root valves shown on the Mechanical Drawings.
 6. Manufacturers: Ashcroft B-Series or approved substitute.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install the instrumentation per the manufacturer's instructions and as shown on the drawings.
- B. Conduit runs and flexible conduit connection shall be installed to prevent moisture from flowing into the instrument.
- C. Contractor shall provide insulating bushings between any copper/brass valves and steel nipples connected to the pressure devices to prevent galvanic corrosion.
- D. Pressure gauges and switches in chlorine service shall be mounted on diaphragm seals to prevent corrosion of the pressure diaphragm.

3.2 TESTING

- A. Installation, testing, calibration, validation, startup and instruction shall be in accordance with Section 170100.

**** END OF SECTION ****

SECTION 175900 MISCELLANEOUS INSTRUMENTATION & ELECTRICAL EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work included:
 - 1. Furnish and install miscellaneous electrical equipment and instrumentation as shown on the drawings and as specified herein.
- B. Furnish miscellaneous instrumentation as specified herein.
 - 1. Related work specified elsewhere:
 - 2. Section 160100
 - 3. Section 170100
- C. Quality Assurance
 - 1. All components shall be of the best quality, constructed of durable materials, and designed for long life in continuous service with a minimum of maintenance.

1.2 SUBMITTALS

- 1. See Section 160100
 - 2. See Section 170100
- B. Protection
 - 1. All mechanisms shall be enclosed in such a manner that they shall be protected against damage from dust, moisture, or striking by external objects.

PART 2 - PRODUCTS

- A. Provide miscellaneous electrical and instrumentation as shown on the drawings.
- B. Equipment shall be by manufacturers shown on the drawings or a prior approved substitute.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The installation of all electrical equipment and instrumentation and associated components shall conform to the Drawings, manufacturer's instructions and as specified.
- B. Equipment shall be installed in a neat and workmanlike manner, and firmly secured to the surface on which it is mounted.
- C. All instruments and instrument groups shall have all internal connections factory piped and wired.
- D. Terminals shall be conveniently located to facilitate external connections.
- E. Install all labels and nameplates required by these specifications including the Arc Flash Warning labels.

3.2 TESTING

- A. Installation, testing, calibration, validation, startup and instruction shall be in accordance with Section 170100.

**** END OF SECTION ****

SECTION 312000

EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Preparing subgrades for walks and pavements.

1.3 DEFINITIONS

- A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
- B. Base Course: Course placed between the subbase course and hot-mix asphalt paving.
- C. Bedding Course: Course placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- E. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
- F. Fill: Soil materials used to raise existing grades.
- G. Subbase Course: Course placed between the subgrade and base course for hot-mix asphalt pavement, or course placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.
- H. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

1.4 SUBMITTALS

- A. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:
 - 1. Laboratory compaction curve according to either ASTM D 698, or ASTM D 1557 for each on-site soil material proposed for fill and backfill.

1.5 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Architect and then only after arranging to provide temporary utility services according to requirements indicated.
 - 1. Notify owner not less than two days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without owner's written permission.
 - 3. Contact utility locator service for area where Project is located before excavating.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: ASTM D 2487 Soil Classification Groups GW, GP, GM, SW, SP, and SM, or a combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
- C. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.
- D. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.
- E. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.
- F. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.
- G. Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.
- H. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and 0 to 5 percent passing a No. 4 sieve.
- I. Sand: ASTM C 33; fine aggregate, natural, or manufactured sand.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- B. Preparation of subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface is specified in Division 31 Section "Site Clearing."
- C. Protect and maintain erosion and sedimentation controls, which are specified in Division 31 Section "Site Clearing," during earthwork operations.

3.2 DEWATERING

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
 - 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
 - 2. Install a dewatering system to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.

3.3 DUST CONTROL

- A. Perform Control Measures during all Earth Moving Operations per Cal Trans Section 18, Dust Palliative Design Guidance.

3.4 EXCAVATION, GENERAL

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
 - 1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

3.5 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.6 SUBGRADE INSPECTION

- A. Proof-roll subgrade with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
- B. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.7 STORAGE OF SOIL MATERIALS

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

3.8 BACKFILL

- A. Place and compact backfill in excavations promptly.
- B. Place backfill on subgrades free of mud, or debris.

3.9 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations as follows:
 - 1. Under grass and planted areas, use satisfactory soil material.
 - 2. Under walks and pavements, use engineered fill.
 - 3. Under steps and ramps, use engineered fill.

3.10 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

3.11 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 6 inches.

- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry unit weight:
 - 1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.
 - 2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 95 percent.
 - 3. Under lawn or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 95 percent.
 - 4. For utility trenches, compact each layer of initial and final backfill soil material at 95 percent.

3.12 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 - 1. Provide a smooth transition between adjacent existing grades and new grades.
 - 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding.

3.13 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
 - 1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
 - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

END OF SECTION 312000

**SECTION 321216
ASPHALT PAVING**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Hot-mix asphalt paving.
- B. Related Sections:
 - 1. Division 31 Section "Earth Moving" for aggregate subbase and base courses and for aggregate pavement shoulders.

1.3 DEFINITION

- A. Hot-Mix Asphalt Paving Terminology: Refer to ASTM D 8 for definitions of terms.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.
 - 1. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.
- B. Qualification Data: For qualified manufacturer and Installer.
- C. Material Certificates: For each paving material, from manufacturer.
- D. Material Test Reports: For each paving material.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by authorities having jurisdiction or the DOT of state in which Project is located.
- B. Installer Qualifications: Imprinted-asphalt manufacturer's authorized installer who is trained and approved for installation of imprinted asphalt required for this Project.

- C. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of Standard Specifications for Construction of Local Streets and Roads of the State of California, Department of Transportation, dated July 2002, which are hereby incorporated by reference.
 - 1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:
 - 1. Prime Coat: Minimum surface temperature of 60 deg F (15.6 deg C).
 - 2. Tack Coat: Minimum surface temperature of 60 deg F (15.6 deg C).
 - 3. Slurry Coat: Comply with weather limitations in ASTM D 3910.
 - 4. Asphalt Base Course: Minimum surface temperature of 40 deg F (4.4 deg C) and rising at time of placement.
 - 5. Asphalt Surface Course: Minimum surface temperature of 60 deg F (15.6 deg C) at time of placement.

PART 2 - PRODUCTS

2.1 AGGREGATES

- A. General: Use materials and gradations that have performed satisfactorily in previous installations.
- B. Coarse Aggregate: ASTM D 692, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.
- C. Fine Aggregate: ASTM D 1073 or AASHTO M 29, sharp-edged natural sand or sand prepared from stone, gravel, cured blast-furnace slag, or combinations thereof.
 - 1. For hot-mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.

2.2 ASPHALT MATERIALS

- A. Asphalt Binder: AASHTO M 320 or AASHTO MP 1a, PG 70-22.
- B. Asphalt Cement: ASTM D 3381 for viscosity-graded material; ASTM D 946 for penetration-graded material.
- C. Water: Potable.

2.3 AUXILIARY MATERIALS

- A. Sand: ASTM D 1073 or AASHTO M 29, Grade Nos. 2 or 3.

2.4 MIXES

- A. Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction and complying with the following requirements:
 - 1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that subgrade is dry and in suitable condition to begin paving.
- B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
 - 1. Completely proof-roll subgrade in one direction. Limit vehicle speed to 3 mph (5 km/h).
 - 2. Proof roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes).
 - 3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.
- C. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 PATCHING

- A. Hot-Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches (300 mm) into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.
- B. Patching: Fill excavated pavements with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.

3.3 SURFACE PREPARATION

- A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.
- B. Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.15 to 0.50 gal./sq. yd. (0.7 to 2.3 L/sq. m). Apply enough material to penetrate and seal but not flood surface. Allow prime coat to cure.

1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
2. Protect primed substrate from damage until ready to receive paving.

3.4 HOT-MIX ASPHALT PLACING

- A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
 1. Place hot-mix asphalt surface course in single lift.
 2. Spread mix at minimum temperature of 250 deg F (121 deg C).
 3. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
 4. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.
- B. Place paving in consecutive strips not less than 10 feet (3 m) wide unless infill edge strips of a lesser width are required.
 1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete a section of asphalt base course before placing asphalt surface course.
- C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.5 JOINTS

- A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.
 1. Clean contact surfaces and apply tack coat to joints.
 2. Offset longitudinal joints, in successive courses, a minimum of 6 inches (150 mm).
 3. Offset transverse joints, in successive courses, a minimum of 24 inches (600 mm).
 4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."
 5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
 6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.6 COMPACTION

- A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate

compactors in areas inaccessible to rollers. Vibratory-plate compactors shall only be used with no adverse impact on occupants on adjacent properties in the form of noise, vibration or other deleterious impacts.

1. Complete compaction before mix temperature cools to 185 deg F (85 deg C).
- B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.
- C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
 1. Average Density: 96 percent of reference laboratory density according to ASTM D 6927 or AASHTO T 245, but not less than 94 percent nor greater than 100 percent.
 2. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent nor greater than 96 percent.
- D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.
- E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.
- F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.
- G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.7 INSTALLATION TOLERANCES

- A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:
 1. Base Course: Plus or minus 1/2 inch (13 mm).
 2. Surface Course: Plus 1/4 inch (6 mm), no minus.
- B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot (3-m) straightedge applied transversely or longitudinally to paved areas:
 1. Base Course: 1/4 inch (6 mm).
 2. Surface Course: 1/8 inch (3 mm).

3.8 DISPOSAL

A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.

1. Do not allow milled materials to accumulate on-site.

END OF SECTION 321216

SECTION 321313
CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes exterior cement concrete pavement for the following:
 - 1. Steps and Ramps.
 - 2. Walkways.
- B. Related Sections include the following:
 - 1. Division 03 Section "Cast-in-Place Concrete" for general building applications of concrete.
 - 2. Division 31 Section "Earth Moving" for subgrade preparation, grading, and subbase course.
 - 3. Division 32 Section "Concrete Pavement Joint Sealants" for expansion joint sealant.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

1.4 SUBMITTALS

- A. Product Data: For each type of manufactured material and product indicated.
- B. Design Mixtures: For each concrete pavement mixture. Include alternate mixture designs when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- C. Qualification Data: For testing agency.
- D. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated, based on comprehensive testing of current materials:
 - 1. Aggregates..

- E. Material Certificates: Signed by manufacturers certifying that each of the following materials complies with requirements:
 - 1. Cementitious materials.
 - 2. Steel reinforcement and reinforcement accessories.
 - 3. Admixtures.
 - 4. Curing compounds.
 - 5. Bonding agent or epoxy adhesive.
 - 6. Joint fillers.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products who complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- B. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.
 - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
- C. ACI Publications: Comply with ACI 301, "Specification for Structural Concrete," unless modified by requirements in the Contract Documents.
- D. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

1.6 PROJECT CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
 - 2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.
- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

2.3 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.
- B. Joint Dowel Bars: Plain steel bars, ASTM A 615/A 615M, Grade 60. Cut bars true to length with ends square and free of burrs.
- C. Epoxy-Coated Joint Dowel Bars: ASTM A 775/A 775M; with ASTM A 615/A 615M, Grade 60, plain steel bars.
- D. Tie Bars: ASTM A 615/A 615M, Grade 60, deformed.
- E. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete, and as follows:
 - 1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.

2.4 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source throughout the Project:
 - 1. Portland Cement: ASTM C 150, Type II. Supplement with the following:
 - a. Fly Ash: ASTM C 618, Class F.
- B. Normal-Weight Aggregates: ASTM C 33, Class 4M coarse aggregate, uniformly graded. Provide aggregates from a single source.
 - 1. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: ASTM C 94/C 94M.
- D. Air-Entraining Admixture: ASTM C 260.
- E. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.

2.5 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.

1. Available Products:

- a. Axim Concrete Technologies; Cimfilm.
- b. Burke by Edeco; BurkeFilm.
- c. ChemMasters; Spray-Film.
- d. Conspec Marketing & Manufacturing Co., Inc.; Aquafilm.
- e. Lambert Corporation; Lambco Skin.
- f. L&M Construction Chemicals, Inc.; E-Con.
- g. MBT Protection and Repair, ChemRex Inc.; Confilm.
- h. Meadows, W. R., Inc.; Sealtight Evapre.
- i. Metalcrete Industries; Waterhold.
- j. Nox-Crete Products Group, Kinsman Corporation; Monofilm.
- k. Sika Corporation, Inc.; SikaFilm.

2.6 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.
- B. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.
 1. Available Manufacturers:
 - a. Davis Colors.
 2. Color: As selected by Architect from manufacturer's full range. 5 sack mix.

2.7 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes or field experience.
 1. Use a qualified independent testing agency for preparing and reporting proposed concrete mixture designs for the trial batch method.
- B. Proportion mixtures to provide normal-weight concrete with the following properties:
 1. Compressive Strength (28 Days): 3000 psi.

2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.50.
 3. Slump Limit: 4 inches, plus or minus 1 inch.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.
- D. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use water-reducing admixture, plasticizing and retarding admixture in concrete, as required, for placement and workability.
 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
- E. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements.
1. Fly Ash or Pozzolan: 25 percent.
- 2.8 CONCRETE MIXING
- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Furnish batch certificates for each batch discharged and used in the Work.
1. When air temperature is between 85 deg F and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.
- B. Proceed with concrete pavement operations only after nonconforming conditions have been corrected and subgrade is ready to receive pavement.

3.2 PREPARATION

- A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

3.5 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.
 - 1. When joining existing pavement, place transverse joints to align with previously placed joints, unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour unless pavement terminates at isolation joints.
 - 1. Continue steel reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of pavement strips, unless otherwise indicated.
 - 2. Provide tie bars at sides of pavement strips where indicated.
 - 3. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys, unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
 - 4. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.
 - 1. Locate expansion joints at intervals of 50 feet, unless otherwise indicated.
 - 2. Extend joint fillers full width and depth of joint.
 - 3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
 - 4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
 - 5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
 - 6. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

- D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:
1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover marks on concrete surfaces.
 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.
 3. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.
- E. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.

3.6 CONCRETE PLACEMENT

- A. Inspection: Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast in. Notify other trades to permit installation of their work.
- B. Remove snow, ice, or frost from subbase surface and reinforcement before placing concrete. Do not place concrete on frozen surfaces.
- C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
- D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.
- E. Do not add water to concrete during delivery or at Project site.
- F. Do not add water to fresh concrete after testing.
- G. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- H. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.
- I. Screed pavement surfaces with a straightedge and strike off.

- J. Commence initial floating using bull floats or darbies to impart an open textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.
- K. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
 - 2. Do not use frozen materials or materials containing ice or snow.
 - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mix designs.
- L. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:
 - 1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 - 2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
 - 3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.7 FLOAT FINISHING

- A. General: Do not add water to concrete surfaces during finishing operations.
- B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
 - 1. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic. Medium Broom finish at walks >4% but <6% slope. Heavy Broom finish at ramps with >6% slope.

3.8 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Comply with ACI 306.1 for cold-weather protection.
- C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing

operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

- D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- E. Curing Methods: Cure concrete by moisture-retaining-cover curing, curing compound, or a combination of these as follows:
 - 1. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - 2. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.9 PAVEMENT TOLERANCES

- A. Comply with tolerances of ACI 117 and as follows:
 - 1. Elevation: 1/4 inch except at ADA surfaces required to be maximum 1:48 all concrete must not exceed 1.95% slope.
 - 2. Thickness: Plus 3/8 inch, minus 1/4 inch.
 - 3. Surface: Gap below 10-foot- long, unleveled straightedge not to exceed 1/4 inch.
 - 4. Lateral Alignment and Spacing of Tie Bars and Dowels: 1 inch.
 - 5. Vertical Alignment of Tie Bars and Dowels: 1/4 inch.
 - 6. Alignment of Tie-Bar End Relative to Line Perpendicular to Pavement Edge: 1/2 inch.
 - 7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Pavement Edge: Length of dowel 1/4 inch per 12 inches.
 - 8. Joint Spacing: 3 inches.
 - 9. Contraction Joint Depth: Plus 1/4 inch, no minus.
 - 10. Joint Width: Plus 1/8 inch, no minus.

3.10 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
 - 1. Testing Frequency: Obtain at least 1 composite sample for each 100 cu. yd. or fraction thereof of each concrete mix placed each day.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mix. Perform additional tests when concrete consistency appears to change.
 3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
 4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
 5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
 6. Compressive-Strength Tests: ASTM C 39/C 39M; test 1 specimen at 7 days and 2 specimens at 28 days.
 - a. A compressive-strength test shall be the average compressive strength from 2 specimens obtained from same composite sample and tested at 28 days.
- C. Strength of each concrete mix will be satisfactory if average of any 3 consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
- D. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
- F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
- G. Remove and replace concrete pavement where test results indicate that it does not comply with specified requirements.
- H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.11 REPAIRS AND PROTECTION

- A. Remove and replace concrete pavement that is broken, damaged, or defective or that does not comply with requirements in this Section.
- B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with portland cement concrete bonded to pavement with epoxy adhesive.
- C. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.

- D. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313

SECTION 321373

CONCRETE PAVING JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Cold-applied joint sealants.

- B. Related Sections:

- 1. Division 07 Section "Joint Sealants" for sealing nontraffic and traffic joints in locations not specified in this Section.
 - 2. Division 32 Section "Asphalt Paving" for constructing joints between concrete and asphalt pavement.
 - 3. Division 32 Section "Concrete Paving" for constructing joints in concrete pavement.

1.3 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. 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.
- C. Pavement-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.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Product Certificates: For each type of joint sealant and accessory, from manufacturer.

- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for joint sealants.
- 1.5 QUALITY ASSURANCE
- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
 - B. Source Limitations: Obtain each type of joint sealant from single source from single manufacturer.
- 1.6 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 or are below 40 deg F (5 deg C).
 - 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.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Compatibility: Provide joint sealants, backing materials, 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. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range, to match adjacent colored concrete.

2.2 COLD-APPLIED JOINT SEALANTS

- A. Single-Component, Nonsag, Silicone Joint Sealant for Concrete: ASTM D 5893, Type NS.
- B. Multicomponent, Pourable, Traffic-Grade, Urethane Joint Sealant for Concrete: ASTM C 920, Type M, Grade P, Class 25, for Use T.

2.3 JOINT-SEALANT BACKER MATERIALS

- A. General: Provide joint-sealant backer materials that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint-sealant manufacturer based on field experience and laboratory testing.

- B. Round Backer Rods for Cold-Applied Joint Sealants: ASTM D 5249, Type 3, of diameter and density required to control joint-sealant depth and prevent bottom-side adhesion of sealant.

PART 3 - EXECUTION

3.1 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.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.

3.3 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. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install joint-sealant backings of kind indicated to support joint 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 joint-sealant backings.
 - 2. Do not stretch, twist, puncture, or tear joint-sealant backings.
 - 3. Remove absorbent joint-sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install joint sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place joint 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.
- E. Tooling of Nonsag Joint Sealants: Immediately after joint-sealant application and before skinning or curing begins, tool sealants according to the following requirements 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 joint sealant from surfaces adjacent to joints.

2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.
- F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.

3.4 CLEANING

- A. Clean off excess joint 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.

3.5 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 and replace with joint sealant so installations in repaired areas are indistinguishable from the original work.

3.6 PAVEMENT-JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Joints within cement concrete pavement.
1. Joint Location:
 - a. Expansion and isolation joints in cast-in-place concrete pavement.
 - b. Contraction joints in cast-in-place concrete slabs.
 - c. Other joints as indicated.
 2. Urethane Joint Sealant for Concrete:
 - a. BASF Sonolastic SL2 joint sealant.
 - b. Tremco Tremflex SL
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range, to match adjacent colored concrete.

END OF SECTION 321373

**SECTION 323113
CHAIN LINK FENCES AND GATES**

PART 1 - GENERAL

1.1 SUMMARY

- A. Related Documents:
 - 1. Drawings and general provisions of the Subcontract apply to this Section.
 - 2. Review these documents for coordination with additional requirements and information that apply to work under this Section.
- B. Section Includes:
 - 1. Fence framework, fabric, and accessories.
 - 2. Excavation for posts.
 - 3. Concrete encasement for posts.
 - 4. Manual gates and related hardware.
- C. Related Sections:
 - 1. Division 01 Section "General Requirements."
 - 2. Division 01 Section "Special Procedures."

1.2 REFERENCES

- A. General:
 - 1. The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.
 - 2. Unless otherwise noted, the referenced standard edition is the current one at the time of commencement of the Work.
 - 3. Refer to Division 01 Section "General Requirements" for the list of applicable regulatory requirements.
Federal Specifications (FS)
- B. FS RR-F-191/1C Fencing, Wire and Post Metal (Chain-Link Fence Fabric)
- C. State of California - California Department of Transportation (CALTRANS):
 - 1. Standard Specifications: Chapter 80-4 excluding Section 80-4.04
- D. American Society for Testing and Materials (ASTM)
 - 1. ASTM A123 / A123M Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - 2. ASTM C94 / C94M Standard Specification for Ready-Mixed Concrete
 - 3. ASTM D 412 Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension
 - 4. ASTM D 792 Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
 - 5. ASTM D 1499 Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Plastics
 - 6. ASTM D 2240 Test Method for Rubber Property—Durometer Hardness

7. ASTM F 668 Standard Specification for Polyvinyl Chloride (PVC) and Other Organic Polymer-Coated Steel Chain-Link Fence Fabric

1.3 SUBMITTALS

- A. Submit under provisions of Division 01 Section "General Requirements."
- B. Submit shop drawings and product data.
 - 1. Include accessories, fittings, hardware, anchorages, and schedule of components.
- C. Manufacturer's installation instructions.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Vinyl Fencing: Materials for vinyl-coated chain link fence shall be as specified herein. Material shall be of the same color of vinyl coating. Painted finishes are not acceptable. The color for this job is the manufacturer's standard black .
- B. Posts and Braces: Section 80-4.01A of CALTRANS
- C. Fabric: Section 80-4.01B of CALTRANS
- D. Accessories: Section 80-4.01C of CALTRANS
- E. Gates: Section 80-4.01D of CALTRANS

2.2 CONCRETE MIX

- A. Concrete: ASTM C 94; type II Portland Cement; 2500 psi at 28 days; 3-inch (75 mm) slump; 3/4-inch (20 mm) maximum size aggregate.

2.3 COMPONENTS

- A. Line Posts: 2.375-inch (59 mm) outside diameter, Schedule 40 galvanized steel pipe or galvanized "H" columns weighing not less than 2.7 lb./ft (13.18 kg/m²).
- B. Corner and Terminal Posts: 2.875-inch (73 mm) outside diameter, Schedule 40 galvanized steel pipe.
- C. Gate Posts: 3.500-inch (89 mm) diameter for man gates and 6.625-inch (168 mm) diameter for vehicular gates; gateposts to be galvanized steel pipe.
- D. Top, Bottom and Brace Rail: 1.660-inch (42.16 mm) outside diameter, plain end, sleeve coupled galvanized steel pipe.

- E. Gate Frame: 1.9-inch (48.26 mm) outside diameter Schedule 40 galvanized steel pipe for fittings and truss rod fabrication.
- F. Chain link fence coated steel fabric: Galvanized steel wire with a continuously bonded vinyl coating, with a finish size (i.e., size after coating) of 8 gauge, and shall comply with ASTM F 668 with knuckled, selvage edges on the bottom and top. Mesh shall be vertically-woven diamond mesh, with a nominal distance of 1 inches (50 mm) between parallel wires.
- G. Tension Bars: 3/16 inches by 3/4-inch (4.76 mm by 20 mm) galvanized steel flat bars.
- H. Caps: Cast steel or malleable iron, galvanized, sized to post dimension, set-screw retained.
- I. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings shall be galvanized steel.
- J. Extension Arms: Cast steel, to accommodate 3 strands of barbed wire, single arm, 12-inches (305 mm) high (measured vertically) above the top edge of the fence fabric, sloped to 45 degrees.
- K. Gate Hardware: Fork type latch with gravity drop; center gate stop and drop rod; three 180 degree gate hinges per leaf.

2.4 FINISHES

- A. Galvanized Surfaces: Galvanize surfaces in accordance with ASTM A 123, with a coating of at least 1.20 oz/sq. ft. Paint any galvanized surfaces black with polyurethane coatings per Section 098000.
- B. Accessories and Components: Same finish as fabric.

2.5 VINYL COATING

- A. The vinyl coating shall conform to FS RR-F-191/1C.
- B. Colors shall be stabilized, and shall have a light fastness to withstand a minimum Weather-O-Meter exposure of at least 1500 hours without deterioration when tested in accordance with ASTM D 1499. Color shall be BLACK.
- C. Specific gravity shall be between 1.26 and 1.30 in accordance with ASTM D 792.
- D. Hardness shall be A90 +/-5 in accordance with ASTM D 2240.
- E. Tensile strength shall be between 2600 and 3000 psi (17.94 MPa and 20.7 MPa) in accordance with ASTM D 412.
- F. Vinyl coating shall be exposure-resistant to dilute solutions of most common mineral acids, sea water, salts, and alkali.
- G. Vinyl coating shall be continuously bonded to the wire under 5000 psi (34.5 MPa) pressure before the wire is woven into fabric.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install framework, fabric, accessories, and gates in accordance with section 80-4.02 of CALTRANS.
- B. Install security fence of 7-foot (2.45 m) fabric height with 1-foot (0.9 m) barbed extension on support arms as shown on Drawings.
- C. Space line posts at intervals not exceeding 10 feet (3 m).
- D. Set gate and posts plumb, in concrete footings with top of footing 1 inch (25 mm) above finish grade. Slope top of concrete for water runoff. Footings for line end and corner posts are to be 8 inches (203) diameter by 3 feet (0.9 m) deep below finish grade and for gates are to be 12 inches (305 mm) diameter by 3 feet 6 inches (1 m) deep below finish grade.
- E. Provide top rail through line-post tops and splice with 7-inch (178 mm) long rail sleeves.
- F. Brace each gate and corner post back to adjacent line post with horizontal center brace rail and diagonal truss rods. Install brace rail, one bay from end and gate posts.
- G. Install center and bottom brace rail on corner and gate leaves.
- H. Stretch fabric between terminal posts or at intervals of 100 feet (30.5 m) maximum, whichever is less.
- I. Position bottom of fabric to no more than 2 inches (50 mm) above concrete or asphalt grade and touching dirt finish grade.
- J. Fasten fabric to top rail, line posts, braces, and bottom tension wire with 11-AWG galvanized wire ties 24 inches (610 mm) maximum on centers.
- K. Attach fabric to end, corner, and gateposts with tension bars and tension bar clips.
- L. Install bottom rail supported at each line and terminal post in such a manner that a continuous brace between posts is formed.

3.2 GROUNDING

- A. 40 feet (13 m) on either side of overhead high voltage electrical transmission lines the fence is to be grounded as shown on the Drawings.

3.3 CONSTRUCTION WASTE MANAGEMENT

- A. Conform with Division 01 Section "Construction Waste Management."

- B. Before concrete pours, designate locations or uses for excess concrete and a location for clean out water from concrete trucks. Designated locations shall meet environmental standards and conform with Section 7-1.01 of CALTRANS.

END OF SECTION 323113

SECTION 331520

FIRE HYDRANTS

PART 1 - GENERAL

1.1 REQUIREMENTS

A. The CONTRACTOR shall provide fire hydrants, complete and operable, including all appurtenances and accessories, as shown on the Plans and in accordance with the Contract Documents.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section 03 300 – Cast-in-Place Concrete

Section 09 800 – Protective Coatings

Section 15 000 – Piping, General

Section 15 200 – Valves, General

PART 2 - PRODUCTS

2.1 WET-BARREL FIRE HYDRANTS

A. Unless shown otherwise, all fire hydrants shall be of the wet-barrel type, in accordance with ANSI/AWWA C503.

B. Where a hydrant is installed it shall have the number, size and type of pumper connections required by the City of Seaside Fire Department. The hydrant head shall have a minimum of one 4-inch pumper connection and one 2-1/2-inch hose connection. Operating nuts and caps shall be 1-1/8 inch pentagonal nuts measured "point to flat". Caps shall be bronze and shall be attached to hydrant with chains. Cap shall have 1/8-inch diameter weep hole drilled through its center adjacent to operating nut. The hydrant inlet shall be 6-inch in diameter. Hydrant shall be isolated by a buried gate valve. Hydrant bury shall be 6-inch diameter cast iron or ductile iron conforming to the requirements of AWWA C502 with a break-away flanged spool connected to the hydrant head. Breakaway spool shall be a 6-inch x 6-inch, 125-pound class, cast iron, 6 bolt-breakaway spool with breakaway (hallow) bolts on top flange. All bolts, nuts, and washers shall be of Type 316 stainless steel with standard HEX head and machined per ASTM A325.

C. The hydrants shall be tested to 300 psig and they shall be suitable for a working pressure of 150 psig. All interior and exterior surfaces shall be coated in accordance with AWWA C550 and Section 09800 - Protective Coatings. Color of finish coat shall be approved by the OWNER. Prior to final inspection of the water system improvements, the CONTRACTOR shall conduct fire flow tests at all new hydrants in accordance with section 7.02, Final Inspection.

D. Unless otherwise specified, hydrant bury shall be 6-inch diameter, 6-hole wet barrel fire hydrant bury with mechanical joint

E. Fire Hydrant Manufacturers, or Equal:

MANUFACTURER	MULTI-FAMILY RESIDENCE, COMMERCIAL & INDUSTRIAL	
	Size	Model
Jones	6"x4"x2 1/2"x2 1/2"	J-3765R
Clow	6"x4"x2 1/2"x2 1/2"	2060

F. Bury Manufacturers, or Equal:

Clow Valve Company
US Pipe and Foundry
Star
Sigma/Napco

PART 3 - EXECUTION

3.1 INSTALLATION

A. All fire hydrants shall be installed in strict accordance with the manufacturer's published recommendations, applicable sections of AWWA Standard C600, AWWA Manual M17, and City of Seaside standards. Hydrants shall be installed plumb and shall be installed before the construction of curb and gutter, and sidewalk where possible. All installations shall be to the satisfaction of the OWNER and the City of Seaside Fire Department.

B. Hydrants located on roads where no sidewalk exists or where sidewalk and curb are separated by a parkway, shall be located 18 inches from the back of the curb. Hydrants located on roads with sidewalk at the back of curb shall be located per the City of Seaside Department of Public Works requirements and shall comply with the requirements of the Americans with Disabilities Act. Hydrants located where no curb exists shall be located a minimum of 36 inches from the edge of pavement and shall be protected by guard posts.

C. A minimum of 18 inches and a maximum of 24 inches clearance shall be maintained between finished ground and the lowest operating nut on the hydrant. The center of the breakaway spool shall be at grade with the top of curb unless the hydrant is set in concrete in which case the spool shall be completely exposed. Breakaway bolts shall be installed with tips pointing down. Bolt threads shall be coated with an approved anti-seize compound. Hydrant isolation valve shall be connected to the hydrant piping by means of a retainer gland. Hydrant shall be installed with a concrete thrust block, calculated for the maximum expected water pressure.

END OF SECTION

SECTION 332565

DUCTILE IRON PIPE (AWWA C151, MODIFIED)

PART 1 - GENERAL

1.1 REQUIREMENTS

A. The CONTRACTOR shall provide ductile iron pipe with polyethylene encasement and all appurtenant work, complete in place, in accordance with the Contract Documents.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section 02140 – Dewatering
Section 02200 – Earthwork & Trenching
Section 02643 – Waterline Disinfection & Testing
Section 02776 – Pavement Replacement
Section 15000 – Piping, General
Section 15042 – Service Connections
Section 15052 – Connections to Existing Waterlines
Section 15119 – Tapping Sleeves
Section 15200 – Valves, General

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards:

ANSI/AWWA C104/A21.4	Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
ANSI/AWWA C105/A21.5	Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids
ANSI/AWWA C110/A21.10	Ductile-Iron and Gray-Iron Fittings, 3 in Through 48 in for Water and Other Liquids
ANSI/AWWA C111/A21.11	Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings
ANSI/AWWA C115/A21.15	Flanged Ductile-Iron and Gray-Iron Pipe with Threaded Flanges
ANSI/AWWA C150/A21.50	Thickness Design of Ductile-Iron Pipe
ANSI/AWWA C151/A21.51	Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids
ANSI/AWWA C153/A21.53	Ductile-Iron Compact Fittings, 3 in. Through 12 in. for Water and Other Liquids
AWWA C209	Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines

AWWA C214

Tape Coating Systems for the Exterior of Steel Water Pipelines

AWWA C600

Installation of Ductile Iron Water Mains and Their Appurtenances

ASTM C 150

Specification for Portland Cement

1.4 CONTRACTOR SUBMITTALS

A. **Shop Drawings:** The CONTRACTOR shall submit shop drawings of pipe in accordance with the requirements in Section 01300 - Contractor Submittals, the requirements of the referenced standards and the following supplemental requirements as applicable:

1. For pipe 24 inches in diameter and larger, line layout and marking diagrams which indicate the specific number of each fitting and the location and the direction of each fitting in the completed line. In addition, the line layouts shall include: the pipe station and invert elevation at all changes in grade or horizontal alignment; all elements of curves and bends, both in horizontal and vertical alignment; and the limits of each reach of restrained joints, or of concrete encasement.

1.5 QUALITY ASSURANCE

A. **Tests:** Except as modified herein, all materials used in the manufacture of the pipe shall be tested in accordance with the requirements of the referenced standards as applicable. The CONTRACTOR shall perform said material tests at no additional cost to the OWNER.

PART 2 - PRODUCTS

2.1 GENERAL

A. Mortar-lined and polyethylene-wrapped ductile iron pipe shall conform to ANSI/AWWA C151, C104, and C105, subject to the following supplemental requirements. The pipe shall be of the diameter and class shown, shall be furnished complete with rubber restraining gaskets as indicated in the Contract Documents, and all specials and fittings shall be provided as required under the Contract Documents.

B. **Markings:** The CONTRACTOR shall legibly mark specials 24 inches in diameter and larger in accordance with the laying schedule and marking diagram. All fittings shall be marked at each end with top field centerline.

C. **Handling and Storage:** The pipe shall be handled by devices acceptable to the OWNER, designed and constructed to prevent damage to the pipe coating/exterior. The use of equipment which might injure the pipe coating/exterior will not be permitted. Stockpiled pipe shall be suitably supported and shall be secured to prevent accidental rolling. All other pipe handling equipment and methods shall be acceptable to the OWNER.

D. **Laying Lengths:** Maximum pipe laying lengths shall be 20 ft with shorter lengths provided as required by the Drawings.

E. **Finish:** The pipe shall have smooth dense interior surfaces and shall be free from fractures, excessive interior surface crazing and roughness.

F. **Bonding and Electrical Conductivity:** All pipe joints shall be prepared for bonding for

electrical conductivity in accordance with the details shown. The CONTRACTOR shall furnish all materials required for joint bonding and electrolysis test station installations.

G. **Closures and Correction Pieces:** Closures and correction pieces shall be provided as required so that closures may be made due to different headings in the pipe laying operation and so that correction may be made to adjust the pipe laying to conform to pipe stationing shown on the Drawings. The locations of correction pieces and closure assemblies are shown on the Drawings. Any change in location or number of said items shall be acceptable to the OWNER.

2.2 PIPE DESIGN CRITERIA

A. **General:** Ductile iron pipe shall be designed in accordance with the requirements of ANSI/AWWA C150 as applicable and as modified in this Section. As a minimum, ductile iron pipe shall be designed for a working pressure of 350 psi with an additional surge allowance of 100 psi. In addition to the requirements of this Section, the minimum wall thickness shall be in accordance with Table 50.5 of ANSI/AWWA C150.

B. **Pipe Wall Thickness for External Load:** The pipe shall also be designed with a net thickness to withstand external loads using ANSI/AWWA C150 Design Equation (2) with the appropriate bending moment and deflection coefficients for Laying Condition Types 4 and 5 as applicable. The pipe deflection shall be checked using ANSI/AWWA C150 Design Equation (3) and the coefficients stated above. The allowable deflection shall not exceed 0.0225 times the nominal diameter. In lieu of ANSI/AWWA C150 Design Equation (4), the earth loads will be computed using the following 2 equations for trench or embankment loading as applicable:

1. Trench Condition:

$$W_d = C_d w B_d^2$$

Where:

W_d	=	Earth Load in pounds per linear foot
C_d	=	Calculation Coefficient
K_u'	=	[0.13]
w	=	[120] lb/ft ³
B_d	=	Trench width at top of pipe, feet

2. Positive Projecting Embankment Condition:

$$W_c = C_c w B_c^2$$

Where:

W_c	=	Earth Load in pounds per linear foot
C_c	=	Calculation Coefficient (based on $r_{sd}P$ of 0.25)
K_u	=	[0.19]
w	=	[120] lb/ft ³
B_c	=	Outside diameter of pipe, feet

C. The above 2 formulas are based on a depth of cover of 10 feet or greater. For depths of cover of less than 10 feet, HS-20 live load shall be included. For depths of cover of 3 feet or less, HS-20 live load plus impact shall be included. The determination of live load and impact factors shall be as recommended by AASHTO in "Standard Specifications for Highway Bridges."

D. If the calculated deflection, $Defl_x$, exceeds 0.0225 times the nominal diameter, the pipe class shall be increased.

2.3 MATERIALS

- A. **Ductile Iron Pipe:** Pipe materials shall conform to the requirements of ANSI/AWWA C151. Pipe shall be **restrained joint TR-Flex** pipe as manufactured by U.S. Pipe Co.
- B. **Cement:** Cement for mortar lining shall conform to the requirements of ANSI/AWWA C104; provided, that cement for mortar lining shall be Type II or V. Cement shall not originate from kilns which burn metal-rich hazardous waste fuel, nor shall a fly ash or pozzolan be used as a cement replacement.
- C. **Polyethylene Encasement:** Material for the polyethylene encasement shall conform to the requirements of ANSI/AWWA C105 with a minimum thickness of 20 mils.

2.4 SPECIALS AND FITTINGS

- A. Fittings for ductile iron pipe shall conform to the requirements of ANSI/AWWA C153/A21.53 or ANSI/AWWA C110/A21.10 for diameters 3-inch through 48-inch and shall have a minimum pressure rating of 250 psi. Ductile iron fittings larger than 48-inch shall conform to the above referenced standard with the necessary modifications for the larger size.

2.5 PIPE

- A. **General:** The pipe furnished shall be ductile iron pipe, mortar-lined and polyethylene-wrapped, with rubber-gasket joints as shown. The pipe shall be designed, manufactured, tested, inspected, and marked according to applicable requirements previously stated and except as hereinafter modified, shall conform to ANSI/AWWA C151. The diameter and minimum wall thickness for each pipe size shall be as specified or shown.
- B. **Fitting Dimensions:** The fittings shall be of the diameter and class shown.
1. Special ductile iron flanges to match up to 250 psi valve and equipment flanges shall meet ANSI/AWWA C110 and be specially drilled to ANSI/ASME B16.1 class 250 standard dimensions with raised face.
- C. **Joint Design:** Ductile iron pipe and fittings shall be furnished with restrained push-on joints, flanged joints, or restrained joints as required.
1. Push-on joints shall not be allowed; see Restrained Joints below.
 2. Flanged joints shall conform to ANSI/AWWA C115/A21.15.
 3. Restrained joints shall be ["Flex-Ring"] ["Lok-Ring"] ["Fast-Grip"] Restrained Joint by American Ductile Iron Pipe, **"TR FLEX" Restrained Joint by U.S. Pipe**, or equal.
- D. For bell-and-spigot ends with rubber gaskets, the clearance between the bells and spigots shall be such that when combined with the gasket groove configuration and the gasket itself, will provide watertight joints under all operating conditions when properly installed. The CONTRACTOR shall require the pipe manufacturer to submit details complete with significant dimensions and tolerances and also to submit performance data indicating that the proposed joint has performed satisfactorily under similar conditions. In the absence of a history of field performance, the results of a test program shall be submitted.
- E. Shop-applied interior linings and exterior coatings shall be held back from the ends of the pipe as shown or as otherwise acceptable to the OWNER.

2.6 CEMENT-MORTAR LINING

A. **Cement-Mortar Lining for Shop Application:** Except as otherwise provided herein, interior surfaces of all ductile iron pipe, fittings, and specials shall be cleaned and lined in the shop with cement-mortar lining applied centrifugally in conformity with ANSI/AWWA C104. During the lining operation and thereafter, the pipe shall be maintained in a round condition by suitable bracing or strutting. The lining machines shall be of a type that has been used successfully for similar work. Every precaution shall be taken to prevent damage to the lining. If lining is damaged or found faulty at delivery site, the damaged or unsatisfactory portions shall be replaced with lining conforming to these Specifications. All shop-applied cement mortar lining shall be given a seal coat of asphaltic material in conformance with ANSI/AWWA C104.

B. The minimum lining thickness shall be as follows:

<u>Nominal Pipe Diameter (in)</u>	<u>Minimum Lining Thickness (in)</u>
3-12	1/8
14-24	3/16
30-54	1/4

2.7 EXTERIOR COATING OF PIPE

A. **Exterior Coating of Exposed Piping:** The exterior surfaces of pipe which will be exposed to the atmosphere inside structures or above ground shall be thoroughly cleaned and then given a shop coat of rust-inhibitive primer.

B. **Exterior Coating of Buried Piping:** The exterior coating shall be an asphaltic coating approximately 3 mils thick.

PART 3 - EXECUTION

3.1 GENERAL

A. Installation shall conform to the requirements of AWWA M23, instructions furnished by the pipe manufacturer, and to the supplementary requirements herein. Wherever the provisions of this Section and the aforementioned requirements are in conflict, the more stringent provision shall apply.

B. Laying, jointing, testing for defects and for leakage shall be performed in the presence of the OWNER, and shall be subject to approval before acceptance. Material found to have defects will be rejected and the CONTRACTOR shall promptly remove such defective materials from the Site.

C. The CONTRACTOR shall determine the location of existing underground utility structures in the vicinity of proposed pipe installation prior to excavation. All existing above and below ground structures within the work area shall be protected in place unless indicated otherwise on the Construction Drawings.

D. Whenever the WORK is not actively in progress, the open ends of all installed pipe shall be plugged or capped with bulkhead mechanical joint end cap to prevent the entry of animals, water, or other undesirable substances.

3.2 HANDLING AND STORAGE

A. **Handling and Storage:** All pipe, fittings, etc., shall be carefully handled and protected against damage, impact shocks, and free fall. All pipe handling equipment shall be acceptable to the OWNER. Pipe shall not be placed directly on rough ground but shall be supported in a manner which will protect the pipe against injury whenever stored at the trench site or elsewhere. No pipe shall be installed where the lining or coating show defects that may be harmful as determined by the OWNER. Such damaged lining or coating shall be repaired, or a new undamaged pipe shall be furnished and installed.

B. The CONTRACTOR shall inspect each pipe and fitting prior to installation to insure that there are no damaged portions of the pipe. All pipe damaged prior to Substantial Completion shall be repaired or replaced by the CONTRACTOR.

3.2 INSTALLATION OF PIPE

A. **Pipe Laying:** The pipe shall be installed in accordance with ANSI/AWWA C600. Bell-and-spigot pipe shall be laid with the bell end pointing in the direction work is progressing. Pipe shall be graded in straight lines, taking care to avoid the formation of any dips or low points. Where necessary to raise or lower the pipe due to unforeseen obstructions or other causes, the OWNER may change the alignment and/or the grades. Such change shall be made by the deflection of joints, by the use of bevel adapters, or by the use of additional fittings. No joint shall be misfit any amount which will be detrimental to the strength and water tightness of the finished joint. Pipe shall not be laid when the conditions of trench or weather are unsuitable. Pipe shall be laid uphill on grades 10% or greater. Pipe which is laid on a downhill grade shall be blocked and held in place until sufficient support is furnished by the following pipe to prevent movement.

B. Each section of pipe 24 inches in diameter and larger shall be laid in the order and position shown on the laying schedule. Pipe shall be laid to the set line and grade, within approximately one inch plus or minus.

C. Pipe shall be supported at its proper elevation and grade, care being taken to secure firm and uniform support. Wood support blocking will not be permitted. Excavations shall be made as needed to facilitate removal of handling devices after the pipe is laid. The full length of each section of pipe and fittings shall rest solidly on the pipe bed, with recessed excavation to accommodate bells, joints, and couplings. Anchors and supports shall be provided where indicated and where necessary for fastening work into place. Fittings shall be independently supported.

D. Short lengths of pipe shall be used in and out of each rigid joint or rigid structure. Piping that does not allow sufficient space for proper installation of jointing material shall be replaced by one of proper dimensions. Blocking or wedging between bells and spigots will not be permitted. Pipe alignment shall be checked after each length of pipe is installed to insure the downstream pipe did not deflect. Pipe shall not deflect at the joints more than 75% of manufacturer's printed recommendations. Trench shall not be backfilled prior to pipeline inspection by the OWNER. Any pipeline buried prior to inspection shall be uncovered by the CONTRACTOR, at his own expense, for the OWNER to inspect.

E. Joints shall be installed according to manufacturer's recommendations. The surfaces of the pipe spigot end, bell and gasket shall be cleaned just prior to joining pipes. The spigot end of the pipe shall be beveled and checked for proper fit in the bell end without causing damage to the gasket. A lubricant, approved by the pipe manufacturer, shall be applied to the spigot end prior to joining pipes. The spigot shall penetrate bell completely as indicated by penetration line. Trenches shall be kept free of water until joints have been properly made. The maximum combined deflection at any coupling shall be in accordance with the manufacturer's recommendations.

F. Pipe shall be cut by means of saws, power driven abrasive wheels, or pipe cutters, which will produce a square cut. No wedge-type roller cutters will be permitted. After cutting, the end of

the pipe shall be beveled using a beveling tool, portable type sander, or abrasive disc. The pipe shall be remarked with a penetration line at the required penetration depth.

G. **Work Stoppage:** At the end of each working day, CONTRACTOR shall plug or cap the open ends of all unfinished pipelines with securely bolted mechanical joint plugs, mechanical joint end caps, or blind flanges. If Pipe is subject to flooding, pipe shall be anchored as precaution against flotation. Trenches shall be backfilled in accordance with the Specifications and Geotechnical report recommendations.

H. **Cold Weather Protection:** No pipe shall be installed upon a foundation into which frost has penetrated or at any time that there is a danger of the formation of ice or penetration of frost at the bottom of the excavation. No pipe shall be laid unless it can be established that the trench will be backfilled before the formation of ice and frost occurs.

I. **Pipe Cleanup:** As pipe laying progresses, the CONTRACTOR shall keep the pipe interior free of all debris. The CONTRACTOR shall completely clean the interior of the pipe of all sand, dirt, mortar splatter and any other debris following completion of pipe laying, pointing of joints and any necessary interior repairs prior to testing and disinfecting the completed pipeline.

3.3 RUBBER GASKETED JOINTS

A. Immediately before jointing pipe, the bell end of the pipe shall be thoroughly cleaned, and a clean rubber gasket lubricated with an approved vegetable-based lubricant shall be placed in the bell groove. The spigot end of the pipe shall be carefully cleaned and lubricated with a vegetable-based lubricant. The spigot end of the pipe section shall then be inserted into the bell of the previously laid joint and telescoped into its proper position. Tilting of the pipe to insert the spigot into the bell will not be permitted. Note: Only restrained joint gaskets are permitted.

3.4 POLYETHYLENE ENCASEMENT UNBONDED COATING

A. Buried ductile iron pipe shall be polyethylene encased in accordance with the requirements of ANSI/AWWA C105/A21.5.

3.5 INSTALLATION OF PIPE APPURTENANCES

A. **Protection of Appurtenances:** Where the joining pipe is tape-coated, buried appurtenances shall be coated with cold-applied tape in accordance with ANSI/AWWA C209, Type II. Where pipe is encased in polyethylene sleeves, buried appurtenances shall also be encased in polyethylene.

B. **Installation of Valves:** All valves shall be handled in a manner to prevent any injury or damage to any part of the valve. All joints shall be thoroughly cleaned and prepared prior to installation. The CONTRACTOR shall adjust all stem packing and operate each valve prior to installation to insure proper operation. All valves shall be installed so that the valve stems are plumb and in the location shown.

END OF SECTION 332565

SECTION 333416

CHEMICAL STORAGE TANKS

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section describes the installation of single wall chemical storage tanks containing 12.5% sodium hypochlorite or 29% Orthophosphate (Carus 4500) solutions to be located indoors. CONTRACTOR shall provide completely installed, tested and operating tanks as shown on the Drawings and as specified herein, including receiving and off-loading the tanks at the project sites.
- B. Related Sections:
 - 1. Section 010400: Coordination and Project Requirements
 - 2. Section 055000: Miscellaneous Metalwork
 - 3. Section 098000: Protective Coatings
 - 4. Section 104000: Identifying Devices
 - 5. Section 150000: Piping, General

1.02 REFERENCES

- A. ANSI Standards: B-16.5, Pipe Flanges and Flanged Fittings
- B. OSHA Standards: 29 CFR 1910.106, Occupational Safety and Health Administration, Flammable and Combustible Liquids
- C. UBC Code: Uniform Building Code, 1997 Edition

1.03 SUBMITTALS

- A. Shop Drawings: Submit the following as a single complete initial submittal in accordance with Section 013300. Sufficient data shall be included to show that the product conforms to Specification requirements.
 - 1. Anchorage and lateral restraint details and calculations prepared by and stamped by a structural engineer, registered in the State of California.
 - 2. Shop drawings showing the locations and types of all tank nozzles, including both integrally molded and post-fabricated nozzles.
 - 3. Provide documentation from the manufacturer stating that the tank system materials are suitable for continuous use for the chemicals specified.
- B. Submit results of field testing.
- C. Affidavits: Furnish affidavits from the manufacturer stating that the tanks have been installed to the manufacturer's requirements and are ready for full-time storage of the specified chemicals.
- D. Submit chain-of-custody certification.

1.04 QUALITY ASSURANCE

- A. Comply with the following Regulatory Standards:
 - 1. Uniform Fire Code, Article 80, Hazardous Materials, with local amendments, if any.
 - 2. Uniform Building Code, Chapter 3, with local amendments, if any.

PART 2 - PRODUCTS

2.01 POLYETHYLENE STORAGE TANKS

- A. Storage tanks shall be manufactured by Poly Processing Co. of French Camp, CA or other Poly Processing facilities. No substitutions are allowed.

2.02 SEISMIC RESTRAINT

- A. Seismic restraint system will be supplied with the chemical storage tanks. Contractor shall design anchorage for the seismic restraint systems. Anchorage designs shall be certified by a Structural Engineer registered in the State of California. Design shall conform to the UBC for Zone 4 requirements. Use a seismic Importance Factor I_p of 1.5. Refer to Section 01040. All anchor bolts and hardware for the seismic restraint system shall be 316 stainless steel. Seismic anchor shoes shall be powder coated steel as recommended by the manufacturer.

2.03 FITTINGS

- A. Install fittings on tanks as shown on the PLANS. Orientation and type of fittings are shown on the drawings.

2.04 CHEMICAL STORAGE TANK SCHEDULE:

Tank	TNK-100	TNK-200	TNK-300	TNK-400
Location	Room 101	Room 101	Room 102	Room 102
Service	Sodium Hypochlorite	Sodium Hypochlorite	Orthophosphate	Orthophosphate
Type	XLPE	XLPE	XLPE	XLPE
Interior lining	OR-1000	OR-1000	none	none
Volume (gals)	6,150	400	2,000	200
Diameter	10'-2"	45"	7'-1"	31"
Height	12'-6"	62"	8'-6"	72
Accessories	IMFO base, FRP ladder		IMFO base pad, FRP ladder	
Nozzles	See Plans	See Plans	See Plans	See Plans

PART 3 - EXECUTION

3.01 STORAGE AND HANDLING

- A. Upon arrival at the destination, inspect for damage in transit. If damage has occurred, the manufacturer shall be notified prior to tank installation.

3.02 INSTALLATION

- A. Install tanks in strict accordance with the manufacturer's instructions and with favorably reviewed shop drawings.

3.03 IDENTIFICATION

- A. Identification signage of the health, flammability, and reactivity of hazardous materials is required for each tank. See Specification Section 10401.

3.04 FIELD TESTING

- A. Notification: Provide the Owner two (2) working days notice prior to field tests so that the Owner may elect to witness the testing.
- B. Field Testing: Provide a 48-hour static leak test for each tank. The tanks shall be leak tested with water to the overfill level. A passing test result shall be no leakage from the tank. If a leak is detected, the tank shall be repaired or replaced in a manner satisfactory to the Owner. Such repairs shall be performed only by the tank manufacturer, at no additional cost to the Owner. After repairs, retest the tank until a passing result is achieved. Demonstrate that all tank accessories are working properly.

3.05 CLEANING

- A. After satisfactory completion of field testing, drain the testing water. Rinse the inside of the tanks with clean, potable water. Hand wipe and dry as required to leave the tank interior clean, dry and ready for storage of the chemical. Clean the tank exterior and accessories and leave in good condition.

END OF SECTION 333416

SECTION 335150

METERS - PROPELLER TYPE

PART 1 - GENERAL

A. Description

This section describes the materials, installation, and testing requirements of flow meter assemblies. CONTRACTOR shall provide (1) vertical flow propeller meter (FQI-950).

B. Related Work Specified Elsewhere

1. Painting and Coating: 09900
2. Chlorination of Water Mains for Disinfection: 150410
3. Hydrostatic Testing of Pressure Pipelines: 150420
4. Electrical: 16000

C. Submittals

Shop drawings shall be submitted for the following:

1. Meter
2. External Painting System

PART 2 – MATERIALS

1. General

All propeller meters shall be new and of current design. All parts of the meter including the transmitter shall be of the same manufacturer. Propeller meters shall meet all of the requirements of these specifications and the standards of AWWA C704.

2. Register

- a. Reading Dials: Register shall have 4" diameter dial with a six digit straight reading type totalizer and 5 digit rate display.
- b. Registration Units: Register shall be calibrated to read in GPM units.
- c. Totalizer Display: Totalizer shall be six digit straight reading type totalizer and shall measure volume in gallon units.
- d. Gears: Register gears for propeller meters shall be bronze.
- e. Drives: Registers shall be driven by magnetic coupling or directly shaft driven.
- f. Lenses: All register lenses shall be tempered glass.

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METERS – PROPELLER TYPE

g. Serial Number: The serial number of each meter shall be imprinted on the register cover.

3. Miscellaneous Hardware

All bolts, nuts, cap screws, studs, and washers shall be Type 316 stainless steel.

4. Meter Tube

Meter tube shall have flat face flanged ends meeting the requirements of AWWA Class 125/ ANSI B16.
Meter tube shall have straightening vanes.

5. Protective Coatings

Propeller meters and strainers shall be internally epoxy coated per Section 09900. Propeller meters shall be externally painted per Section 09900.

6. Certification

The manufacturer shall furnish certified test results for each meter showing that it has been tested for accuracy of registration and that it meets or exceeds the accuracy requirements of these specifications for the entire range of specified flows.

7. Performance Requirements

Propeller meters shall be rated for the following continuous flow rates meet the following accuracy requirements:

Meter Size	Min. Continuous Flow	Max. Continuous Flow	Accuracy
16-inch	420 GPM	5000 GPM	+/- 2%

9. Warranty

Propeller meters shall be warranted by the manufacturer for a period of 5 years.

10. Manufacturer

Propeller meters shall be manufactured by **Water Specialties Model VF30-D**, or an approved equal.

PART 3 - EXECUTION

A. Meter Installations

Meters shall be installed as shown on the Drawings and as recommended by the manufacturer.

END OF SECTION

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METERS – PROPELLER TYPE

SECTION 335160

METERS - MAGNETIC TYPE

PART 1 - GENERAL

A. Description

This section describes the materials, installation, and testing requirements of magnetic flow meter assemblies. CONTRACTOR shall provide THREE flow meters as indicated on the Plans, (FQIT -900, -915, and -925). To maintain continuity with existing District facilities, Sparling 656 Tigermag EP meters are required. No substitutions shall be allowed for Magnetic flowmeters.

B. Related Work Specified Elsewhere

1. Painting and Coating: 09900
2. Chlorination of Water Mains for Disinfection: 150410
3. Hydrostatic Testing of Pressure Pipelines: 150420
4. Electrical: 16000

C. Submittals

Shop drawings shall be submitted for the following:

1. Meter/Transmitter
2. Grounding Rings and meter appurtenances
3. External Painting System

PART 2 – MATERIALS

1. Contractor shall provide and install 3 each, Sparling Tigermag FM 656 magnetic flow meters. No substitutions will be allowed.
2. The magnetic flowmeter shall be microprocessor-based, and flanged. It shall indicate, totalize, and transmit flow in full pipes in both forward and reverse directions.
 - a. The magnetic flowmeter shall utilize DC bipolar pulsed coil excitation, operating at frequencies up to 100 Hz and automatically re-zeroing after every cycle.
 - b. The accuracy shall be at least 0.5% (>50% of span) of flow rate over a 33:1 turndown at all flow rates above 1 fps. Accuracy shall be verified by calibration in a flow laboratory traceable to the U.S. National Institute of Standards and Technology.
 - c. The flow sensor liner shall be Polyurethane, suitable for Potable water service. The housing shall be steel.

- d. The integrally-mounted flow sensor and transmitter shall be FM approved for outdoor service, with NEMA 4X rating.
 - e. The electronics shall be integrally or remote mounted.
 - f. The flowmeters shall include a Grounding Ring kit consisting of 2 grounding rings of 304 stainless steel.
 - g. The flowmeter shall be suitable for operation at temperatures from -40°F to 266°F and at pressures from full vacuum to 150 psi.
 - h. The flowmeter electrodes shall be 316 stainless steel and shall not require O-rings.
 - i. The meter shall incorporate HI-Z circuitry. The preamplifier input impedance shall not be less than 10^{12} ohms. External ultrasonic electrode cleaners shall not be acceptable.
3. Available outputs shall be 1) Isolated analog 4-20 mAdc into 800 ohms (standard); 2) scaled pulse 24 Vdc with selectable 12.5/25/50/100 ms on time, max. freq. 60 Hz.; 3) 0-1000 Hz freq., for 0-100% flow rate. 15 Vdc; 4) two flow alarms; 5) fault, with open collector; 6) RS232 communication; 7) flow direction with open collector; 8) Positive Zero Return (PZR) for external relay contacts. Outputs 2 & 3 can be open collector if required. Flow meters shall have MODBUS TCP communications.
- a. Low flow cutoff shall be selectable from 0-9% of FS and there shall be two flow alarms settable from 0-99% of span.
 - b. A 2-line, 16 character backlit alphanumeric display shall indicate user-defined flow units and total flow. All menu advice and commands shall be visible on this display. The display shall be modular and rotatable 360°, in 90° increments. Characters shall be at least 0.125" high for ease of readability.
 - c. The flowmeter shall incorporate the MAG-COMMAND feature allowing menu selection and changes to be made from outside the housing via Hall-effect sensors. It shall not be necessary to remove covers, panels or fasteners to accomplish calibration or program changes.
 - d. The diagnostic functions shall not require the technician to carry test equipment or open the housing. Current ramp, complete coil check and true front-end input simulator may be activated in MAG-COMMAND without opening the enclosure.
 - e. The meter software shall incorporate a password feature preventing inadvertent program changes.
 - f. The meter shall feature nonvolatile E²PROM memory and universal electronics module compatibility between all Tigermag EP meters.
 - g. The flowmeter shall have a switching power supply having an operating range from 77 - 265 Vac 50/60 Hz (12-60 Vdc). Power consumption shall not exceed 20 Watts.
 - h. All printed circuit boards shall be contained in a plug-in module and be interchangeable for any size without requiring test equipment.
 - i. The flowmeter manufacturer shall have meters of the DC pulse type in similar flowing

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METERS – MAGNETIC TYPE

mediums for a minimum of five years.

4. The flowmeter shall be warranted against defective workmanship or materials for a period of two years from date of shipment.
5. Totalized flow and programmed configuration shall be maintained in memory for the meters lifetime.
6. The flowmeter shall be MODEL 656 Tigermag EP as manufactured by Sparling Instruments, Inc.
7. Meter sizes shall be 16", 20", and 24" for the 3 meters.

Meter ID	Size	Sparling Meter Part #	Grounding Ring Part #
FQIT-900	24"	FM656-245-1A0-0 MODBUS	AC615-24-1
FQIT-915	16"	FM656-165-1A0-0 MODBUS	AC615-16-1
FQIT-925	20"	FM656-205-1A0-0 MODBUS	AC615-20-1

PART 3 - EXECUTION

A. Meter Installations

Meters shall be installed as shown on the Drawings and as recommended by the manufacturer.

END OF SECTION

SECTION 335200

VALVES - GENERAL

PART 1 - GENERAL

1.1 REQUIREMENTS

A. The CONTRACTOR shall provide all valves, actuators, valve cans, and appurtenances, complete and operable, in accordance with the Contract Documents.

B. The provisions of this Section shall apply to all valves and valve actuators except where otherwise indicated. Valves and actuators in particular locations may require a combination of units, sensors, limit switches, and controls indicated in other Sections of the Specifications.

C. Where a valve is to be supported by means other than the piping to which it is attached, the CONTRACTOR shall obtain from the valve manufacturer a design for support and foundation. The design, including drawings and calculations sealed by the PROJECT ENGINEER, shall be submitted with the Shop Drawings. When the design is approved, the support shall be provided.

D. **Unit Responsibility:** A single manufacturer shall be made responsible for coordination of design, assembly, testing, and furnishing of each valve and actuator; however, the CONTRACTOR shall be responsible to the OWNER for compliance with the requirements of each valve section. Unless indicated otherwise, the responsible manufacturer shall be the manufacturer of the valve.

E. **Single Manufacturer:** Where two or more valves of the same type and size are required, the valves and actuators shall be furnished by the same manufacturer. Where indicated, valves may be provided with actuators manufactured by the valve manufacturer. Where actuators are furnished by different manufacturers, the CONTRACTOR shall coordinate selection to have the fewest number of manufacturers possible.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section 05500 - Miscellaneous Metalwork
Section 09800 - Protective Coatings
Section 15000 - Piping, General

1.3 CONTRACTOR SUBMITTALS

A. **General:** Submittals shall be furnished in accordance with Section 01300 - Contractor Submittals.

B. **Shop Drawings:** Shop Drawings shall contain the following information:

1. Valve name, size, Cv factor, pressure rating, identification number (if any), and specification section number.

2. Complete information on valve actuator, including size, Manufacturer, model number, limit switches, and mounting.

3. Cavitation limits for all control valves.

4. Assembly drawings showing part nomenclature, materials, dimensions, weights, and relationships of valve handles, handwheels, position indicators, limit switches, integral control systems, needle valves, and control systems.

C. **Technical Manual and Spare parts List:** The Technical Manual shall contain the required information for each valve. A Spare Parts List for each control valve shall contain the required information for each control valve assembly, where indicated.

PART 2 - PRODUCTS

2.1 GENERAL

A. **General:** Valves and actuators shall be new and of current manufacture. Shut-off valves 6-inches and larger within vaults shall have actuators with position indicators. Buried valves shall be provided with valve cans and lids, and valve stem extensions. Valves sized 3-12 inch shall be resilient seat gate valves; valves larger than 12 inch size shall be butterfly valves.

B. **Protective Coatings:** The exterior surfaces of all valves and the wet interior surfaces of ferrous valves of sizes 4 inches and larger shall be coated in accordance with Section 09800 - Protective Coatings. The valve Manufacturer shall certify in writing that the required coating has been applied and tested in the manufacturing plant prior to shipment, in accordance with these Specifications.

C. **Valve Labeling:** Except when such requirement is waived by the OWNER in writing, a label shall be provided on all shut-off valves and control valves except for hose bibs. The label shall be of 1/16-inch plastic or stainless steel, minimum 2 inches by 4 inches in size, and shall be permanently attached to the valve or on the wall adjacent to the valve as directed by the OWNER.

D. **Valve Testing:** As a minimum, unless otherwise indicated or recommended by the reference Standards, valves 3 inches in diameter and smaller shall be tested in accordance with manufacturer's standard and 4 inches in diameter and larger shall be factory tested as follows:

1. **Hydrostatic Testing:** Valve bodies shall be subjected to internal hydrostatic pressure equivalent to twice the water rated pressure of the valve. Metallic valves rating pressures shall be at 100 degrees F and plastic valves shall be 73 degrees, or at higher temperature according to type of material. During the hydrostatic test, there shall be no leakage through the valve body, end joints, or shaft seals, nor shall any part of the valve be permanently deformed. The duration shall be sufficient time to allow visual examination for leakage. Test duration shall be at least 10 minutes.

2. **Seat Testing:** Valves shall be tested for leaks in the closed position with the pressure differential across the seat equal to the water rated pressure of the valve. The duration of test shall be sufficient time to allow visual examination for leakage. Test duration shall be at least 10 minutes. Leakage past the closed valve shall not exceed 1 fluid ounce per hour per inch diameter for metal seated valves and drop-tight for resilient seated valves.

3. **Performance Testing:** All valves shall be shop operated from fully closed to fully open position and reverse under no-flow conditions in order to demonstrate the valve assembly operates properly.

E. **Certification:** Prior to shipment, the CONTRACTOR shall submit for valves over 12 inches

in size, certified, notarized copies of the hydrostatic factory tests, showing compliance with the applicable standards of AWWA, ANSI, or ASTM.

F. **Valve Marking:** Valve bodies shall be permanently marked in accordance with MSS SP25 - Standard Marking Systems for Valves, Fittings, Flanges, and Unions.

2.2 MATERIALS

A. **General:** Materials shall be suitable for the intended application. Materials not indicated shall be high-grade standard commercial quality, free from defects and imperfections that might affect the serviceability of the product for the purpose for which it is intended. Actuators shall be current models of the best commercial quality materials and liberally-sized for the required torque. Unless otherwise indicated, valve and actuator bodies shall conform to the following requirements:

1. **Cast Iron:** Close-grained gray cast iron, conforming to ASTM A 48 - Gray Iron Castings, Class 30, or to ASTM A 126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
2. **Ductile Iron:** ASTM A 536 - Ductile Iron Castings, or to ASTM A 395 - Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
3. **Bronze:** ASTM B 62 - Composition Bronze or Ounce Metal Castings, and valve stems not subject to dezincification shall conform to ASTM B 584 - Copper Alloy Sand Castings for General Applications.
4. **Stainless Steel:** Stainless steel valve and operator bodies and trim shall conform to ASTM A 351 - Steel Castings, Austenitic, for High-Temperature Service, Grade CF8M, or shall be Type 316 stainless steel.
5. **NSF Standard 14:** All materials shall be listed for use in contact with potable water.

2.3 VALVE CONSTRUCTION

A. **Bodies:** Valve bodies shall be cast, molded (in the case of plastic valves), forged, or welded of the materials indicated, with smooth interior passages. Wall thicknesses shall be uniform in agreement with the applicable standards for each type of valve, without casting defects, pinholes, or other defects that could weaken the body. Welds on welded bodies shall be done by certified welders and shall be ground smooth. Valve ends shall be as indicated, and be rated for the maximum temperature and pressure to which the valve will be subjected.

B. **Bonnets:** Valve bonnets shall be clamped, screwed, or flanged to the body and shall be of the same material, temperature, and pressure rating as the body. The bonnets shall have provision for the stem seal with the necessary glands, packing nuts, or yokes.

C. **Stems:** Valve stems shall be of the materials indicated, or, if not indicated, of the best commercial material for the specific service, with adjustable stem packing, O-rings, Chevron V-type packing, or other suitable seal. Where subject to dezincification, bronze valve stems shall conform to ASTM B 62, containing not more than 5 percent of zinc or more than 2 percent of aluminum, with a minimum tensile strength of 30,000 psi, a minimum yield strength of 14,000 psi, and an elongation of at least 10 percent in 2 inches. Where dezincification is not a problem, bronze conforming to ASTM B 584 may be used, except that zinc content shall not exceed 16 percent.

D. **Stem Guides:** Stem guides shall be provided, spaced 10-feet on centers unless the

manufacturer can demonstrate by calculation that a different spacing is acceptable. Submerged stem guides shall be 304 stainless steel.

E. **Internal Parts:** Internal parts and valve trim shall be as indicated for each individual valve. Where not indicated, valve trim shall be of Type 316 stainless steel or other best suited material.

F. **Operating Nuts:** Buried operating nuts shall comply with AWWA C500 - Metal-Seated Gate Valves for Water Supply Service.

G. **Nuts and Bolts:** Nuts and bolts on valve flanges and supports shall be in accordance with Section 05500 - Miscellaneous Metalwork.

2.4 ACTUATORS

A. **General:** Unless otherwise indicated, valves and gates shall be furnished with manual actuators. Valves in sizes up to and including 4 inches shall have direct acting lever or handwheel actuators of the Manufacturer's best standard design. Larger valves and gates shall have gear-assisted manual actuators, with an operating pull of maximum 60 pounds on the rim of the handwheel. Buried and submerged gear-assisted valves, valves 30 inches in diameter and larger, and where so indicated, shall have worm-gear actuators, hermetically-sealed and grease-packed, where buried or submerged. All other valves 6 inches to 24 inches in diameter may have traveling-nut actuators, worm-gear actuators, spur- or bevel-gear actuators, as appropriate for each valve. The CONTRACTOR shall furnish actuators complete and operable with mounting hardware, handwheels, levers, and extensions, as applicable. Actuators shall have the torque ratings equal to or greater than required for valve seating and dynamic torques, whichever is greater and shall be capable of holding the valve in any intermediate position between fully-open and fully-closed without creeping or fluttering.

B. **Mounting:** Actuators shall be securely mounted by means of brackets or hardware specially designed and sized for this purpose and of ample strength. The word "open" shall be cast on each valve or actuator with an arrow indicating the direction to open in the counter-clockwise direction. Non-buried gear and power actuators shall be equipped with position indicators.

C. **Manual Worm-Gear Actuator:** The actuator shall consist of a single or double reduction gear unit contained in a weather-proof cast-iron or steel body with cover and minimum 12-inch diameter handwheel. The actuator shall be capable of 90-degree rotation and shall be equipped with travel stops capable of limiting the valve opening and closing. The actuator shall consist of spur or helical gears and worm-gearing. The spur or helical gears shall be of hardened alloy steel and the worm-gear shall be alloy bronze. The worm-gear shaft and the handwheel shaft shall be of 17-4 PH or similar stainless steel. All gearing shall be accurately cut with hobbing machines. Ball or roller bearings shall be used throughout. Actuator output gear changes shall be mechanically possible by simply changing the exposed or helical gearset ratio without further disassembly of the actuator. All gearing shall be designed for a 100 percent overload.

D. **Traveling-Nut Actuator:** The actuator shall consist of a traveling-nut with screw (Scotch yoke) contained in a weather-proof cast-iron or steel housing with spur gear and minimum 12-inch diameter handwheel. The screw shall run in 2 end bearings, and the actuator shall be self-locking to maintain the valve position under any flow condition. The screw and gear shall be of hardened alloy steel or stainless steel, and the nut and bushings shall be of alloy bronze. The bearings and gear shall be grease-lubricated by means of grease nipples. All gearing shall be designed for a 100 percent overload.

2.5 VALVE CANS AND LIDS

A. Unless otherwise indicated, buried valves shall be in cast iron valve cans with lids permanently labeled "WATER" for potable waterlines. Valves shall have extension stems with square nuts or floor stands, position indicators, and PVC pipe extensions for valve cans. Size and type of valve cans and lids shall match existing valve cans and lids so as to be interchangeable. Valve cans shall be the 3-piece adjustable type. All materials used in manufacturing shall conform to ASTM 48-30. Frame and Cover shall exceed H-20 wheel loading. Castings shall be dipped in black bituminous coating. Valve cans shall be Parkson "Buffalo" style, South Bay Foundry as indicated below, or approved equal.

South Bay Foundry	
Part	Model/Part Number
Lid	B-5220
Top	B-5221
Bottom	B-5222

2.6 VALVE STEM EXTENSIONS AND ACCESSORIES

A. Unless otherwise indicated, buried valves shall be furnished complete with valve stem extensions and other accessories required to provide a functional system. Buried valves shall have valve stem extensions extending to 12 inches below finished grade. Valve stem extensions shall be fabricated steel or fiberglass. The maximum length of fiberglass valve stem extensions shall be 8 feet. Fiberglass valve stem extensions shall be manufactured by Pipeline Products, San Marcos, CA, or approved equal.

2.7 SPARE PARTS

A. The CONTRACTOR shall furnish the required spare parts suitably packaged and labeled with the valve name, location, and identification number. The CONTRACTOR shall also furnish the name, address, and telephone number of the nearest distributor for the spare parts of each valve. Spare parts are intended for use by the OWNER, after expiration of the warranty period.

PART 3 - EXECUTION

3.1 VALVE INSTALLATION

A. **General:** Valves, actuating units, stem extensions, valve cans, and accessories shall be installed in accordance with the Manufacturer's written instructions and as indicated. CONTRACTOR shall carefully inspect valves and operate valves before installation to verify all parts are in proper working order. If a valve is found to be defective no attempt shall be made to repair it. The defective valve shall be returned to the manufacturer and replaced with a new properly working valve.

B. **Access:** Valves shall be installed with easy access for actuation, removal, and maintenance and to avoid interference between valve actuators and structural members, handrails, or other equipment. Valves shall be firmly supported to avoid undue stresses on the pipe. Mainline valves shall be set plumb and securely braced into place using concrete anchor blocks. Non-buried actuators shall be located to be readily accessible for operation and maintenance, and shall not be mounted where shock or vibrations will impair their operation, nor shall the support systems

be attached to handrails, process piping, or mechanical equipment.

C. **Valve Accessories:** Where combinations of valves, sensors, switches, and controls are indicated, the CONTRACTOR shall properly assemble and install such items so that systems are compatible and operating properly. The relationship between interrelated items shall be clearly noted on Shop Drawing submittals. All buried valves shall be provided with valve cans. Valve cans shall be installed centered and plumb over the operating nut. Valve cans shall be supported on bonnet of valve. In areas where road construction is not completed, set valve can covers to pavement subgrade level to prevent damage during construction of road base and AC pavement.

D. **Corrosion Protection:** All nuts and bolts on valves for buried service shall be tape wrapped, after valve installation is completed, using heavy duty joint wrap, in accordance with Section 09800 – Protective Coatings.

3.2 SERVICES OF MANUFACTURER

A. Field representatives of manufacturers of valves with pneumatic, hydraulic, or electric actuators shall adjust actuator controls and limit-switches in the field for the required function.

END OF SECTION

SECTION 335202
BUTTERFLY VALVES

PART 1 - GENERAL

1.1 REQUIREMENTS

- A. The CONTRACTOR shall provide butterfly valves and appurtenances, complete and operable, in accordance with the Contract Documents.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section 03300 – Cast-in-Place Concrete
Section 09800 – Protective Coatings
Section 09810 – Polyethylene Tape Coating
Section 15000 – Piping, General
Section 15200 – Valves, General

1.3 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall furnish submittals in accordance with Section 01300 – Contractor Submittals and Section 15200 – Valves, General.
- B. Shop Drawings. The CONTRACTOR shall submit complete Shop Drawings of butterfly valves and actuators, with drawings showing valve port diameter complete with dimensions, part numbers and materials of construction. Certification of proof-of-design test from the valve manufacturer shall also be provided.
- C. Manufacturer's Certification that the valve complies with all applicable provisions of AWWA C504 – Rubber-Seated Butterfly Valves.

1.4 QUALITY ASSURANCE

- A. Valves shall be subjected to performance, leakage, and hydrostatic tests in accordance with procedures and acceptance criteria established by AWWA C504.

PART 2 - PRODUCTS

2.1 RUBBER SEATED BUTTERFLY VALVES 25 TO 150 PSI (AWWA)

- A. **General:** Butterfly valves for steady-state water working pressures and steady-state differential pressure up to 150 psi and for fresh water service having a pH range from 6 to 10 and temperature range from 33 to 125 degrees F shall conform to AWWA C504 and be as indicated.
- B. Valves shall be of the body type, pressure class, end joint, and actuator indicated. The valve actuators shall be equipped with counter-clockwise opening stems, in accordance with Section 15201. Valves shall be marked with manufacturers name, size, pressure rating, and year manufactured.
- C. **Construction:** Unless otherwise indicated, all materials of construction shall be in accordance with AWWA C504, suitable for the service. The seats shall be positively clamped or bonded into the disc or body of the valve, but cartridge-type seats which rely on a high coefficient of friction for retention shall not be acceptable.

Description	Material Standards
Valve Bodies	[ASTM A 48, Class 40] or [Cast iron, ASTM A 126, Class B], or [Ductile iron, ASTM A 536, grade 65-45-12 or 70-50-05] [Alloy cast iron, ASTM A 436, Type 1 or 2], or [ASTM A 439, Type D2, with minimum lead content of 0.003 percent]
End flanges	The same material as the valve bodies
Valve shafts	Stainless steel ASTM A 276, Type 316
Valve discs	The same material as for the valve bodies.
Rubber sets	New natural or synthetic rubber
Seat mating surfaces	Stainless steel, ASTM A 276, Type 316
Clamps and retaining rings	Type 316 retaining rings and cap screws.
Valve bearings	Self lubricating materials per AWWA C504
Shaft seals	Resilient non-metallic materials suitable for service
Painting and coating	Refer to Section 09800 – Protective Coatings

D. Manufacturers, or Equal

De Zurik Corporation
Clow Valve Company
M & H Valve Company
Mueller Company
Henry Pratt Company
Rodney Hunt Company (24 inches and larger)

2.2 RUBBER SEATED BUTTERFLY VALVES, 250 PSI (AWWA).

A **General:** Butterfly valves for steady-state water working pressures and steady-state differential pressure up to 250 psi and for fresh water service having a pH range from 6 to 10 and temperature range from 33 to 125 degrees F shall conform to AWWA C504. Valves shall be designed and manufactured in accordance with the intent of AWWA C504 except valves shall be suitable for 250 psi service and as indicated herein.

B. Valves shall be of the body type, pressure class, end joint, and actuator indicated.

C. One prototype valve for each size of valve required by the project shall be subjected to proof of design test in accordance with the procedures established by AWWA C504. Certificate of proof-of-design test shall be submitted to the OWNER prior to delivery of the valves.

D. **Construction:** Unless otherwise indicated, all materials of construction shall be in accordance with AWWA C504, suitable for the service. The seats shall be positively clamped or bonded into the disc or body of the valve, but cartridge-type seats, which rely on a high coefficient of friction for retention, shall not be acceptable.

Description	Materials Standards
Valve Bodies	[ASTM A 48, Class 40] or [Cast iron, ASTM A 126, Class B], [Ductile iron, ASTM A 536, grade 65-45-12 or 70-50-05]

	[Alloy cast iron, ASTM A 436, Type 1 or 2], or [ASTM A 439, Type D2, with minimum lead content of 0.003 percent]
End flanges	The same material as the valve bodies
Valve shafts	Stainless steel ASTM A 276, Type 316
Valve discs	The same material as for the valve bodies.
Rubber sets	New natural or synthetic rubber
Seat mating surfaces	Stainless steel, ASTM A 276, Type 316
Clamps and retaining rings	Type 316 retaining rings and cap screws.
Valve bearings	Self lubricating materials per AWWA C504
Shaft seals	Resilient non-metallic materials suitable for service
Painting and coating	Refer to Section 09800 – Protective Coatings

E. **Manual Actuators:** Unless otherwise indicated, all manually-actuated butterfly valves shall be equipped with a handwheel and 2-inch square actuating nut and position indicator. Screw-type (traveling nut) actuators will not be permitted for valves 30 inches in diameter and larger.

F. **Worm Gear Actuators:** Valves, 30 inch and larger, as well as all submerged and buried valves, shall be equipped with worm-gear actuators, lubricated and sealed to prevent entry of dirt or water into the housing.

G. Manufacturers, or Equal

De Zurik Corporation
Henry Pratt Company
Rodney Hunt Company (24 inches and larger)

PART 3 - EXECUTION

3.1 INSTALLATION

A. All exposed butterfly valves shall be installed with a means of removing the complete valve assembly without dismantling the valve or operator. The installation shall be in accordance with Section 15200 – Valves, General.

END OF SECTION

SECTION 335206

GATE VALVES

PART 1 - GENERAL

1.1 REQUIREMENTS

A. The CONTRACTOR shall provide resilient-wedge gate valves and appurtenances, complete and operable, in accordance with the Contract Documents.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section 03300 – Cast-in-Place Concrete
Section 09800 – Protective Coatings
Section 09810 – Polyethylene Tape Coating
Section 15000 – Piping, General
Section 15200 – Valves, General

1.3 CONTRACTOR SUBMITTALS

A. The CONTRACTOR shall furnish submittals in accordance with Section 01300 – Contractor Submittals and Section 15200 - Valves, General.

PART 2 - PRODUCTS

2.1 GENERAL

A. Buried valves shall be of the inside screw, non-rising stem type. The valve actuators shall be as indicated, with counter-clockwise opening stems, in accordance with Section 15200 – Valves, General. Valves shall be marked with manufacturers name, size, pressure rating, and year manufactured.

2.2 RESILIENT-SEATED GATE VALVES (3- to 16-inch)

A. **General:** All gate valves shall be resilient-wedge gate valves unless directed otherwise by the OWNER.

B. **Construction:** Resilient-wedge gate valves shall conform to ANSI/AWWA C509 - Resilient-Seated Gate Valves for Water and Sewerage Systems. The valves shall be suitable for a design working water pressure of 200 psig, with flanged, bell and spigot, or mechanical joint ends. The valve body, bonnet, and disc shall be of cast iron or ductile iron and the disc or body shall be rubber-coated. Body and bonnet wall thickness shall be equal to or greater than the minimum wall thickness as listed in Table 2 of ANSI/AWWA C509. The stem, stem nuts, glands, and bushings shall be of bronze, with the stem seal per ANSI/AWWA C 509. Valves shall be internally coated in accordance with AWWA C550.

C. **Actuators:** Unless otherwise indicated, resilient-wedge gate valves shall have manual actuators in accordance with Section 15200 – Valves, General.

D. Manufacturers, or Equal

American Flow Control
Clow Valve Co.

M & H Valve Company
Mueller Company (Grinnell Corp.)
Stockham Valves and Fittings

2.3 GATE VALVES (SMALLER THAN 3-INCH)

A. **Construction:** Gate valves, smaller than 3-inch, for general purpose use, shall be non-rising stem, heavy-duty type for industrial service, with screwed or soldered ends to match the piping. The bodies shall have union bonnets of bronze conforming to ASTM B 62 - Composition Bronze or Ounce Metal Castings. The stems shall be of bronze conforming to ASTM B 62, or ASTM B 371 - Specification for Copper-Zinc-Silicon Alloy Rod. The solid wedges shall be of bronze conforming to ASTM B 62. The valves shall have malleable iron handwheels, unless otherwise indicated, and stem seals shall be of Teflon-impregnated or other acceptable non-asbestos packing. All valves shall have a pressure rating of minimum 125 psi steam, and 200 psi coldwater, unless otherwise indicated.

B. Manufacturers, or Equal

Crane Company
Milwaukee Valve Company
Wm. Powell Company
Stockham Valves and Fittings
Walworth Company

2.4 HIGH-PRESSURE GATE VALVES (2- TO 12-INCH)

A. **Construction:** High-pressure gate valves, except for buried valves, shall have cast iron bodies and flanged bonnets conforming to ASTM A 126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings, with 250 psi flanged ends. The valves shall have outside screw & yoke rising stems, or non-rising stems as indicated on the Construction Drawings. The valves shall be rated for 250 psig steam and 500 psig cold water working pressure. The solid wedges shall be of bronze or cast iron, bronze-fitted and the stem shall be of bronze with non-asbestos fiber packing.

B. **Actuators:** Unless otherwise indicated, high-pressure gate valves shall have cast iron or ductile iron handwheels with 2-inch square operating nuts, in accordance with Section 15201 - Valve & Gate Actuators.

C. Manufacturers, or Equal

Crane Company
Milwaukee Valve Company
Wm. Powell Company
Stockham Valves and Fittings
Walworth Company

2.5 TAPPING VALVES (4- TO 24-INCH)

A. **Construction:** Tapping valves shall meet the requirements of ANSI/AWWA C500 or C509 and shall have flanged ends. Double disc gate valve gates, gate rings, and body-seat rings shall be oversized to permit entry and exit of tapping machine cutters.

B. Valve end connecting to tapping sleeve shall have a flange for bolting to the sleeve. The flange shall have a tongue, which fits a recess in the sleeve. The flanged and bolt pattern of the tapping valve shall match the flange and bolt pattern of the tapping sleeve. Resilient-wedge gate valves having a port diameter equal to or exceeding $\frac{1}{4}$ inch over nominal diameter shall not require

a tongue. Flange dimensions and drilling shall meet the requirements of ANSI B16.1. Nuts, bolts, and gaskets for flange joints shall meet the requirements of ANSI/AWWA C110. Nuts and bolts shall be 316 stainless steel. A full nominal diameter cutter shall be used for tapping.

C. Tapping valve coating and lining shall be applied per Section 09800 – Protective Coatings and shall be System 103 Fusion Bonded Epoxy, unless otherwise directed by the OWNER.

PART3 - EXECUTION

3.1 GENERAL

- A. Gate valves shall be installed in accordance with the provisions of Section 15200 – Valves, General.
- B. Care shall be taken when installing valves on plastic pipe. Valve shall be supported at each end of the valve.

END OF SECTION

SECTION 335218

MODULATING VALVES

PART 1 – GENERAL

1.0 Modulating valves include self modulating, pilot controlled, and externally actuated globe style valves. To maintain consistency with other MPWMD and Cal-Am facilities, all modulating valves shall be manufactured by Cla-Val Co. No substitutions shall be made for any modulating valves.

Modulating valves include the following:

- FCV-916, 16-inch Flow Control Valve
- FCV-926, 20-inch Flow Control Valve
- PSV-955, 16-inch Pressure Relief Valve

1.1 REQUIREMENTS

- A. The CONTRACTOR shall provide pressure relief valves and appurtenances, complete and operable, in accordance with the Contract Documents.
- B. The requirements of Section 15200 - Valves, General, apply to this Section.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section 09800 – Protective Coatings
Section 15000 – Piping, General
Section 15200 – Valves, General

1.3 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall furnish submittals in accordance with Section 01300 – Contractor Submittals and Section 15200 – Valves, General.

PART 2 - PRODUCTS

2.1 FLANGED MODULATING VALVES, SIZES 1 1/2 INCHES THROUGH 24 INCHES

A. **Valve Characteristics:** The modulating pressure relief valves shall open when the inlet pressure exceeds a set maximum level, or when the pilot system solenoid is energized. It shall maintain that level and gradually close as the inlet pressure drops below the maximum pressure. The valve shall be a hydraulically operated, adjustable, pilot controlled, diaphragm or piston type globe or angle valve as indicated. All necessary repairs shall be possible without removing the valve from the pipeline. Externally actuated modulating valves shall be incrementally opened or closed by energizing the respective solenoids in the pilot system. Valve position and opening/closing shall be driven through a microprocessor unit supplied by the valve manufacturer.

B. **Valve Body:** The valve body shall be of cast iron, ASTM A 48 - Gray Iron Castings, or ASTM A 126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings, with [125 lb] [250 lb] flanged ends to ANSI/ASME B 16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800, or the body shall be of ductile iron to ASTM A 536 - Ductile Iron Castings, with [150 lb] [300 lb] flanged ends to ANSI/ASME B 16.42 - Ductile Iron Pipe Flanges and Flanged Fittings. The valve cover shall be flanged and be of the same material as the body.

C. **Valve Trim:** The valve stems, springs, body seat rings, and all bolts, nuts, and washers shall be of Type 302, 303, or 316 stainless steel. The valve stems shall have top and bottom

guides. All rubber parts shall be of Buna-N. The diaphragms shall be of Nylon-reinforced Buna-N, supported firmly between body and valve cover.

D. **Valve Controls:** The valve shall be furnished with a complete, externally mounted control system, including adjustable speed control needle valves, strainer, and all necessary copper or stainless steel connecting tubing and fittings. The controls shall be capable of achieving all the flow and speed adjustment indicated.

E. **Factory Tests and Warranty:** Valves shall be factory tested with a hydrostatic test and a functional test and a test certificate shall be submitted to the OWNER prior to delivery of the valve. The valve shall be warranted for a period of 3 years from the date of shipment to be free of defects in materials and workmanship.

F. **Valve Ordering:** The valves shall be designated by the following by the Cla-Val factory:

Valve ID	Size	Cla-Valve Model Number	Voltage
FCV-916	16"	131G-FA-BCENPSYKC D/S 150LB w/ VC-22D VALVE CONTORLLER and X117D 4-20 ma valve position transmitter	24vdc
FCV-926	20"	131G-FA-BCENPSYKC D/S 150LB w/ VC-22D VALVE CONTORLLER and X117D 4-20 ma valve position transmitter	24vdc
PSV-955	16"	650E-G-03BCSKYC-D/S 150LB w/120 vac solenoid and manual operator	120vac

G. **Spare Parts:** The following spare parts shall be furnished in accordance with Section 15200:

1. 1 set of all resilient seals, and discs
2. 1 diaphragm

H. Manufacturer shall be Cla-Val Company; no substitutions shall be allowed.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Valves shall be installed in accordance with provisions of Section 15200 – Valves, General.

3.2 SERVICES OF MANUFACTURER

A. **Inspection, Startup, and Field Adjustment:** The service representative of the valve manufacturer shall be present at the Site for one work day, to assist the CONTRACTOR in the installation and adjustment of the valve(s). For the purpose of this paragraph, a work day is defined as an eight hour period, excluding travel time.

END OF SECTION

SECTION 335299

PVC PIPING, VALVES AND MISC. ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes PVC piping, fittings, valves, and miscellaneous accessories shown on the Drawings, but not specified in other Sections. Although this Section may not include every item required to completely interconnect all equipment with piping for complete and operable systems, the Contractor is still required to furnish and install such items.
- B. Related Sections Including Work Provided in this Section:
 - 1. Section 026430: Waterline Disinfection and Testing
 - 2. Section 098000: Protective Coatings
 - 3. Section 104000: Identifying Devices

1.02 REFERENCES

- A. American Society of Testing and Materials (ASTM)
- B. American Society of Mechanical Engineers (ASME)
- C. American National Standards Institute (ANSI)

1.03 SUBMITTALS

- A. Shop Drawings:
 - 1. Verify by excavation, inspection and measurement all installation conditions, including existing utilities and structures, for buried pipe before preparation of Shop Drawings. Submit field measurements and photos with Shop Drawings where exposed conditions are significantly different than indicated on the Drawings.
 - 2. Layouts and Schematics: Submit detailed installation drawings or schematics for piping that deviates from the Plans. The schematics shall include pipe support locations and types, fittings, valves, and other appurtenances.
 - 3. Submit data to show that the following items conform to the Specification requirements:
 - a. Pipe, fittings, and accessories.
 - b. Valves and Accessories.
 - 4. Submit certified test reports as required herein and by the referenced standard specifications.

1.04 QUALITY ASSURANCE

- A. Materials and equipment furnished under this Section shall be of manufacturers who have been regularly engaged in the design and manufacture of the materials and equipment for a period of at least 5 years. Demonstrate to the satisfaction of the Owner that the quality is equal to the materials and equipment made by the manufacturers specifically named herein, if an alternate manufacturer is proposed.
- B. Factory Quality Control: The Contractor shall test all products as noted herein and by the reference specifications.
 - 1. The Contractor shall:
 - a. Perform leakage tests.
 - b. Be responsible for the costs of additional inspection and retesting by the Owner resulting from noncompliance.

1.05 APPURTENANCES

- A. Furnish and install all necessary guides, inserts, anchors and assembly bolts, washers and nuts, hangers, supports, gaskets, couplings and flanges; all other appurtenant items shown on the Drawings, specified or required for the proper installation and operation of the piping; devices included in or on the piping equipment; and piping accessories.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Pipe and valve sizes are nominal inside diameter unless otherwise noted.
- B. All materials delivered to the job site shall be new, free from defects, and marked to identify the material, class, chemical compatibility with the process fluid, and other appropriate data such as thickness for piping.
- C. Acceptance of materials shall be subject to strength and quality testing in addition to inspection of the completed product. Acceptance of installed piping systems shall be based on inspection and leakage tests as specified hereinafter.

2.02 CORRECTIVE WORK

- A. Perform corrective work as specified in Part 3 (Execution) of the specifications.

2.03 GENERAL MATERIAL REQUIREMENTS

- A. Gaskets: Unless specifically specified otherwise, all gaskets, seals, and O-Rings for chemical or waste piping shall be PTFE, FKM, or Viton.
- B. Bolts: Unless specified otherwise herein, flange bolts and nuts, coupling bolts and nuts, and other hardware shall be as follows:
 - 1. Exposed: Electroplated zinc or cadmium steel.
 - 2. Submerged: Titanium; minimum tensile strength: 50,000 psi.
 - 3. Fully Concrete Encased: Carbon Steel ASTM A53.
 - 4. Buried: Type 316 stainless steel, minimum tensile strength: 60,000 psi.
 - 5. Apply an anti-seize compound to the threads of stainless steel bolts.
- C. Flexible Sealant: Flexible sealant for pipe penetrations through walls, where shown on the Plans, shall be a two-component polysulfide, non-sag; Sikaflex 412, Dualthane, or equal. Use Link Seal annular seals for pipe sizes 3" and larger.

2.04 PIPING MATERIALS

- A. Schedule 80 PVC Pipe:
 - 1. Pipe: Schedule 80 polyvinyl chloride (PVC), gray, normal impact, Type 12454 B, ASTM D1784 and ASTM D1785. Pipe shall bear the National Sanitation Foundation (NSF) label.
 - 2. Joints: Solvent weld all joints, except flanged or union/O-Ring faced are permitted where required at equipment connections and where required on the Plans. Use Military Specification T-27730A Teflon tape for threaded joints.
 - 3. Fittings: Solvent weld, socket type, of same material as the pipe, Schedule 80, ASTM D2467.
 - 4. Cement: Solvent weld, ASTM F-493, IPS 724 PVC by Harrington Plastics or Weldon 724 PVC; no other equal. PVC primer shall be Weldon P-70 only, no substitutions.
 - 5. Pipe Cleaner: As recommended by the pipe manufacturer for the schedule and size to be joined.

- B. Stainless Steel Pipe:
 - 1. Pipe: Stainless steel, ASTM A312, type 304L, Schedule 40S.
 - 2. Joints: Butt welded, except where screwed or flanged joints are required adjacent to valves or equipment.
 - 3. Fittings: Wrought stainless steel, ASTM A403, type 304L, ANSI B16.9 for dimensions.
 - 4. Flanges: Welding neck or slip-on, raised face, ASTM A182, F316L. ANSI B16.5 for dimensions. Class 125, drilling to match adjacent accessories or valves.
 - 5. Gaskets: Full face gasket per ANSI B16.21, non-asbestos gasket.
- C. Galvanized Steel Pipe:
 - 1. Pipe: Galvanized steel, ASTM A53, Schedule 40.
 - 2. Fittings:
 - a. Pressure Pipe Service: Galvanized malleable iron, screwed, ASTM A197 for materials, ANSI B16.3 Class 150 for dimensions (rated 300 psig WOG at 150°F.
 - b. Drain Pipe Service: Galvanized cast iron drainage pattern, ANSI B16.12.
 - 3. Threads: ANSI B2.1.
 - 4. Unions: Galvanized malleable iron, ASTM A197 for materials and ANSI B16.39 for dimensions, with brass seats.
 - 5. Thread Compound: Permatex No. 2; Crane equivalent; or equal, or teflon tape.
- D. PVC Tubing for Waste Sump discharge pump connection:
 - 1. General: Tubing shall be smooth bore PVC and may be reinforced with a Teflon™ braid. Braid shall be contained within the tubing wall and shall not interfere with visual inspection of flow. Install tubing in buried PVC double containment conduits where shown on the Plans. Connect the tubing to the injection point and leave a sufficient coil for connection to the chemical system at the opposite end.
 - 2. Size: As shown on the Plans.
 - 3. Minimum Pressure Rating: 200 psi at 70° F.
 - 4. Fittings: Insert type hose fittings with clamps.
 - 5. Manufacturer: Ryan Herco Herco-Braid Reinforced Tubing, or equal.

2.05 VALVES AND ACCESSORIES

- A. General Requirements for Valves:
 - 1. All valves of each type shall be the product of one manufacturer.
 - 2. All valves shall be furnished with operators, handwheels, levers, or other suitable type wrench including handles as specified herein or as shown on the Drawings.
 - 3. All threaded stem valves shall open by turning the valve stem counter-clockwise.
 - 4. All exposed valves and valve operators shall have a non-bleeding shop coat, unless otherwise specified.
 - 5. All ball valves for chemical piping shall be Vented (Bleach) Ball valves, as manufactured by Spears, George Fisher, or equal. Valves shall be installed so that the vented ball is facing towards the low-pressure side of process.
- B. Solenoid Valves: Valves shall be rated for 150 psi pressure, water, oil, or gas; 120-Volt ac service, with a watertight enclosure and ½" or ¾" conduit connection for power. Valve body shall be brass, seats Buna-N, with stainless steel plug. Valves shall be normally closed except where noted otherwise. Provide manual override control. Valves shall be ASCO Series 8210; Skinner L or R Series; or equal.
- C. Needle Valves: Globe style valve with PVC body and rated for 200 psi water pressure. Valve shall have Teflon™ seal with socket glue connections.
- D. Hose Bibs:
 - 1. Indoor: Nibco Model 55; Arrowhead Brass Model 353; or equal.
 - 2. Outdoor (Non-freezing type): J.R. Smith 5913; Zurn Z-1385; or equal.

- E. Link-Type Seals: Link-type seals shall be interlocking synthetic rubber links connected by stainless steel bolts and nuts to form a continuous belt. Tightening of the bolts shall expand the rubber to form a watertight seal of the annular space between a pipe and the hole or sleeve in the wall.
- F. PVC Basket Strainers:
 - 1. PVC Basket Strainers shall be Spears Co. Model BS33P8-020, with FKM O-Ring seal; flanged connection, 2" size, 8 mesh basket. No substitutions allowed.
- G. Pipe Escutcheons:
 - 1. Manufactured wall, ceiling, and floor plates; cast brass, polished chrome plated, with set-screw, deep pattern type where required to conceal protruding fittings and sleeves.
 - 2. Inside Diameter: Closely fit around pipe, tube, and insulation of insulated piping.
 - 3. Outside Diameter: Completely cover opening.
 - 4. One-piece design for piping to plumbing fixtures and to equipment in finished spaces.
 - 5. Split, concealed hinge type for piping not serving plumbing fixtures or equipment in finished spaces.
- H. PVC Ball Check Valves:
 - 1. PVC Ball check valves shall be Hayward TC series or equal, True Union style, socket glue fittings, with PTFE, FKM, or Viton seals. Size as shown on the Plans.
- J. Safety Shower / Eyewash assemblies:
 - 1. Safety Shower/Eyewash units shall be Haws Co Model 8300 or approved equal.
 - 2. For shower / eyewash units in the lower double containment area of Chemical Rooms 101 and 102, install a 15" (approximate) galvanized steel extension in the shower base to raise the shower and eyewash unit to correct height with the FRP grate subfloor in place.

PART 3 - EXECUTION

3.01 PIPING INSTALLATION

- A. General Handling and Placing:
 - 1. Exercise great care to prevent injury to or scoring of the pipe lining and coating, as applicable, during handling, transportation or storage. Do not store pipe on rough ground and do not roll the pipe on the coating. Any damaged pipe sections, specials, or fittings shall be repaired or replaced at the expense of the Contractor as satisfactory to the Owner.
 - 2. Carefully inspect each pipe, fitting, valve and accessory before installation to insure there is no defective workmanship or obstructions. Inspect the interior and exterior protective coatings and patch all damaged areas in the field or replace to the satisfaction of the Owner.
 - 3. Place or erect all piping to accurate line and grade and backfill, support, hang, or brace against movement as specified or shown on the Drawings, or as required for proper installation. Remove all dirt and foreign matter from the pipe interior prior to installation and thoroughly clean all joints before joining.
 - 4. Use reducing fittings where any change in pipe size occurs. Bushings shall be used in accordance with District Standard Details and where specifically noted on the Drawings. Use eccentric reducing fittings wherever necessary to provide free drainage of lines.
 - 5. Cast all metallic pipes and sleeves 6-inch and larger into new concrete walls without blockout. Pipes 5 inches and smaller may be cast in place or installed in a smooth core drilled hole using a link type seal at the Contractor's option. Maintain at least 1/2-inch clearance between reinforcing steel and metal pipe in penetrations.
 - 6. Cover polyvinyl chloride (PVC) pipe stored outside for more than two months with canvas or other opaque material. Provide for air circulation under the covering.

B. General Buried Piping Installation:

1. Trenching, bedding, and backfill for buried piping shall be as shown on the Drawings and as specified in Section 02200.
2. Where pipe grade elevations are shown on the Drawings, install the pipe with straight grades between the indicated elevations.
3. Where no pipe grade elevations are shown on the Drawings, install buried piping with at least 3 feet of cover to finished grade. Where piping crosses under buried electrical ducts, provide at least 4 feet 6 inches of cover. Provide 12 inches minimum separation between the buried pipes and ducts.
4. Provide each pipe with a firm, uniform bearing for its full length in the trench except at field joints. Do not lay pipe in water or when trench conditions or weather are unsuitable for such work.
5. Protect buried piping against thrust by use of restrained pipe joints and/or thrust blocks. All exposed free pipe ends shall be securely braced. Cap or plug pipe ends that are left for future connections as shown on the Drawings and in a manner favorably reviewed by the Owner.
6. Where piping leaves a structure or concrete encasement, provide a joint capable of angular deflection within 12 inches of the structure. Conform to details on the Drawings.
7. Snake buried PVC pressure pipe from side to side in the trench in long sweeps.
8. Concrete Encasements: All piping and conduits, except plumbing lines, installed under slabs or footings on earth or crushed rock shall be encased in concrete not less than 6-inch thickness on all sides and extending up to the bottom of the slab or footing, unless otherwise specifically noted on the Drawings. Encasement shall extend to within 6 inches of the first pipe joint beyond the slab or footing. Provide concrete encasement whether or not the encasement is shown on the Drawings. Provide encasement under slabs on earth or crushed rock even if the structure is supported on piles, caissons, or footings.

C. General Exposed Piping Installation:

1. Unless shown otherwise, install piping parallel to building lines, plumb and level.
2. Install piping without springing or forcing the pipe in a manner that would set up stresses in the pipe, valves, or connected equipment.
3. Set all pipe flanges level, plumb, and aligned. All flanged fittings shall be true and perpendicular to the axis of the pipe. All bolt holes in flanges shall straddle vertical centerline of pipes.
4. Flexibility and Expansion: Provide flexible couplings, flexible hose, or flexible spools for all piping connections to motor driven equipment and where otherwise shown. The Contractor may install additional flexible couplings at favorably reviewed locations to facilitate piping installation, provided that he submits complete details describing location, pipe supports, and hydraulic thrust protection. Anchor piping subject to expansion or contraction in a manner permitting strains to be evenly distributed. Sleeves for branches through walls from adjacent mains shall be of sufficient size to allow for free side motion of covered pipe in sleeves.
5. Install unions or flexible connections where shown on the Drawings, and at all non-motor-driven equipment to facilitate removal of the equipment.
6. Provide valves wherever equipment drain connections are furnished and carry the discharge pipe to the nearest floor drain, drain trench or sump. Where no receptacle for drain exists, install drain piping to 1-inch above the floor. Drain piping and valve materials shall conform to the requirements of the system served.
7. Where piping conveying liquids passes over motor control centers, electrical panels and other electrical devices, install a protective drainage tray below the piping.

D. Pipe Welding:

1. General: Unless specified otherwise, shop and field welding of pipe shall conform to ANSI B31.1 as amended by this paragraph.
2. All field and shop welding shall be done by the electric arc process unless otherwise specified. All field welding shall be done in passes not thicker than 1/4-inch. Size and

type of electrodes, and current and voltages used, shall be subject to the favorable review of the Owner. Give particular attention to the alignment of edges to be joined, so that complete fusion and penetration will be effected throughout the bottom of the weld. Welds shall contain no valleys or undercuts in the center or edges of the weld. Thoroughly clean each pass, except the final one, of dirt, slag, and flux before the succeeding bead is applied.

3. Clean completed field welds of pipe joints of dirt, slag and flux, and then visually inspect. Completely chip out all defects in welds discovered during field inspection in a manner that will permit proper and complete repair by welding subject to the favorable review of the Owner. Under no circumstances will caulking of defective welds be permitted.
4. All welding shall be done by experienced, skilled operators familiar with the methods and materials to be used. Hand welding will be done only by welders qualified under the standard qualification procedure of Section IX of the ASME Boiler and Pressure Vessel Code.
6. A single, continuous, watertight, full fillet weld shall be the minimum required at all field joints. Double weld joints will be required on all piping specifically noted to be double welded.
7. See installation specifics for welding of stainless steel pipe.

E. Installation Specifics:

1. Schedule 80 PVC Pipe:
 - a. Place PVC pipe within the installation areas at least 24 hours prior to installation to permit temperature equalization.
 - b. Cut pipe ends squarely, ream and deburr inside and out.
 - c. Solvent Weld Joints: Clean pipe ends and sockets and join in strict conformance with the pipe manufacturer's instructions. Make joints in accordance with ASTM D2855. Handle solvent cements and primers in accordance with ASTM F402.
 - e. No threaded joints or connections shall be permitted in PVC chemical piping.
2. Stainless Steel Pipe:
 - a. Install and weld in accordance with CGA G-4.4 and ANSI B31.1. Back purge all welds with cover gas. Seal weld all slip-on flanges.
 - b. Provide anti-seize compound on threaded connections.
 - c. Temporarily plug or cap all points of connection to exclude moisture, dust or other contaminants or impurities prior to being connected.
3. Galvanized Steel Pipe: Threaded joints shall have connections made metal to metal tight. Remove all burrs from ends of pipe, and clean threads of all oil and chips. Coat male threads with joint lubricant.
4. PVC Tubing: Install in accordance with tube and fitting manufacturers' instructions.

3.02 INSTALLATION OF VALVES AND ACCESSORIES

- A. Install valves and accessories such that all parts are easily accessible for maintenance and operation.
- B. Where valve handwheels are shown on the Drawings, valve orientation shall be as shown. Where valve handwheels are not shown, orient valves to permit easy access to the handwheels or handles and to avoid interferences.
- C. Provide a union adjacent to each screwed end valve and accessory with additional unions as necessary to facilitate removal.
- D. Where valves or other pipeline items require metal full-face connecting flanges, provide intermediate flanges if the connecting flange is not adequate.

- E. Provide a suitable chrome plated escutcheon on pipes passing through walls, floors, ceilings and partitions in finished areas.
- F. PVC Vented Ball Valves shall be installed so that the vented ball is facing towards the low-pressure side of process.

3.03 CLEANING

- A. Prior to testing, thoroughly clean the inside of each completed piping system of all dirt, loose scale, sand and other foreign material. Cleaning shall be by flushing with water or blowing with compressed air. Flushing shall achieve a velocity of at least 3 feet per second. The Contractor shall install temporary strainers, temporarily disconnect equipment or take other appropriate measures to protect equipment while cleaning piping.

3.04 FIELD TESTING

- A. General: Test pipes in accordance with Section 02643, except where that section does not apply to specific pipe types and applications. In that case, perform tests as specified herein. Furnish all equipment, material, personnel and supplies to perform the tests and make all taps and other necessary temporary connections. The test pressure, allowable leakage and test medium shall be as specified and as shown in the following Schedule. Test pressure shall be measured at the highest point on the line unless specifically noted otherwise. Leakage tests shall be performed on all piping at a time agreed upon and in the presence of the Owner.
- B. Buried Piping: The leakage test for buried piping shall be made after all pipe is installed and backfilled. However, the Contractor may conduct preliminary tests prior to backfill. If the Contractor elects to conduct preliminary tests, provide any necessary temporary thrust restraint.
- C. Exposed Piping: All supports, anchors and blocks shall be installed prior to the leakage test. No temporary supports or blocking shall be installed for final test.
- D. Encased Piping: The leakage test for encased piping shall be made after all pipe is installed and encased, and before any structures are constructed above it. However, the Contractor may conduct preliminary tests prior to encasement. If the Contractor elects to conduct preliminary tests, provide any necessary temporary thrust restraint.
- E. Accessories: It shall be the responsibility of the Contractor to block off or remove equipment, valves, gauges, etc., which are not designed to withstand the full test pressure.
- F. Testing Apparatus: Provide pipe taps, nozzles and connections as necessary in piping to permit testing including valves to isolate the new system, addition of test media, and draining lines and disposal of water, as is necessary. These openings shall be plugged in a manner favorably reviewed by the Owner after use. Provide all required temporary bulkheads.
- G. Correction of Defects: If leakage exceeds the allowable amount, the installation shall be repaired or replaced and leakage tests shall be repeated as necessary until conformance to the leakage test requirements specified herein have been fulfilled. All visible leaks shall be repaired even if pipeline passes the allowable leakage test.
- H. Reports: The Contractor shall keep records of each piping test, including:
 - 1. Description and identification of piping tested.
 - 2. Test pressure.
 - 3. Date of test.
 - 4. Witnessing by Contractor and Owner.
 - 5. Test evaluation.

6. Remarks, to include such items as:
 - a. Leaks (type, location).
 - b. Repairs made on leaks.
7. Test reports shall be submitted to the Owner.
- I. Venting: Where not shown on the Drawings, the Contractor may install valved "tees" at high points on piping to permit venting of air. Valves shall be capped after testing is completed.
- J. Testing Specifics: Piping shall be tested as indicated in the following Schedule. All other piping systems shall be tested as required for the pipe type used. Unless specified otherwise, test each system for two (2) hours.

Pipe Type	Test Pressure	Test Medium	Allowable Leakage
Schedule 80 PVC	200 psi	Water	None
Stainless Steel	200 psi	Water	None
Galvanized Steel	200 psi	Water	None
PVC Tubing	200 psi	Water	None

END OF SECTION 335299